Version 2.0

HO-HUMS-RP-v2.0

Health and Usage Monitoring Systems

HeliOffshore Recommended Practice Guidance

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Safety Through Collaboration

Safety Through Collaboration

Collaboration empowers safety and is at the very heart of HeliOffshore. This Health and Usage Monitoring Systems (HUMS) Recommended Practice is a great example of how our industry – from designers and maintainers, to pilots and passengers – works together and learns from each other to ensure no lives are lost in offshore flight.

I would like to thank the HeliOffshore HUMS Working Group, industry stakeholders and every HeliOffshore member who came together to deliver this guidance. Thank you for your commitment and contribution. Together, we will implement and sustain ever-higher levels of performance so those we are responsible for travel home safely every day.

Tim Rolfe
CEO, HeliOffshore

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Disclaimer

About Health and Usage Monitoring Systems

Health and Usage Monitoring Systems (HUMS) are sensor-based systems that measure the health and performance of mission-critical components in aircraft. They provide actionable information so that maintainers can make data-informed decisions.

HUMS are increasingly effective in providing additional data on emerging technical issues and, with the development of Automated Detection Tools, the accuracy and predictability of HUMS continues to improve.

IOGP Report 690 specifies:

"Contracted aircraft have a HUMS system installed, which is OEM supported and meets the documented certification requirements, such as CS-29.1465."

This HUMS recommended practice guide is referenced by IOGP Report 690 as a means of compliance.

Delivering HeliOffshore's HUMS Recommended Practice Guidance

from the co-chairs of the HUMS Working Group

In October 2014, efforts to exchange HUMS processes became global after HeliOffshore members identified the sharing of HUMS recommended practice as an industry-wide safety priority.

Revision 2.0 represents seven months of collaboration by our industry's top HUMS specialists. This work builds upon a wealth of knowledge and experience shared from HUMS operators worldwide. It is critical that we tap into the wisdom of these industry professionals in order to eliminate potential unintended risks that may stem from the introduction of untested procedures or technologies. We are confident that implementation of the HUMS Recommended Practice Guide by operators, large and small, will make a difference to airworthiness and safety.

Our work will continue as HUMS and our use of these systems continues to evolve, and our industry continues to experience the benefits of implementing these recommended practices.

Thank you to the working group who dedicated their time and expertise to this revision.

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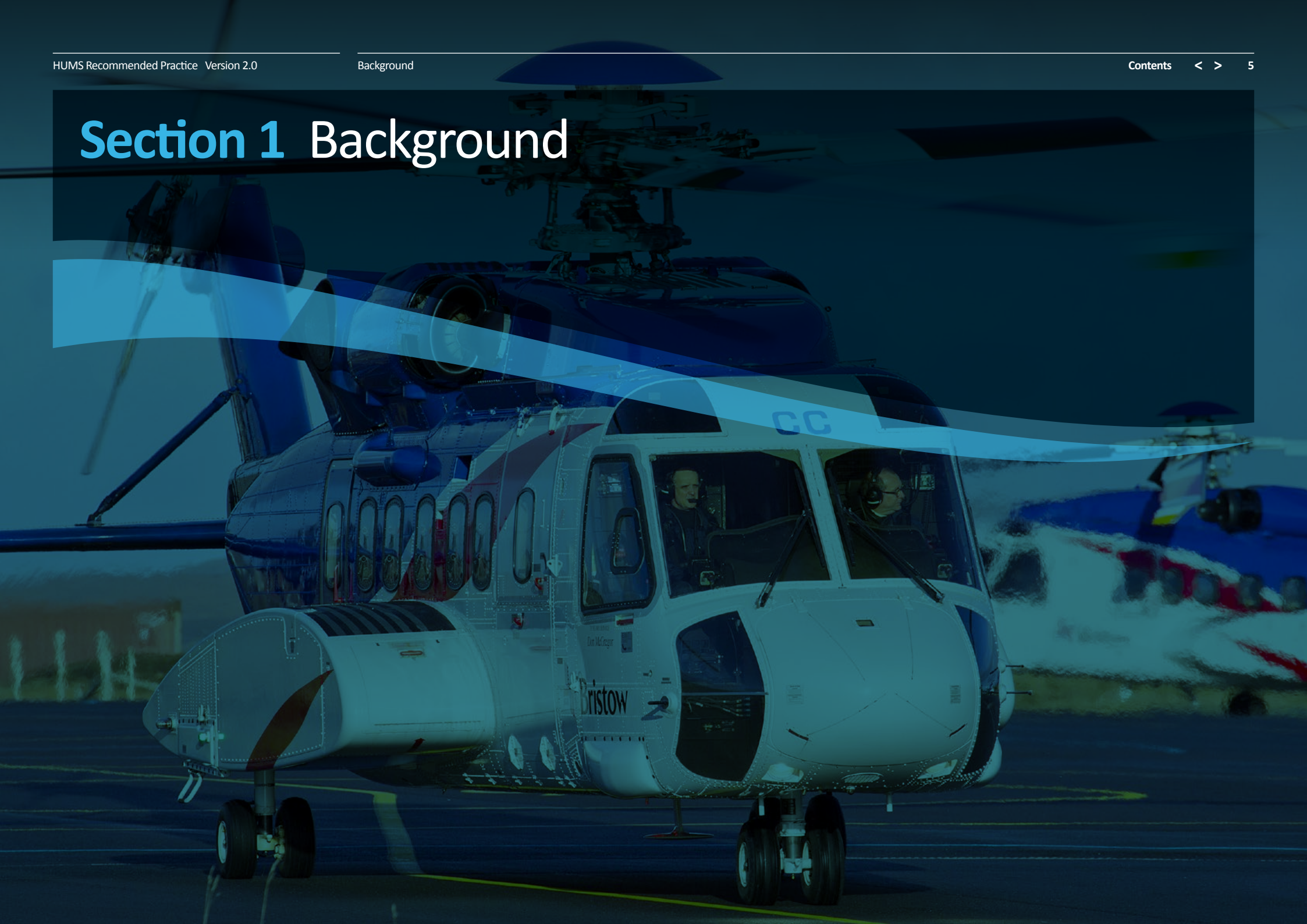
The above contents table correlates with IOGP Report 690 paragraph 34C.1

Section 1 Background



Section 1
Background

The use of Health and Usage Monitoring Systems (HUMS), while not mandated by regulation in all parts of the world, has become an offshore standard and is increasingly effective in providing additional data on emerging technical issues.

Historically, it has been inconsistently applied in terms of its potential proactive nature. The development of Automated Detection Tools have the potential to further enhance the capabilities of HUMS. OEMs are investing in this technology in an effort to reduce error and provide more effective fault detection. To be effective, operators should fully understand the capabilities as well as the limitations, and influence a path to create a standard recommended practice wherever possible.

The HeliOffshore HUMS Working Group formed in August 2014. One of its objectives was to drive publication of Standardized Operating Principles for all helicopter types fitted with HUMS.

This document provides both a definition and describes recommended practice to enable operators to manage HUMS-related tasks in a way that provides safety benefit in all operations.

The document is not a replacement for regulatory or guidance documents (such as CS29.1465, CAP 753, etc.) but an additional document that provides enhancement and clarification on recommended practices.

HeliOffshore HUMS Recommended Practice Guide Rev 2.0 Working Group

The primary working group included the following HeliOffshore members:

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- Mario Magalhaes (Chief Inspector/ Maintenance Quality Control Coordinator)

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Acknowledgements

We want to acknowledge the many HeliOffshore members, including manufacturers, oil companies, suppliers and consultants, who devoted their time and effort to help review this document.

Section 2 Document Use

Section 2
Document Use

The document is written for offshore oil and gas operations based on available systems at the time of publication.

The recommended practice may be reviewed by operators and assessed for suitability in their specific operations.

Recommended practice guidance may be varied in certain regions or for specific missions using a risk-based approach.

Document Review, Amendment and Update Process

We will maintain this guidance as HUMS systems and recommended practice evolve. This will be done in a structured manner so that only information that enhances the guidance is added:

Document Owner: HeliOffshore is the document owner and is responsible for maintaining its currency. HeliOffshore will delegate these duties to an appropriately qualified person/group.

Change Procedures: This document and future changes and/or additions will be submitted to the HeliOffshore HUMS Working Group. Once agreed, a revised version will be presented to HeliOffshore for approval, implementation and release.

Change Markings: Changes will be identified by a black bar adjacent to the change except when there is a complete re-issue of the document. Explanation of the change will be provided with the revision/re-issue.

Acronyms

ADT	Automated Detection Tools
AMM	Aircraft Maintenance Manual
CAMO	Continuing Airworthiness Management Organization
CAT	Commercial Air Transport
CI	Condition Indicator
CRS	Certificate of Release to Service
FDM	Flight Data Management
FH	Flight hours
GSC	Ground Station Computer
GSS	Ground Station Software
HUMS	Health and Usage Monitoring System
KPI	Key Performance Indicator
MEL	Minimum Equipment List
MOB	Main Operating Base
OEM	Original Equipment Manufacturer
TCH	Type Certificate Holder
VHM	Vibration Health Monitoring

Definitions

Analysis (Primary)	The review of HUMS data and comparison with respect to predefined threshold levels using OEM/TCH provided ground station software.
Automated Detection Tools (ADT)	Automated Detection Tools (ADT) are advanced methods of HUMS data analysis that may utilize prepared models, complex algorithms, automatic data comparison, or other similar methods in order to enhance detection capability.
Secondary Analysis	Detailed comparison of HUMS data against aircraft of the same type to determine the statistical significance.
Download	Process of retrieving collected/stored HUMS data from aircraft for transfer and process on to the GSC to perform analysis.
Exceedance	When the HUMS ground station indicates that a vibration signal has surpassed a set threshold limit
HUMS authorized personnel	Individual who will review, analyze and certify HUMS data. Depending on region, it can be referred to by different titles. Typically: **Transport Canada Region:** Aircraft Maintenance Engineer, Avionics Aircraft Maintenance Engineer or Mechanic/Technician **FAA Region:** Aircraft Maintenance Technician (AMT), Avionics, FAA licensed A&P mechanics **EASA Region:** Line Engineer, Technician, EASA Licensed B1/B2 Engineer **Asia/Pacific Region:** A&C Licenced B1.3 Type Engineer (equivalent to A&P). Technician/AME/Avionics
Main Operating Base (MOB)	Location of an aircraft's permanent/temporarily assigned operating base for daily flight operations that has the ability to support HUMS download and analysis.
Trend	Series of typically two or more data points used to determine propagation of a series of data points over the subsequent flight hours. Under normal circumstances, and depending on the acquisition schedule and flight profile, gathering data points may be a matter of minutes or tens of minutes apart. Acquisition also depends on serviceability of instrumentation and associated vibration processing equipment.
Normal Monitoring	HUMS authorized personnel download and analysis in accordance with appropriate HUMS procedures, utilizing applicable maintenance data, as directed/prompted by the HUMS.
Close Monitoring	During Download and Analysis, we may determine that some trends be reviewed more closely to ensure data has been collected and that the trend has not reached an unacceptable level. Should a determined level be reached, further maintenance inspection/intervention may be required. Vibration level of trends can vary both up or down for a variety of reasons (as below).
Trending	Provide proactive prognostic data analysis to identify significant changes within collected data patterns to facilitate data-driven maintenance actions and overall continuous improvement of the operator's Maintenance Program. Data trending identifies changes over time in the airframe, and includes components (e.g. gearboxes, shafts, and rotors). The basis of trend analysis is to recognize a change in pattern. Several patterns can be distinguished from a trend review, including a gradual drift, rising trend, step change, and data spike.
Trending – Gradual Drift	Gradual drift can be caused by long-term wear of a component or by bedding- or settling-in after initial installation.
Trending – Rising / Falling Trend	A rising/falling trend is a faster change than gradual drift. It normally indicates a developing fault in a component. Rising/falling trends are the most common patterns recognized for action. By determining the 'rate of change' within a trend pattern, it is possible to 'predict' the possibility of data reaching a threshold limit.

Trending – Step Change	Step change is caused by maintenance actions, sensor/calibration changes, sudden component failures, or a change in mode of operation. Step changes within a trend pattern are easily identifiable and can be remedied by a follow up to previous maintenance activities on the component in question or by a relearn of the threshold in conjunction with the HUMS OEM/TCH.
Trending – Data Spike	A data spike is not usually related to a fault. Therefore, an exceedance caused by data spikes can normally be rejected by the data elimination process. Multiple or recurring data spikes maybe indicative of a defect and should be investigated.
Trending – Train Spike	A Train Spike is when an indicator is affected by a particular flight parameter (e.g. Nr). The spike lasts for the duration of the flight parameter variance and then returns to normal. In this case, it is important to only collect data in the range where the indicator is steady.

Section 3 Scope

Section 3
Scope

Throughout this guidance, reference is made to HUMS policy, procedures and practices. It is expected that appropriate written procedures are put in place by an operator.

This document is focused on the vibration and health monitoring aspects of HUMS with no specific reference made to usage monitoring.

HUMS Data Monitoring

a. Data Collection
HUMS indicator(s) registering an exceedance, or that are 'of concern' should be tracked and reviewed in accordance with the operator's procedures. It is important that data is gathered for these indicator(s) and that they are reviewed as often as practicable.

b. Detection Capability
As part of reviewing data output from HUMS, the normal data-gathering process is capable of detecting differing situations:

1. Component replacements
2. Mechanical component outwith maintenance limits, or tending towards failure
3. Maintenance interventions (e.g. bearing greasing, rotor balancing, etc.)
4. Instrumentation

We typically rely on thresholds set within HUMS to prompt HUMS authorized personnel whenever action is required. These are normally set by the HUMS OEM/TCH but, depending on the aircraft type, reliability statistics, and aircraft history, there may be areas of the drive train that have operator/regulator applied limitations. These would be more restrictive than the OEM/TCH threshold.

Section 4 Ground Station Software and Data Management

Section 4
Ground Station Software and Data Management

A fundamental element of operating and managing HUMS is a robust ground station software and data management policy.

4.1 Installing a new Ground Station Software Application

Any GSS application must be installed in accordance with OEM/TCH instructions and system requirements. Unless agreed with the OEM/TCH, operators of multiple HUMS should not install more than one GSS application type in any single operating system environment as it may produce undesirable results.

As an airworthiness maintenance tool, the integrity of the HUMS database is vitally important. HUMS authorized personnel rely on the output of HUMS data and correctly set thresholds as a basis for aircraft airworthiness decision making.

As interaction testing of differing HUM Systems is not normally carried out by the OEM/TCH, the continued integrity of each system can therefore not be confirmed.

4.2 Establishing a New HUMS Database

When setting up a new HUMS database, it is preferable to have a minimum of 14 days/ 50 FH of historical data available to HUMS authorized personnel on the same database (not applicable for new aircraft).

4.3 Backup and Archiving Data

Data should be retained for at least two years or 500 FH, whichever is greater. Archived data should be retained on external storage media or remote server. Consideration should be given to the location, security, flood and fireproofing of archived material.

4.4 Hardware and Software Control

Only authorised Field Loadable Software may be installed on a controlled ground station. Ground stations should be controlled in a similar manner to special tool control systems and software changes should be tracked. When upgrading the computer's Operating System, verify with the OEM that your HUMS software is compatible. Ground stations should be thoroughly tested following such an upgrade to confirm the integrity of each system.

4.5 PC and Laptop Replacement

In line with IT policy, a PC or laptop replacement plan should be established to ensure reliability. This will typically align with the manufacturer's warranty. For improved standardisation, use of data imaging software is recommended and the Company IT support is best placed to advise.

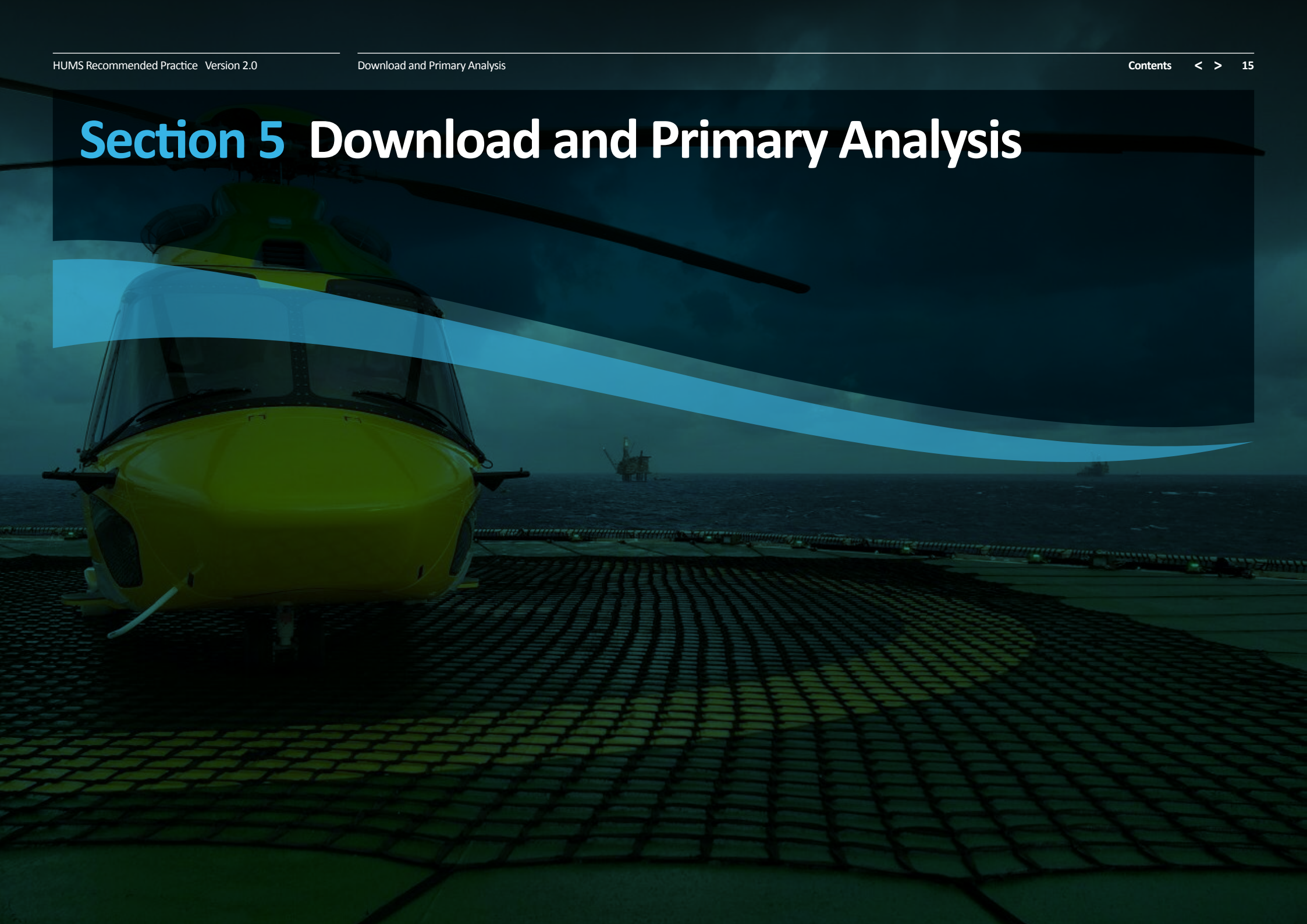
4.6 HUMS GSS Checklist

Establish a checklist of what is installed on each ground station, for each HUMS, and a process for installation documented in company HUMS procedures.

4.7 HUMS OEM/TCH Data Transfer and Network Links

All HUMS data should be transmitted to the OEM/TCH at regular intervals and be monitored to confirm successful transfer. This should be carried out via a network link. If this is not possible but OEM/TCH support is available, a suitable alternative method should be employed.

Section 5 Download and Primary Analysis



Section 5
Download and Primary Analysis

Download and Primary Analysis is the collection, download, transfer and analysis of HUMS data at intervals specified by operator's procedures. Ideally, the download intervals will be at each return to the operator's main operating base.

Analysis of HUMS data at line level must be performed at each download. As a minimum, HUMS authorised personnel will check for items that have registered an exceedance. These items must be actioned and recorded in accordance with applicable maintenance data and operator's procedures before the next flight.

A signed record (written or electronic) by HUMS authorised personnel is required for every download and review of data. A copy of this should be retained in the aircraft records.

IOGP Report 690 specifies:

"The HUMS download and initial analysis result are recorded and certified in the aircraft technical log or similar document."

Different levels of HUMS exceedances require different levels of investigation in order to be resolved. In most cases, an exceedance after the last flight of the day allows the time to investigate without any operational disruption. When HUMS exceedances occur between turnarounds, it may be necessary to pre-warn flight operations that the aircraft may be temporarily unavailable until the alert is resolved.

Applying good human factors principles, care should be taken to avoid any pressure, or perceived pressure, on maintenance to complete the investigation before the next scheduled flight for that aircraft.

5.1 Download Periodicity – Normal Monitoring

This guidance does not supersede any OEM/TCH requirements.

a. Operations from Main Operating Base (MOB)

Download and analysis should be carried out at every return to the main operating base.

IOGP Report 690 specifies:

"The HUMS is downloaded and an initial line analysis, to review threshold alerts, is conducted at the following periodicities: For offshore flights – on every return to the Main Operating Base (HeliOffshore HUMS Recommended Practice definition), whether for passenger or crew change or for shut down"

b. Download Periodicity Exceptions

Operations with Short Sector Lengths

For operations where the aircraft routinely returns to the operating base at a high frequency, due to short sector lengths, the download frequency can be extended out to a period not exceeding 10 hours of elapsed flying time.

IOGP Report 690 paragraph 32C.1 .2 mirrors this requirement

Operations away from MOB

When an aircraft is operating away from the MOB, a remote ground station should be used to allow for an equivalent capability, where practicable. Where this is not possible, the total flight time between downloads should not exceed 15 FH.

IOGP Report 690 specifies:

"The HUMS is downloaded and an initial line analysis, to review threshold alerts, is conducted at the following periodicities:

Where aircraft are based offshore, in remote locations, or detached to another base, arrangements are made using portable ground stations and platform internet connections to provide an equivalent capability where practicable. The total time between downloads is at a minimum daily."

Unplanned/unexpected Operations

In the event of an unplanned shutdown, diversion, evacuation or lifesaving operation away from the MOB, the aircraft can exceed the download periodicity limit providing the aircraft then returns directly to the MOB for a HUMS download or a remote HUMS download is carried out.

5.2 Download Periodicity – Close Monitoring

Total flight time between downloads while under Close Monitor should be 'on each return to the MOB not exceeding 10 FH', or as per OEM/TCH recommendations (whichever is less).

5.3 HUMS Data Collection

If the aircraft has not been in the required flight regime for a sufficient period of time, it is acceptable to have collected a partial HUMS data set. However, a complete HUMS data set must be collected within a 15 FH period.

IOGP Report 690 specifies:

"If the aircraft has not been in the required flight regime for a sufficient period of time, it is acceptable to have collected a partial HUMS data set. However, a complete HUMS data set must be collected within a 15 flying hours period."

The HUMS should be capable of generating a warning that indicates no data has been acquired on any monitored component for a period of ≥5 FH. If a specific system does not have this feature or equivalent functionality, the operator should confirm that the required data has been collected at the end of each flight day or during Second Line HUMS Analysis.

IOGP Report 690 specifies:

"The HUMS should be capable of generating a warning that indicates no data has been acquired on any parameter for a period of ≥5 flying hours. If a specific system does not have this feature or equivalent functionality, the operator should have a process to confirm the required data has been collected."

5.4 System Unserviceability/MEL

The operator should define a Minimum Equipment List (MEL), Minimum Departure Standard (MDS), or equivalent document. This should list the HUMS equipment that may be temporarily unserviceable, and include associated operating conditions, limitations, or procedures as applicable.

IOGP Report 690 specifies:

"The MEL, MDS, or equivalent document details the HUMS equipment that can be temporarily unserviceable, and includes associated operating conditions, limitations, or procedures as applicable." It is recommended that individual client operating contractual requirements are reviewed for specific items.

System unserviceability and subsequent deferment of unserviceable channels should be based upon the table below, and the deferment period for individual channels should be tracked as separate defects.

	Deferment Period
Failure under Close Monitoring	0 FH*
Failure under Normal Monitoring	15 FH

Table 1: MEL Deferment

This table relates to 'non-acquisition of HUMS data' and HUM System/sensor failures. Both failure types will be linked to a physical component, and all component failures separately tracked. This guidance does not supersede any OEM/TCH requirements.

IOGP Report 690 specifies:

"Deferment period for individual accelerometers or components are tracked as separate defects."

Application of this table also only relates to CAT flights (e.g. Offshore), and does not include maintenance check flights.

* When an item is placed under Close Monitor, full serviceability is required on HUMS components relevant to that item including but not limited to processors, accelerometers, data transfer devices, and ground stations.

IOGP Report 690 specifies:

"The unserviceability or unavailability of any other single component of the system, including individual accelerometers, is:

- *Failure while Close Monitoring: 0 (zero) flying hours*
- *Failure while under Normal Monitoring: 15 flying hours."*

5.5 Primary Analysis

Exceedance Management

Any exceedance should be actioned immediately in accordance with the OEM/TCH holder's requirements by following applicable maintenance data, and recorded in the aircraft maintenance records.

When a green status is displayed for all given parameters, and no other indications or close-monitored items are of concern, no further HUMS-related actions will be required to be performed prior to release to service of the aircraft.

An Amber (caution) health warning will require an assessment of the trend and an aircraft system may require inspection before further flight. The assessment of the severity of the threshold breach of an exceedance should also include examination of associated parameters to aid fault diagnosis. Evidence of steady or rapid upward trend and/or persistent generation of a defect should lead to a detailed investigation being carried out. A technical log entry must be raised if the indicator is to be close monitored.

An Amber exceedance with evidence to indicate a significant rising trend, or if continued at the same rate would result in a red exceedance on the next flight, should be actioned as a Red exceedance.

For a Red exceedance, unless the OEM/TCH approved maintenance data specifies otherwise, no further flight shall take place until an acceptable response is received from the operator's HUMS specialist. When requested, the OEM/TCH will provide support directly to the operator's HUMS specialist and, when necessary, will contact HUMS authorized personnel directly.

For existing exceedances under close monitoring where there is insufficient data or no data from the previous flight, a maintenance check flight will be needed to collect the required data set.

IOGP Report 690 specifies:

"The aircraft dispatch procedure for flight following the download and initial analysis details and includes the following requirements for action:

Where there are no HUMS exceedances – the aircraft is clear for dispatch with no further action

With a yellow, amber, or intermediate HUMS exceedances – the dispatch of an aircraft with an existing alert is subject of either a maintenance action which is recorded and certified, or to control process within the operator's continued airworthiness organization, a record of which is in the aircraft approved documentation.

With a red or high HUMS exceedance – the aircraft is not dispatched until a full analysis and, where necessary, maintenance investigation has been completed and any subsequent defect rectification certified, and the aircraft released to service."

5.6 Download and Analysis Matrix

A matrix including aircraft type, mission type, and customer requirement should be available to display the information to the operator's personnel. This will aid accurate decision making. An example is shown in *Appendix 1.*

5.7 Second Line HUMS Analysis

As part of a quality control process a second line review should take place each day and review:

I. Latest HUMS defects on GSC
II. Open HUMS support requests (include OEM/TCH communication data)
III. Maintenance documents for corrective actions
IV. Technical log for open HUMS defects

5.8 HUMS Specialist Support

Trending

The operator should have a process in place to:

- Conduct daily aircraft-specific trending against predefined condition indicators and identify threshold advisories for potential maintenance actions (minimum 14 day/50 FH trend). Note: The list of CI's to be monitored will vary depending on the aircraft model and/or operator, based on experience and communication with the OEM.
- Validate accuracy of system data and line level trends, conduct fleet wide trend comparison, and evaluate potential immediate and long term maintenance actions.
- Notify OEM/TCH of significant component condition indicator trends.

5.9 Threshold Management

All predefined thresholds will be set by the OEM/TCH. Threshold relearning or adjustment can only be carried out in accordance with applicable OEM/TCH maintenance data (either detailed in the aircraft maintenance manual or via technical agreement).

Relearning or adjustment may be applicable when a component has been removed and reinstalled, or replaced.

The process for threshold change should be carried out using approved maintenance data from the OEM/TCH.

Custom thresholds (if possible with system design) should always be set lower than OEM/TCH threshold to enable enhanced or earlier failure detection.

Periodic threshold reviews should be performed as follows:

1. For a false exceedance, thresholds used to generate the exceedance and any related thresholds, should be re-assessed in light of new data and results shared with the OEM.
2. Thresholds will be re-evaluated for reliability.
   I. For new HUM system or aircraft types this should be carried out during the Controlled Service Introductory period.
   II. For mature systems or aircraft type this should be carried out at least biennially (every 2 years), provided that statistically valid data is obtained and the HUMS is still supported.
3. Records are to be kept for at least two years or 500 FH, indicating the relationship between the operator and OEM/TCH holder; to include the process and communication of all threshold reviews.

5.10 Real-Time HUMS: Live Streaming, Vibration Exceedance Notification, and Maintenance Manual Limit Exceedance Notification

If in-flight transmission of HUMS data takes place, it should be no more invasive than a notification to HUMS/Maintenance personnel at a Main Operating Base to alert that an inbound aircraft has registered an exceedance and will require HUMS analysis upon arrival.

At this time, the data is not of sufficient integrity to make in-flight decisions, and therefore, should not be shared with crews in flight. If HUMS data is to be used in this manner in the future, the accuracy and integrity level of this data would need to be similar to that currently required for a cockpit display. Achieving this goal will ultimately require improvements to technology, certification standards, data integrity, False Exceedance Rates, and OEM support and approved procedures. During any development phase, a Controlled Service Introduction processes should be utilized to monitor system performance.

IOGP Report 690 specifies:

…that such systems to be in place if available, provided strict procedures and training in place to cover the use of the system.

Section 6 Communication

Section 6
Communication

Internal Communication

The operator should define a process for action relating to exceedances generated by the HUM System, utilizing OEM/TCH applicable maintenance data.

An internal escalation process should be established to provide suitable tracking, management, and oversight of HUMS-related issues within an organization.

Establishing a second tier of support within an operational organization to manage the communication process and oversight within the HUMS program is recommended. These individuals may be experienced HUMS authorized personnel based within the Line Operation, or constitute a HUMS Support team.

External Communication

The operator should have a clear and auditable process in place for all HUMS-related communications to the OEM/TCH. Ideally, the OEM/TCH will provide the means for this style of communication; however, if this is not defined, the operator should establish a process and agree it with the OEM/TCH.

Both operator and OEM/TCH should provide a regularly updated list of any points of contact. This will typically include email and phone numbers.

Operators should establish, in collaboration with the OEM/TCH an appropriate response time for HUMS-related queries. These should be consistent with operational requirements.

All personnel responsible for dealing with, and responding to, HUMS-related issues, should have access to OEM/TCH approved maintenance data.

The entry point for receiving approved maintenance data should be defined within the operator's HUMS procedures.

Generally, having a single point of contact is the most effective way to manage the information flow between your organization and the OEM/TCH. This also allows for the HUMS team to collect and document details to create a knowledge base that can be beneficial for future analysis and troubleshooting.

Instructions from the OEM/TCH should be followed, the result of which should be sent back. This will either prompt further instruction or closure of the communication.

Section 7 Automated Detection Tools and Web Portals

Section 7
Automated Detection Tools and Web Portals

Interconnectivity

Ground station computers should have a permanent network or internet connection to facilitate regular data transfer to secondary analysis system portals. Alternatively, a robust manual data transfer process should be in place to ensure regular data transfer.

System Use

Automated system-generated exceedances should be actioned and acknowledged promptly. ADT systems should be reviewed by the HUMS specialist on a regular basis (minimum weekly). Analysis of the systems should include an in-depth review of data and comparison with primary ground station systems. Analysis of the HUMS data should include a comparison of the maintenance records to identify any maintenance actions which could be correlated to the HUMS trend change.

Sharing Information

The OEM should be informed of secondary system performance by reporting cases where the system has detected or failed to detect an anomaly in advance. Performance reviews should be carried out to ensure continued system reliability.

OEM Instructions

The OEM should provide detailed instructions on ADT/Web Portal use and applicable maintenance data for fault isolation/defect rectification.

Section 8 System Performance Reports

Section 8
System Performance Reports

Reports are produced when components are removed from the aircraft and routed to the overhaul shop or OEM/TCH for repair. Collected data is used to validate discrepancies found, or guide troubleshooting for a root cause of removal. Additionally, this type of information is shared with the OEM/TCH.

Operator Maintenance Action Support

The operator should have a procedure in place to compile relevant data on components removed prematurely to assist in subsequent troubleshooting, repair, and improved component reliability.

Original Equipment Manufacturer/ Overhaul Facility Support

The operator should have a procedure in place to provide timely and relevant data to the OEM/TCH Overhaul facility on HUMS-related premature component removals and/or failures, to support root cause analysis efforts. Subsequently, the operator should ensure that the OEM/Overhaul facility provides a detailed component condition report for validation.

Defect Trending Reports

Defect trending should be presented to the operator's Management team during periodic review meetings. These reviews should include operational specifics of HUMS status in the day-to-day operation. In addition, current trends are provided to managers during their normal scheduled meetings and distributed at their respective field base location as feedback to HUMS authorized personnel and flight crew. Presentations may include HUMS data analysis results for each aircraft type being monitored and associated system from the previous quarter.

Performance Report Content Examples:

1. False Exceedance Rate
2. Sensor Failure Rate
3. Instrumentation Defect Rate
4. Number of Diagnostic Reports/ Fault Cases
5. HUMS Component Reliability
6. Ground Station Software Serviceability
7. Usage Exceedance Reports
8. Defect Trending

Examples of HUMS Key Performance Indicators can be seen in *Annex 1.*

Section 9 Responsibilities & Process Descriptions

Section 9
Responsibilities & Process Descriptions

Responsibilities

The table below describes how various HUMS duties may be assigned, and how they may overlap.

Table 2: Example of Distribution of Common Duties

	HUMS Authorized Personnel	HUMS Specialist	HUMS Manager
Download Data	P		
First Analysis of HUMS Data	P		
Troubleshoot HUM System	P		
Troubleshoot Aircraft	P		
Rotor Track and Balance	P		
Return to Service	P		
Monitor Downloads		P	
Manage OEM/TCH communication		P	
Record Findings		P	
Support Field Efforts		P	S
Analyze Data		P	S
Suggest Corrective Action		P	S
Manage Close Monitor items		P	S
Interface with HUMS Technical Representative/OEM		P	S
ADT/Web Portals		P	S
Trending /Fleet Comparisons		S	P
Monitor Training /Proficiency		S	P
Assist with Training		S	P
Root Cause Analysis			P
Procedures			P
Database Management			P
Tie-in to other Programs			P
Reporting			P
Monitor Staffing Levels			P
Link to Sr. Management			P
Participate in Working Groups/Conferences			P

P = Primary S = Secondary

Note: These roles may be combined based on operator size and complexity.

Process Descriptions

a. Download Data
Collection, download, and transfer of HUMS data at intervals specified by company procedure.

b. First Analysis of HUMS Data
Review of HUMS data at the field level must be performed at each download. At a minimum, the individual performing the review will check for items that have registered an exceedance. These items must be addressed and documented before the next flight, in accordance with the relevant maintenance manuals and company procedures.

c. Troubleshoot HUM System
The responsibility to troubleshoot and maintain the serviceability of the system.

d. Troubleshoot Aircraft
The responsibility to initiate maintenance action on the aircraft in relation to indications originating from the analysed HUMS data.

e. Rotor Track and Balance
The responsibility to monitor and tune Rotor Track and Balance in accordance with OEM limits.

f. Return to Service
The responsibility to ensure that all maintenance actions are performed and recorded in accordance with approved maintenance data, ensuring serviceability of the aircraft.

g. Monitor Downloads
Ensure that data from each active aircraft was received, processed, and reviewed in accordance with company procedures.

h. Manage OEM/TCH Communication
The responsibility to manage and record all OEM/TCH HUMS communication for fault analysis or system faults.

Replies from the OEM/TCH HUMS Support teams will be reviewed and communicated to HUMS authorized personnel at the relevant operating base.

i. Record Findings
The responsibility to ensure that all maintenance actions carried out to correct the HUMS discrepancy are documented and disseminated to all relevant parties. This will enhance the knowledge database and enable beneficial reporting.

j. Support Field Efforts
The responsibility to respond to questions or queries regarding line level activities. This may include diagnostics, hardware, software and system functionality.

k. Analyze Data
In-depth analysis of HUMS data. To include additional Condition Indicator and expanded trend timeframe review, as well as wider fleet/aircraft type comparison.

l. Suggest Corrective Action
Provide suggested routes of troubleshooting for HUMS authorized personnel to follow.

m. Manage Close Monitor Items
Assess, assign, track, record and communicate all items in close monitor.

n. Interface with HUMS Technical Representative and OEM/TCH
At times, it will be necessary to interface with tech reps, OEM/TCH analysts, and engineering staff in order to bring an open HUMS issue to closure.

o. ADT and Web Portals
Where available, automated system-generated exceedance reviews should be carried out at intervals specified by company procedure and OEM/TCH recommendations. Analysis should include an in-depth review of secondary analysis system data and comparison with primary ground station systems. It will also be necessary both to ensure that all necessary data flows into the web services provided by the OEM/TCH support groups, and to utilize this information to enhance the diagnostic process and communications.

p. Trending/Fleet Comparison
Identify differences within a fleet type that may indicate a potential airframe-specific defect. These findings may require OEM/TCH involvement, and a broader investigation could be implemented. The outcome may result in a revised inspection frequency, or change in procedure etc.

q. Monitor Training/Competency
Identify and define training requirements. Coordinate feedback of HUMS authorized personnel competency assessments to ensure continual programme development and fit for purpose.

r. Assist with Training
Ensure that courseware and training material is current and accurate. This may include developing class material, training the trainers and having a presence in classes if needed.

s. Root Cause Analysis
Assist with detailed investigations to discover underlying HUM System and/or aircraft-related issues. This can remove the problematic symptoms, thus avoiding future undesirable results. The OEM/TCH or repair facility should be liaised with where required.

t. Procedures
Establish, promote, monitor and improve company HUMS procedures. Where possible, this should align with HUMS Recommended Practice and be consistent across the operator's organisation.

u. Database Management
Ensure that HUMS databases are secure and running efficiently. Ensure that there is a current backup stored in a protected, yet accessible location in the case of computer failure.

v. Tie-In to Other Programs
Share information gained from the HUMS in order to promote continual improvement of operational and maintenance departments within the company.

w. Reporting
Compiling data that conveys the effectiveness of HUMS, related systems and company procedures. This information can be shared with management as well as distributed to field base locations as feedback to HUMS authorized personnel and flight crews.

x. Monitor Staffing Levels
Manage the HUMS support staffing, to ensure responsibilities are carried out in an efficient manner to provide an acceptable level of assurance that aircraft continue to be airworthy. Reviewing and recommending any changes in level, based on workload capacity - this can be affected by fleet size, utilization and additional responsibilities.

y. Link to Senior Management
Establish and maintain a process to ensure senior management's awareness of HUMS activity, HUMS benefits, and critical findings linked to HUMS.

Provide information in regard to upcoming challenges, new product development, and OEM support services.

Evaluate for timely, effective OEM HUMS support and notify Senior Managers of discrepancies so that they may be promptly rectified.

z. Participate in Working Groups/ Conferences
Engage with OEM/ TCH, operators and other related entities to provide feedback on HUM System improvements and evolutions. This can be through working groups, conferences, and symposiums that bring together subject matter experts for continual improvement of HUMS. These opportunities enable recommended practice to be shared.

Section 10 Training

Section 10
Training

The operator should have a system of training that provides HUMS authorized and specialist personnel with suitable instruction. All training should be recorded in the employees' permanent training records. Through effective training, you provide your employees with the tools and information they need to deliver their work, safely and efficiently.

Training should include:

a) Initial / Familiarization Training

Based on fleet size and HUMS types, initial/familiarization training should be given to all line maintenance employees. At a minimum, it should include in-depth HUMS procedures, an overview of systems operated by the company, and general data interpretation instruction.

b) On-the-Job Training

On-the-job training is used when employees transition to an unfamiliar system and are waiting for a formal course. Training should highlight key points of the process. It must be administered by HUMS authorized personnel who have previously documented training and experience on the system.

c) Aircraft-Specific/System-Specific Training (OEM or equivalent)

When scheduling HUMS training, the OEM/TCH should tailor their HUMS courseware for each group. Courses designed for HUMS authorized personnel should focus on the system components, ground station usage, maintenance manual resources, day-to-day upkeep of the system/aircraft, troubleshooting, and basic analysis. The analyst should be offered a similar version to that of the HUMS authorized personnel course, with an added higher-end analytical element and administrative functions.

If an operator-specific HUMS training program is established, the analysts and trainers should have attended an OEM/TCH (or equivalent) course. This information should be developed into courseware tailored to complement the individual operation.

Consideration should be given to additional training for Avionics Technicians and should include:

- HUMS integration into major aircraft systems; including, but not limited to, digital buses, AFCS, ADC, CVFDR, FMS.
- General maintenance practices including accelerometer fitment and mounting, cable termination, downloadable media and hardware issues.

d) Recurrent/Continuation Training

This should occur every two years (minimum), and include, but not be limited to:

- HUMS procedures
- System changes
- Fleet additions
- Software updates
- HUMS case histories
- Known occurrences and issues
- Advanced interpretation instruction

This may align with other recurrent/continuation training.

Section 11 Management Oversight

Section 11
Management Oversight

An effective HUMS program should have appropriate levels of accountability for the HUMS processes and procedures.

Corporate Oversight

The operator should have a process in place to bring HUMS program Key Performance Indicators (KPIs) to the attention of Senior Management, regularly. KPIs should include, but not be limited to: successful data acquisition rates, current indicator trends, HUMS-initiated proactive maintenance actions, and top obstacles to achieving program objectives. Utilizing the information provided, an appropriate action plan should be developed. This plan may include internal and external actions.

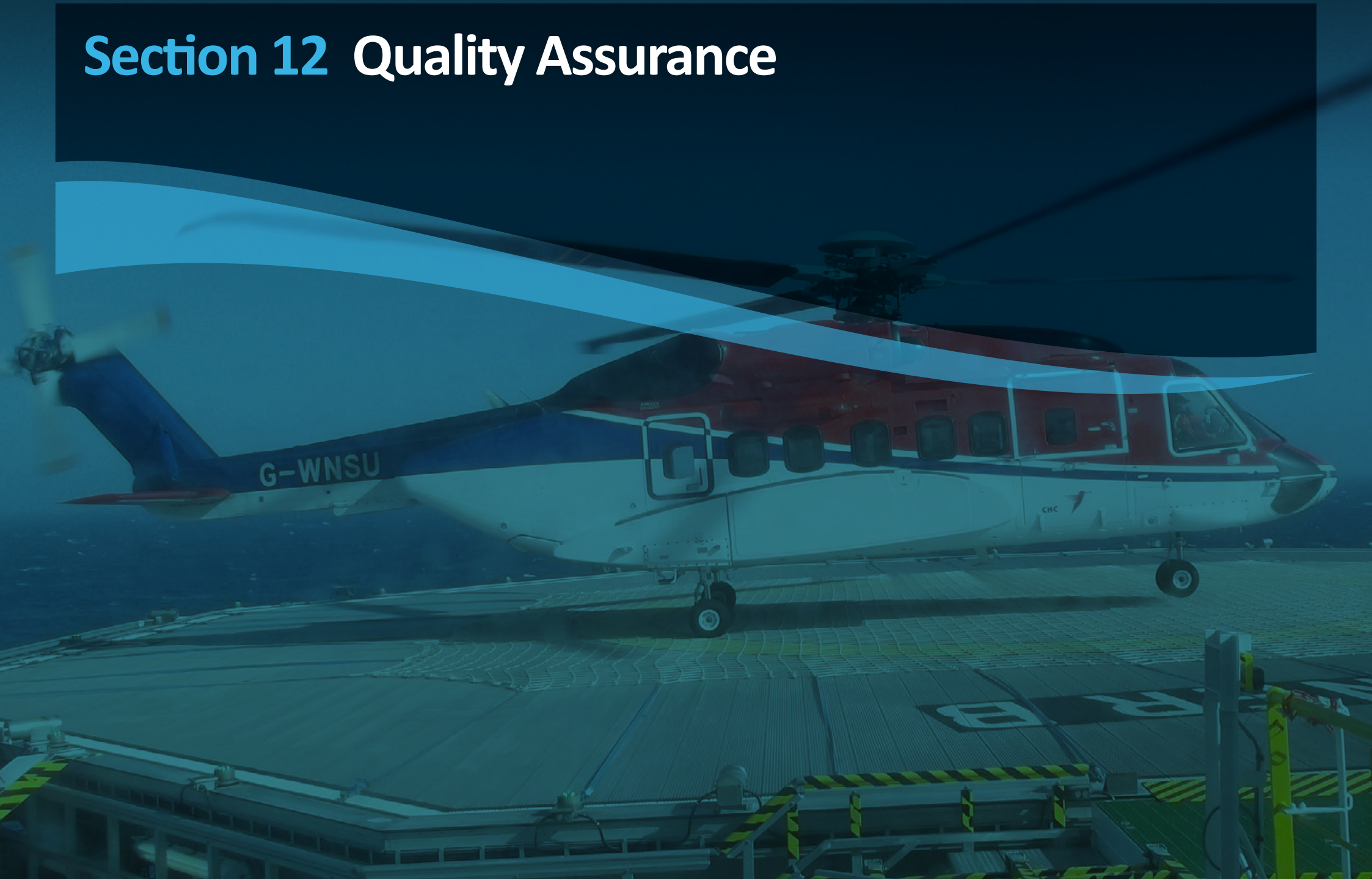
Departmental Oversight

The operator should have a HUMS program representative whose responsibilities include the oversight of the process of collection and analysis of HUMS data and any subsequent maintenance actions.

Line Level Oversight

The operator should have an appropriate organizational structure in place to ensure the HUMS data collection, analysis, and maintenance actions required at the HUMS authorized personnel level are carried out effectively.

Section 12 Quality Assurance



Section 12
Quality Assurance

Having implemented recommended practice, an effective quality assurance plan is essential to test the resilience of the HUMS process and to ensure HUMS delivers the greatest safety benefit to your organisation

a. Audit Plan

The operator should have an audit plan that will be implemented by the Quality Assurance team. This may form part of the Safety Management System.

A combined annual HUMS audit of HUMS Department and a sample operating base should be carried out. The annual maintenance audit at each operating base should also include a HUMS element.

Auditing of the OEM/TCH supplier should be carried out in line with operator's existing supplier audit plan, consideration should be given to the requirements of the HUMS support contract (if applicable).

The operator may also be subject to audits by regulatory bodies, customers and aircraft lessors.

Internal Auditor training should at least include a basic overview and process of HUMS for that system and knowledge of regulatory requirements and company procedures.

The below items give guidance for specific areas which should be audited as part of the operator's internal audit plan.

Appendix 2 contains a suggested audit plan to cover all aspects of HUMS operation.

IOGP Report 690 specifies:

"The audit programme covers internal processes, specialised activities, such as FDM and HUMS, as well any externally contracted operations or activities."

b. Documentation

This audit area should cover all HUMS-related documentation including company policies and procedures and OEM/TCH data.

c. Training

This should cover training requirements and records of both HUMS support staff and certifying staff involved in HUMS activity for both initial and recurrent training.

d. Support Staff

This should cover the communication, support capability and resources available to support HUMS operation. Attention should also be paid to the level of liaison between HUMS authorized personnel and other HUMS support staff and OEM/TCH engagement.

e. Data Analysis, Investigation and Communication

This should cover all areas of data analysis, any investigation carried out and the communication protocol when defects are found and maintenance actions are required.

f. Close Monitor

Review of close monitor policy and procedures and evidence of activity.

g. GSS & Data Management

This section covers review of software and data management and system for backing up and recovering data.

h. Control Service Introduction, HUMS Review and System Improvement

This section covers control of new systems and how performance is monitored and communicated for system improvement.

Section 13 Appendices

Appendices

Appendix 1: Download Policy Matrix Example

Aircraft type	Aircraft type A	Aircraft type B	Aircraft type C
HUMS Type	**Brand A**	**Brand B**	**Brand C**
Download periodicity – Normal Monitoring	Every return to MOB		
Download periodicity – Close Monitoring	Every return to MOB, not to exceed 10 FH or as per OEM/TCH recommendations (whichever is less)		
Download periodicity – Short Sector Length Flights	Not to exceed 10 FH		
Rotors running download capacity	No	Yes	No
Is a HUMS maintenance check flight required when no HUMS data has been collected during a 15 FH period, when not on close monitor?	Yes	Yes	Yes
Is a HUMS maintenance check flight required when no HUMS data has been collected on a component under close monitoring, during a 10 FH period?	Yes	Yes	Yes
HUM System to be serviceable for CAT	Yes	Yes	Yes
HUM System to be serviceable for non-CAT	No	No	No

Appendices

Appendix 2: HeliOffshore HUMS Audit Guide

This guide is a suggested approach to auditing a HUMS operator to ensure recommended operating practices are being applied.

Note: A combined annual HUMS audit of HUMS Department and a sample operating base should be carried out. In addition the annual maintenance audit at each operating base should also include a HUMS element.

GSS & Data Management	COMMENTS	FINDING LEVEL
Is data accessible to certifying staff? (Check ground station location).		
Is there a method to verify what the latest revision available is? (Check records).		
Does each ground station have the latest software? (Check ground station).		
Does each aircraft have its own ground station when deployed temporarily away from base? (Check records/ground station used on recent deployment).		
Is all aircraft data kept in a fleet central repository that is accessible to the HUMS Support team? (Check sample aircraft data).		
Is data from remotely located aircraft transferred daily to a fleet central repository? (Check sample aircraft data).		
Are there backups of the HUMS data? (Check records).		
Download & Primary Analysis	**COMMENTS**	**FINDING LEVEL**
Is there a HUMS manual (or equivalent) with appropriate documented policies and procedures? (Reference the manual).		
Are all HUMS-equipped aircraft being monitored? (Check sample aircraft data).		
Is the data download and review being carried out at the periodicity required in the operator's procedures? (Check sample aircraft data).		
Is the OEM/TCH contacted as required? (Check records).		

Is OEM/ TCH maintenance data for the HUMS available and used? (Check accessibility of manuals)		
Is HUMS data assessed alongside other data, such as magnetic chip/ particle detectors/oil debris? (Check maintenance records).		
Is there an appropriate close monitoring policy in place? (Check manual).		
Are close monitor items recorded and ultimately cleared? (Check records).		
Are requests/instructions for continuing airworthiness, appropriately conducted and recorded? (Check maintenance records).		
Are findings and work carried out recorded? (Check maintenance records).		
Is an appropriate procedure followed when 'no HUMS data' is recorded? (Check records).		
Communication	**COMMENTS**	**FINDING LEVEL**
Is there adequate liaison between the HUMS support staff, management, line maintenance, OEM/TCH and the CAMO on HUMS? (Check records / discuss).		
Is there an auditable trail of communication between the operating base, the HUMS support staff and the OEM? (Check records).		
Are suspected software bugs being tracked and reported? (Check records).		
ADT and Web Portals	**COMMENTS**	**FINDING LEVEL**
Are any supplemental software tools utilized as required by OEM/ TCH and/or company policy? (Check records).		
System Performance Reporting	**COMMENTS**	**FINDING LEVEL**
Is HUMS performance reviewed routinely? (Check records/ discuss).		
Is HUMS reliability examined within reliability reviews etc? (Check records).		
Are strip reports requested when necessary, received and reviewed? (Check records).		
Are improvements being made to the HUMS process? (Check records/discuss).		
Responsibilities	**COMMENTS**	**FINDING LEVEL**
Are the duties of the HUMS support staff and certifying staff clearly defined in relation to HUMS? (Check manual).		
Is there an appropriate reporting line for the HUMS support staff? (Check organogram).		
Are all aspects of HUMS support appropriately covered (mechanical diagnosis, HUMS avionics, ground stations)? (Validate personnel capability).		

Is the HUMS support staff sufficient for the fleet monitored? (Checks resources vs. fleet/ discuss).		
Is the organization actively involved in HUMS Operator Conferences/Meetings? (Check records).		
Training	**COMMENTS**	**FINDING LEVEL**
Do the HUMS support staff and certifying staff have the necessary HUMS training? (Check training records).		
Are HUMS-related issues fed back into training material for HUMS authorized personnel? (Check course material).		
Are HUMS support staff receiving regular recurrent training/ development training? (Check training records/discuss).		
Control Service Introduction (CSI), HUMS Review and System Improvement	**COMMENTS**	**FINDING LEVEL**
If the system is undergoing a CSI, is the organization actively involved? (Check records/ discuss).		

Annexes HUMS KPI

Annexes

Annex 1

This annex to HeliOffshore's HUMS Recommended Practice Guidelines was developed by a sub-group of the HeliOffshore HUMS Working Group to assess the effectiveness of in-service Health and Usage Monitoring Systems.

This list of nine KPIs lays a framework to evaluate HUMS performance based on various levels of exceedances, false exceedances, close monitoring, failures, diagnostic and support system requests, and HUMS deferred defects.

#	KPI	Denominator
1	Red Exceedance	Flying Hours
2	Amber Exceedance	Flying Hours
3	False Exceedance	Flying Hours
4	Close Monitor Initiated (Total)	Flying Hours
5	Diagnostic & Support System Requests Raised	Flying Hours
6	HUMS LRU Failures	Flying Hours
7	Sensor/Cable/Connector Failures	Flying Hours
8	Unscheduled replacement of monitored mechanical components as the result of a HUMS indication	Flying Hours
9	HUMS Deferred Defects	Flying Hours

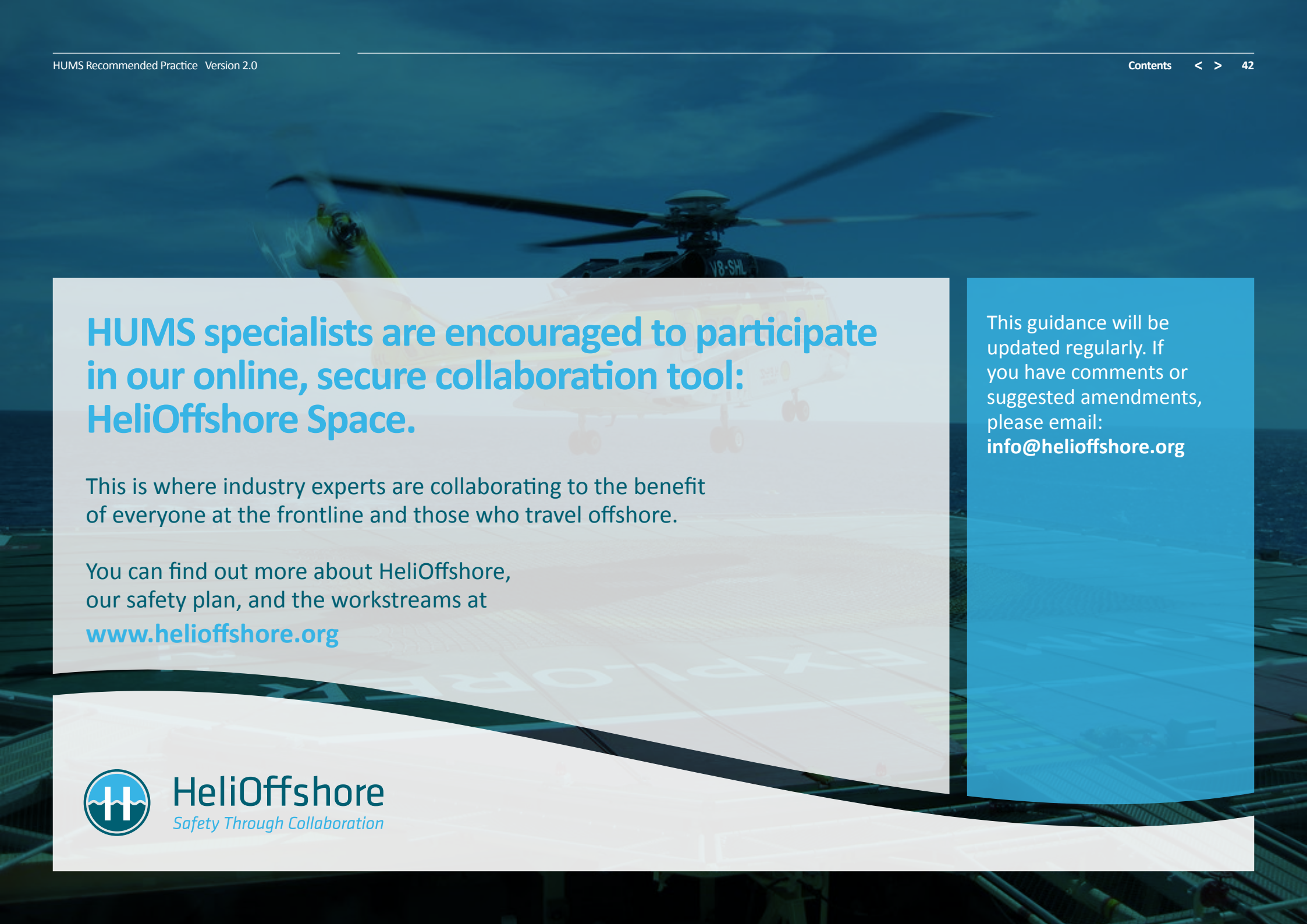
Notes:

Exceedance is when the HUMS Ground Station indicates that a vibration signal has surpassed a set threshold limit.

False Exceedance is when the HUMS Ground Station indicates that a vibration signal has surpassed a set threshold limit, but it is proven to be erroneous through further analysis or maintenance action. (For this KPI, exclude sensor/cable/connector failures because they are tracked as a separate KPI in item 7 of this list).

Red Exceedance represents the OEM's upper threshold limit. (For this KPI, track multiple exceedances for an individual event as a single occurrence).

Amber Exceedance represents the OEM's medium/lower threshold limit. (For this KPI, track multiple exceedances for an individual event as a single occurrence).



HUMS specialists are encouraged to participate in our online, secure collaboration tool: HeliOffshore Space.

This is where industry experts are collaborating to the benefit of everyone at the frontline and those who travel offshore.

You can find out more about HeliOffshore, our safety plan, and the workstreams at

www.helioffshore.org

HeliOffshore

Safety Through Collaboration

This guidance will be updated regularly. If you have comments or suggested amendments, please email:

info@helioffshore.org