

# APPENDIX 3

# ADVANCED

# STATISTICS FOR

# HELICOPTERS



# Appendix 3

## Advanced statistics for helicopters

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This appendix covers the advanced statistics for all operations involving EASA certified or validated helicopters. The chapters are organised per type of operations.

The first section of each chapter outlines the safety risks, that have been derived from occurrence data from the European Central Repository (ECR). They provide per type of operation the relative safety risk level and frequency of each key risk area (KRA). The KRA is the most likely type of accident that would have resulted if an occurrence had escalated into an accident. It is one element of the European Risk Classification Scheme (ERCS). In terms of safety performance, they are the Tier 2 safety performance indicators for the domain. The KRAs are prioritised based on their aggregated risk contribution using the ERCS, as applied by the competent authorities from 2023 onwards in accordance with the Commission Implementing Regulation (EU) 2021/2082 published in November 2021. The timespan of the 2024 edition is, therefore, limited to one year (i.e., 2023, the first year of ERCS implementation) and will be expanded on a yearly basis until a five-year timespan is achieved. The frequency of occurrences and the related aggregated ERCS numerical equivalent scores are determined per KRA, considering accidents, serious incidents and incidents, where the KRA and the ERCS safety risk score have been completed by the competent authority. An ERCS completion rate per domain and operation type as necessary, complements therefore the presented data for the contextualisation.

The other sections provide an overview of the Human Factors (HF), Human Performance (HP) and airworthiness issues. This overview is only to be found in the chapter dedicated to all helicopter operations.

The term HF describes human characteristics, abilities and limitations. The knowledge of HF is used throughout the aviation industry to design systems, equipment and work in ways that support humans in performing at their best. HP refers to how people perform their tasks. Following safety occurrences, HF and HP knowledge can also be used diagnostically to better understand what went wrong, what went right and, more importantly, to understand how to prevent such occurrences from happening again. The same European Co-ordination Centre for Accident and Incident Reporting Systems (ECCAIRS) taxonomy that helps us to identify our safety issues and KRAs also provides us with HF and HP codes. This taxonomy groups event types at different levels, so that all the issues relating to personnel are grouped at the highest level into 'personnel'. The personnel issues are then further subdivided into four categories: experience and knowledge events, physiological events, situational awareness and sensory events and personnel task performance events. A further two levels of subdivision exist, providing increasing granularity on the type of HF or HP issues identified. The presented data consider all occurrences of a domain, i.e., accidents, serious incidents and incidents.

The term 'airworthiness' includes aircraft design, aircraft production and aircraft maintenance. The attribute 'event type' in the ECCAIRS taxonomy allows regulators and industry to code the causes and contributing factors to

occurrences. The first level of airworthiness analysis shows the contribution of the aircraft system loss and malfunction to accidents and serious incidents, including the distribution of the main Air Transport Association (ATA) chapters and aircraft general/generic events. The second level of analysis goes a step further, showing the contribution of design, production and maintenance to aircraft system loss and malfunction, i.e., highlighting the systemic root cause of a system or equipment failure. The presented data consider all occurrences of a domain, i.e., accidents, serious incidents and incidents.

## 1 Advanced statistics for all helicopter operations

This chapter provides the safety risks, an overview of the HF/HP issues, as well as an overview of the airworthiness issues, for all operations involving EASA-certified or validated helicopters.

### Safety risks

The safety risks identified hereafter are derived from occurrences data recorded in the ECR, covering the one-year period of 2023. From more than 2200 occurrences in 2023, only 648 occurrences were completed with the KRA and ERCS safety risk score, representing an ERCS completion rate of 30% for the domain. The hereafter information is solely based on this restricted dataset.

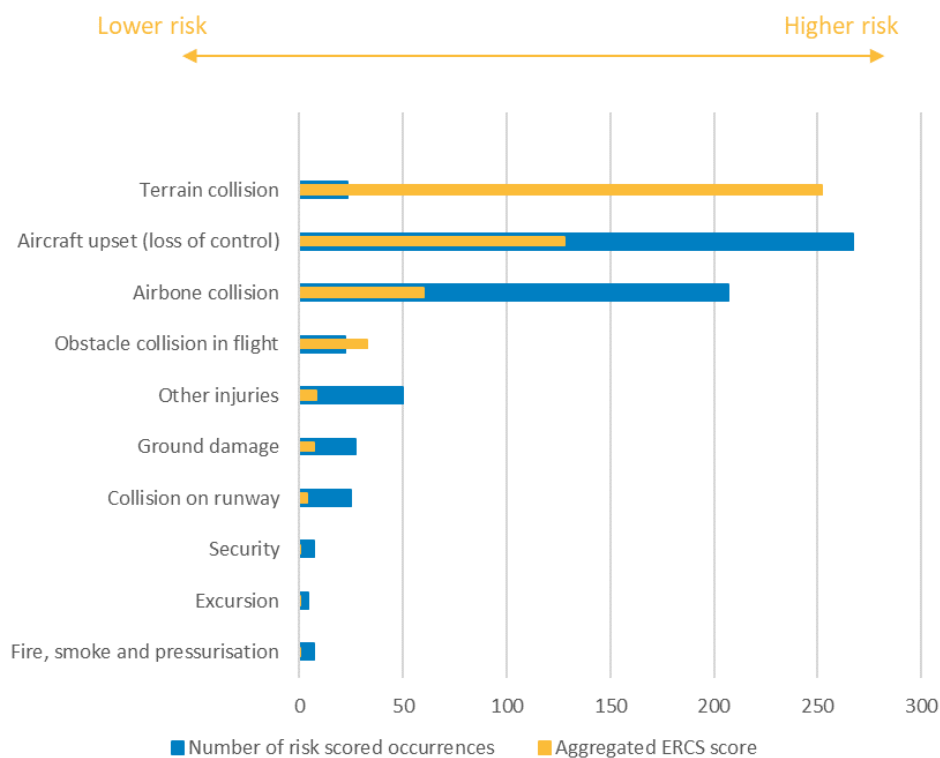
The relative comparison between KRAs for this domain is highlighted in **Appendix 3 Figure 1**. KRAs and occurrence categories (refer to core document Figure 3.4) have different purposes. While occurrence categories describe actual factors and outcomes of an occurrence, KRAs describe the potential outcome of an occurrence. The KRA is defined by the most likely type of accident that an occurrence could have escalated to. Unlike occurrence categories, where multiple categories may be assigned to a single occurrence, there can only be one KRA per occurrence. The KRA is one element of the ERCS. This scheme is applied when determining the safety risk score of an occurrence and is further detailed in the ASR introduction.

As all occurrences that have been ERCS scored are used for this year's risk picture by KRA, it has changed, when compared to the previous year, where the dataset was limited to accidents and serious incidents of the last five years.

However, this change is not significant for the higher aggregated ERCS scored KRAs, top three remain unchanged and mainly are noticeable as a change in sequence; namely aircraft upset KRA has changed position with terrain collision.

In the visual below you can see the top KRAs with the higher-risk KRAs being:

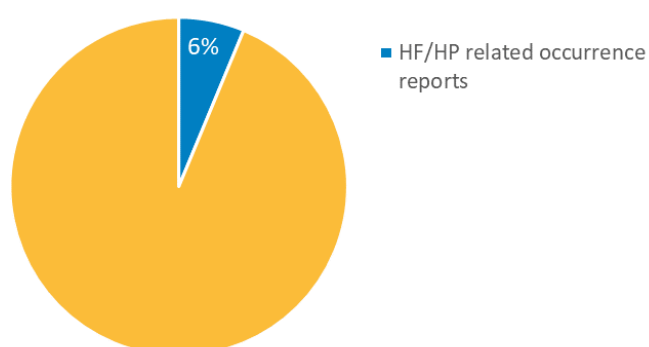
- **Terrain collision (CFIT)** includes occurrences where an aircraft collides with terrain, without indication that the flight crew was unable to control the aircraft. Analysing data for the last year, terrain collision is not the most frequent outcome of accidents but when looking at the ERCS score it has the highest ERCS equivalent weight. Today, accident data shows that terrain collision occurrences are much lower.
- **Aircraft upset (loss of control)** includes an undesired aircraft state characterised by unintentional divergences from parameters normally experienced during operations, which might ultimately lead to an uncontrolled impact with terrain. It remains a critical KRA of helicopter occurrence, particularly concerning due to their potentially severe consequences, emphasising the critical need for comprehensive safety measures and preventive strategies within the aviation industry. Various factors contribute to aircraft upset. These factors can range from engine failures, adverse weather conditions, maintenance events, or HP deficiencies such as, but not limited to; inappropriate energy management, inappropriate automation management, spatial disorientation, weakness in monitoring, etc. Understanding the nature of these factors is crucial for developing effective strategies to mitigate the risk of aircraft upset accidents.
- **Airborne collision** includes all occurrences involving actual or potential airborne collisions between aircraft, while both aircraft are airborne and between aircraft and other airborne objects (excluding birds and wildlife). Despite accounting for a relatively small percentage of ERCS equivalent weight, over the past year, airborne collision is a significant contributor to occurrences. The statistics highlight the importance for both manned and unmanned aircraft operated by aviation professionals to recognise that we have entered a new era with a complex airspace catering to the individual needs of commercial, specialised operations, military, general aviation and new entrant airspace users (UAS).



Appendix 3 Figure 1 KRAs by aggregated ERCS score and number of risk-scored occurrences involving all helicopter operations

### Human factors and human performance (HF/HP)

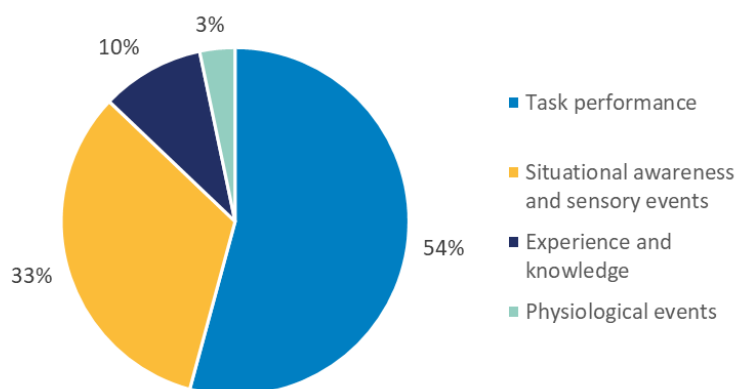
There were just above 19 300 occurrence records involving helicopters over the period 2019-2023. From the dataset extracted from the ECR on April 15, 2023, 1 213 occurrence records identified HF/HP as a contributing factor, including 42 accidents and 42 serious incidents. These occurrences are labelled as personnel occurrences in the ECCAIRS taxonomy. It is important to highlight that HF/HP issues are often not recorded within the initial occurrence report and may surface at a later date. Appendix 3 Figure 2 indicates the percentage of HF/HP related occurrence records from the total number of occurrence records for the past five years that concern helicopters.



Appendix 3 Figure 2 HF/HP occurrences involving all helicopter operations

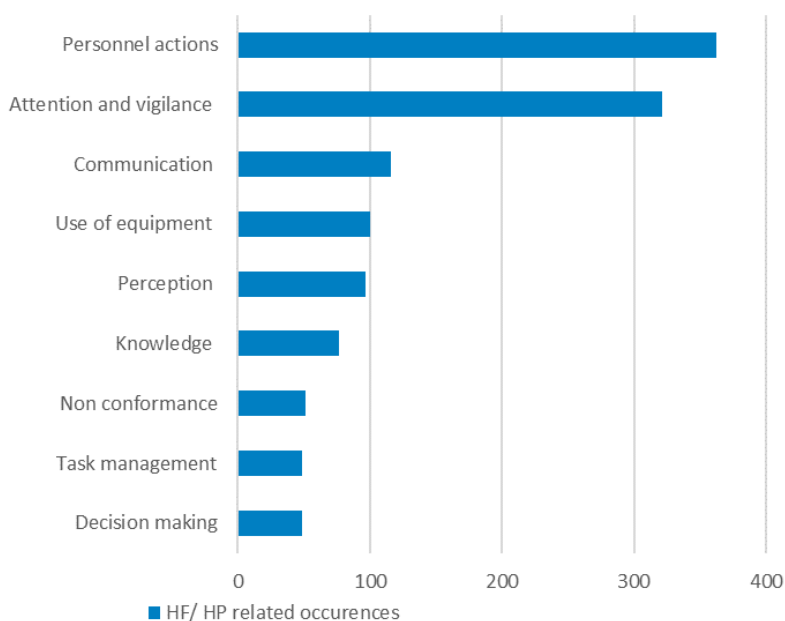
The application of the first-level HF/HP codes can be seen in Appendix 3 Figure 3. Out of the 1 213 HF/HP related occurrence records, 728 were coded under task performance events, 442 under situational awareness events, 129 under experience and knowledge events and 44 under psychological events. Note that one occurrence may indicate

more than one HF/HP event. Issues relating to situational awareness and to task performance events, persist in being more commonly recognised, experienced and reported following an occurrence than the factors that cause them. As in other chapters of this review, physiological events remain less recognised, experienced, or coded.



Appendix 3 Figure 3 High-level HF/HP event codes applied to occurrences involving all helicopter operations

Appendix 3 Figure 4 provides the number of occurrences per detailed HF/HP event codes. Data shows that issues related to personnel actions that have been reported in 362 occurrence records and attention and vigilance in 321 records are the most prevalent, indicating them as areas with the most HF/HP related safety concerns for helicopter operations.



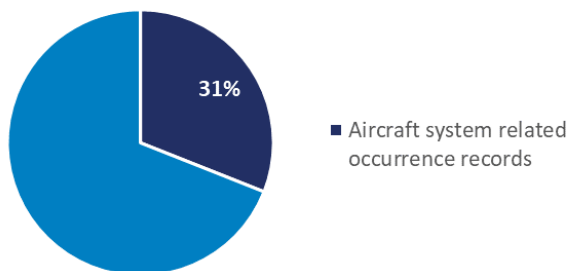
Appendix 3 Figure 4 Detailed HF/HP event codes by number of occurrences involving all helicopter operations

### Airworthiness

There were just over 19 300 occurrence records involving helicopters (all operations) over the period 2019-2023. The data was extracted from the ECR on April 23, 2024.

Appendix 3 Figure 5 provides the percentage of occurrence records that were aircraft systems related. Around one record out of three identified that the loss or malfunction of an aircraft system contributed to the occurrence,

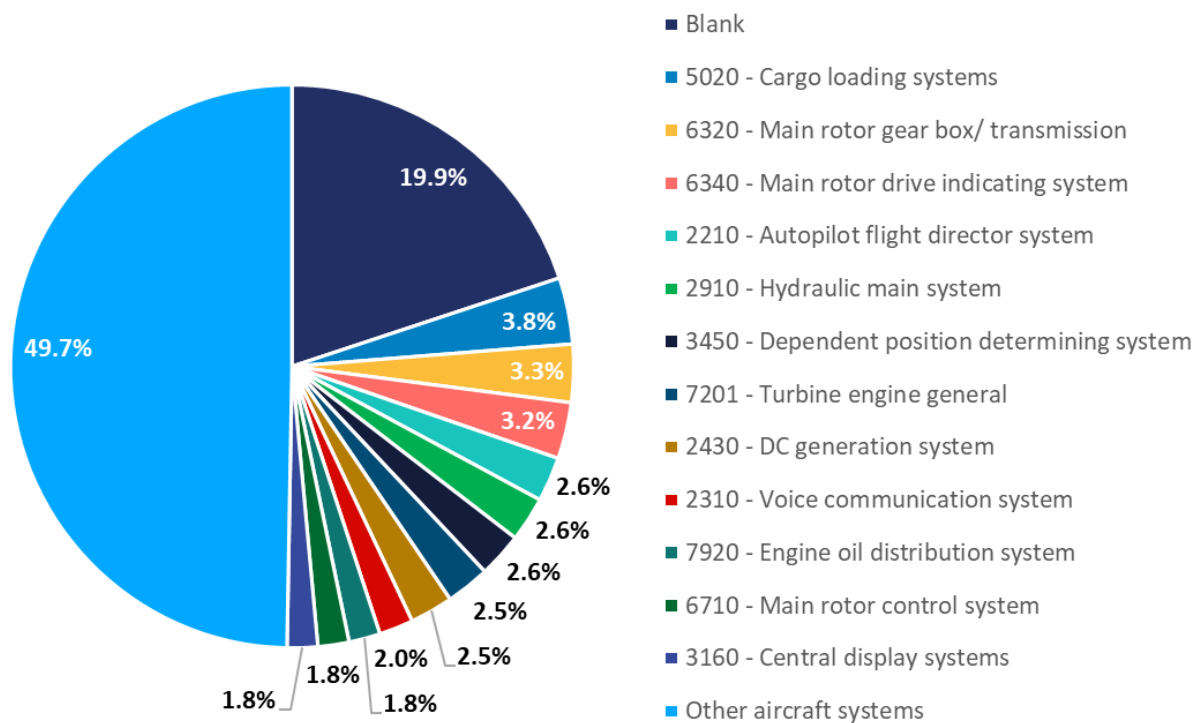
corresponding to 5 988 occurrence records, including 81 accidents and 56 serious incidents. These numbers mainly include records where the loss or malfunction of the aircraft system is the cause of the occurrence (e.g., engine failure). They may also include records where the aircraft system is adversely affected by another event (e.g., engine overspeed resulting in the tail rotor shaft failure).



Appendix 3 Figure 5 Aircraft system-related occurrence records involving all helicopter operations

Appendix 3 Figure 6 provides the list of the values for the event type ‘equipment’, excluding ‘aircraft general explosions/fire/fumes/smoke events’ and ‘aircraft generic’ and shows their relative distribution in terms of the number of occurrence records. Affected aircraft systems with less than 100 occurrence records were grouped together in the value ‘other aircraft systems’.

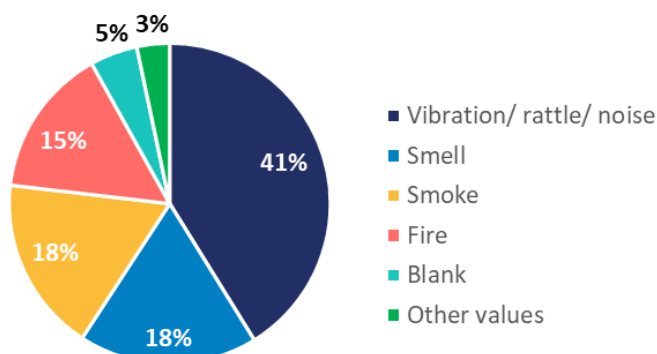
The main affected aircraft systems were cargo loading system (220 records), main rotor gearbox/transmission (192 records), main rotor drive indicating system (187 records), autopilot flight director system (148 records), hydraulic main system (148 records), dependent position determining system (148 records), turbine engine (145 records), electrical DC power generation system (143 records), voice communication system (113 records), engine oil distribution system (104 records), main rotor control system (103 records) and central display systems (101 records).



Appendix 3 Figure 6 Aircraft system-related occurrence records per ATA chapter involving all helicopter operations

**Appendix 3 Figure 7** provides the list of the values for the event types ‘aircraft general explosions/fire/fumes/smoke events’ and ‘aircraft generic’ and shows their relative distribution in terms of the number of occurrences. Values with less than five occurrence records were grouped together in the value ‘other values’.

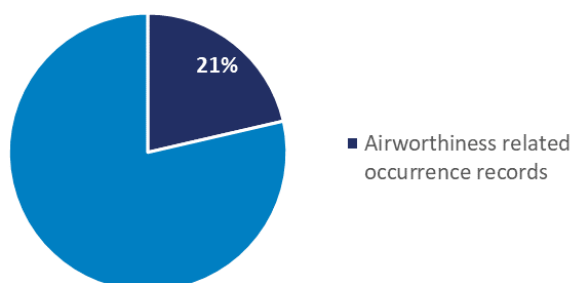
The value ‘vibration/rattle/noise’ was coded in 112 occurrence records, while the values ‘smell’, ‘smoke’ and ‘fire’ were respectively coded in 49, 48 and 41 instances.



**Appendix 3 Figure 7 Aircraft generic event related occurrence records involving all helicopter operations**

From the 5 988 occurrence records where the loss or malfunction of an aircraft system was identified in the occurrence, 1 281 occurrence records were attributed to an airworthiness issue, distributed in 1 090 records to aircraft maintenance, 118 records to aircraft design and 89 records to aircraft production<sup>1</sup>.

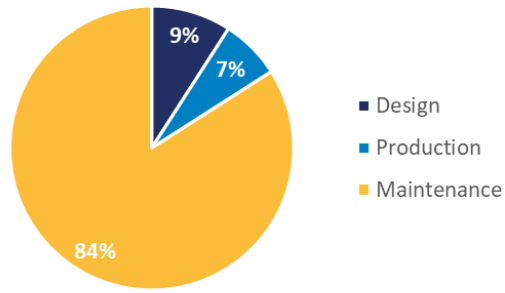
**Appendix 3 Figure 8** provides the percentage of aircraft system related occurrence records where the occurrence was attributed to an airworthiness issue, while **Appendix 3 Figure 9** shows the occurrence record distribution between aircraft design, aircraft production and aircraft maintenance.



**Appendix 3 Figure 8 Airworthiness related occurrence records involving all helicopter operations**

<sup>1</sup> One occurrence record may be attributed to one or more airworthiness domains.





**Appendix 3 Figure 9** Airworthiness related occurrence records per airworthiness domain involving all helicopter operations

## 2 Advanced statistics for commercial air transport (CAT) helicopters

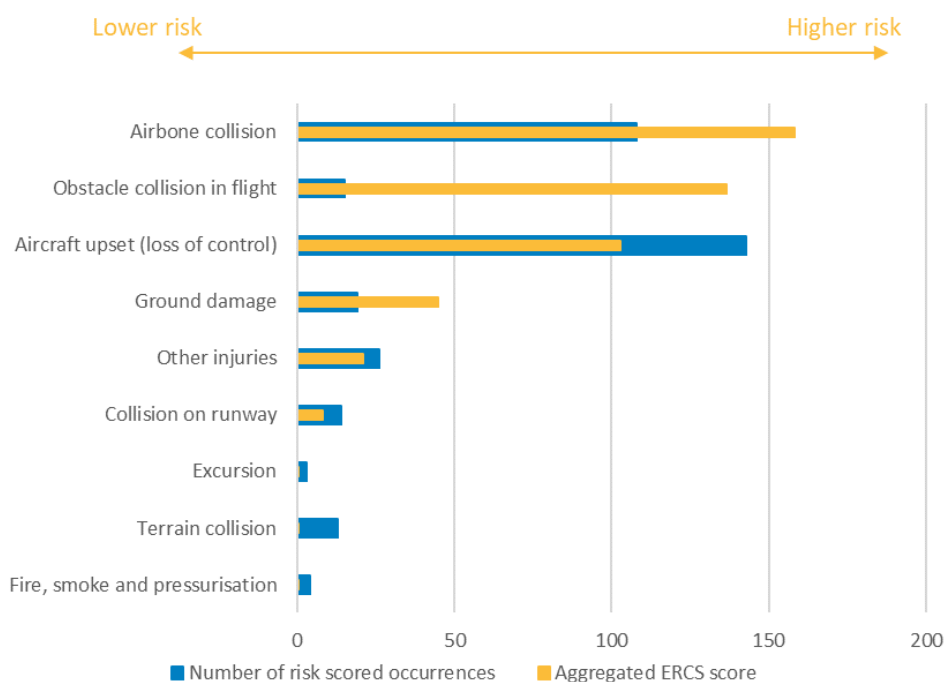
The safety risks for CAT helicopters are derived from occurrences data recorded in the ECR, covering the one-year period 2023. From the 1 429 occurrences in 2023, only 395 occurrences were completed with the KRA and ERCS safety risk score, representing an ERCS completion rate of 27% for the domain. The hereafter information is solely based on this restricted dataset.

The relative comparison between KRAs for this domain is highlighted in **Appendix 3 Figure 10**. KRAs and occurrence categories (refer to core document Figure 3.11) have different purposes. While occurrence categories describe actual factors and outcomes of an occurrence, KRAs describe the potential outcome of an occurrence. The KRA is defined by the most likely type of accident that an occurrence could have escalated to. Unlike occurrence categories, where multiple categories may be assigned to a single occurrence, there can only be one KRA per occurrence. The KRA is one element of the ERCS. This scheme is applied when determining the safety risk score of an occurrence and is further detailed in the ASR introduction.

The aggregated ERCS score indicates that airborne collision is the top KRA, while obstacle collisions in flight pose a similar level of aggregated risk but occur much less frequently. This statistic is a strong reminder of the dangers of airborne collision, highlighting the importance of taking the necessary precautions to avoid such a catastrophic event. It serves as a warning to pilots and other aircraft operators to be extra vigilant when flying in the vicinity of other aircraft. Furthermore, it emphasises the need for improved safety protocols and regulations to reduce the risk of aircraft collisions. With common sense and strict adherence to rules and regulations will prevent further accidents.

Aircraft upset is the other main KRAs of the CAT helicopters domain. Due to the nature of their activity and the conditions they get flown in, such as flying at low altitudes and in challenging weather conditions, in order to reach patients in remote or inaccessible areas, CAT helicopters are exposed to operational and environmental threats.

The KRA other injuries include the occurrence scenarios that do not fit into other KRAs, but which can still cause actual or potential injury. That KRA includes injuries due to turbulence encounters, hoist operations and ground operators' injuries, particularly persons being injured on the ground from falling loads, or from any part falling from an aircraft in flight.



**Appendix 3 Figure 10** KRAs by aggregated ERCS score and number of risk-scored occurrences involving CAT helicopters

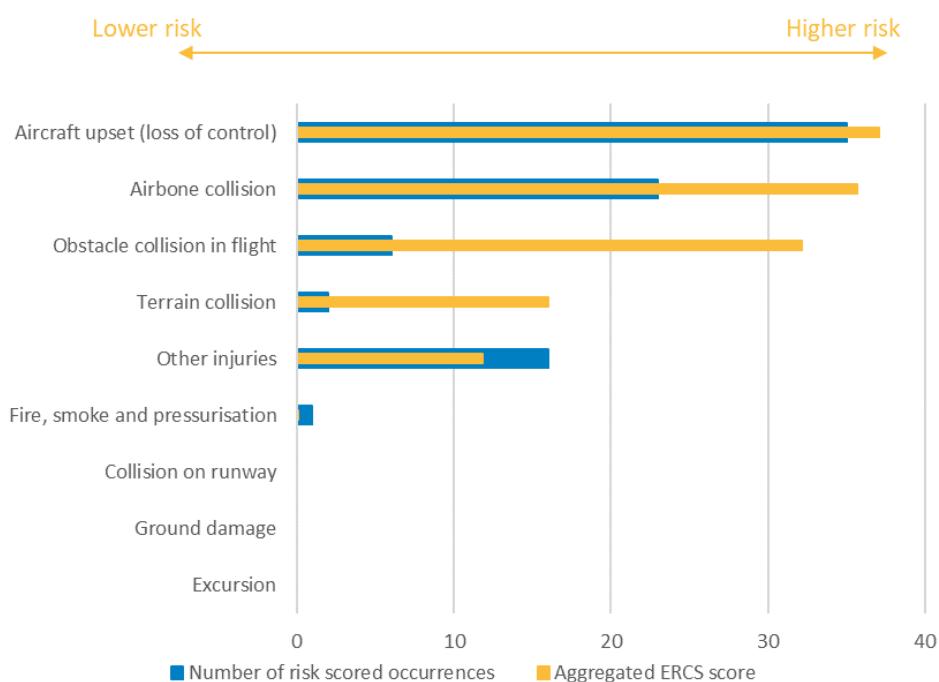
### 3 Advanced statistics for specialised operations (SPO) helicopters

The safety risks for SPO helicopters are derived from occurrences data recorded the ECR, covering the one-year period 2023. From the 300 occurrences, only 90 was completed with the KRA and ERCS safety risk score, representing an ERCS completion rate of 30% for the domain. The hereafter information is solely based on this restricted dataset.

The relative comparison between KRAs for this domain is highlighted in **Appendix 3 Figure 11**. KRAs and occurrence categories (refer to core document Figure 3.19) have different purposes. While occurrence categories describe actual factors and outcomes of an occurrence, KRAs describe the potential outcome of an occurrence. The KRA is defined by the most likely type of accident that an occurrence could have escalated to. Unlike occurrence categories, where multiple categories may be assigned to a single occurrence, there can only be one KRA per occurrence. The KRA is one element of the ERCS. This scheme is applied when determining the safety risk score of an occurrence and is further detailed in the ASR introduction.

When it comes to KRA, aircraft upset or loss of control in flight is most risky, both in terms of numbers of occurrences and aggregated risk, which is not surprising given the conditions and the common environmental factors that come with this type of operation. Helicopter pilots navigate the most harrowing environments known to flight, where recovery has no margin for delayed and human reaction. Specific specialised operations and as part of the high scored occurrences are the ones related to refuelling procedures, such as not enough fuel or fuel and oil safety linked to oil cowling.

Airborne collision remains the second KRA in terms of both, number of occurrences and aggregated risk and represents a strong reminder of the potential for disastrous consequences.



Appendix 3 Figure 11 KRAs by aggregated ERCS score and number of risk-scored occurrences involving SPO helicopters

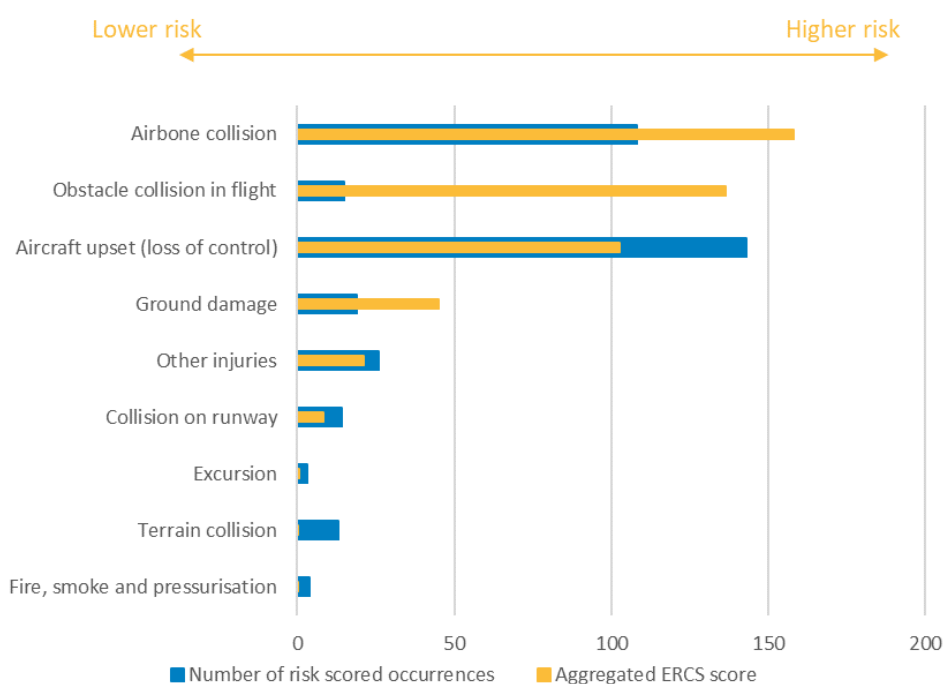
## 4 Advanced statistics for non-commercial operations (NCO) helicopters

The safety risks for NCO helicopters are derived from occurrences data recorded the ECR, covering the one-year period 2023. From the 680 occurrences, around half of them (310) were completed with the KRA and ERCS safety risk score, representing an ERCS completion rate of 48% for the domain. The hereafter information is solely based on this restricted dataset.

The relative comparison between KRAs for this domain is highlighted in **Appendix 3 Figure 12**.

KRAs and occurrence categories (refer to core document Figure 3.27) have different purposes. While occurrence categories describe actual factors and outcomes of an occurrence, KRAs describe the potential outcome of an occurrence. The KRA is defined by the most likely type of accident that an occurrence could have escalated to. Unlike occurrence categories, where multiple categories may be assigned to a single occurrence, there can only be one KRA per occurrence. The KRA is one element of the ERCS. This scheme is applied when determining the safety risk score of an occurrence and is further detailed in the ASR introduction.

The data reviewed on the occurrences involving NCO helicopters shows that terrain collision is by far the top KRA in terms of aggregated risk, followed by aircraft upset which is high risk in both number of occurrences and ERCS score. This is to be expected considering that the speed of the impact in controlled flight into terrain can have substantial energy and therefore high-risk score. On top of this, the flight envelope that they are being exposed in in flight training mission presents more risk as well (e.g., engine off landings, practice forced landings, advanced autorotations). Airborne collision is a top KRA in terms of both, number of occurrences and aggregated risk and represents a strong reminder of the high energy; highlighting the importance of taking the necessary precautions to avoid such a catastrophic event. It serves as a warning to pilots and other aircraft operators to be extra vigilant when flying in the vicinity of other aircraft. Furthermore, it emphasis the need for improved safety protocols and regulations to reduce the risk of aircraft collisions.



**Appendix 3 Figure 12** KRAs by aggregated ERCS score and number of risk-scored occurrences involving NCO helicopters