

**NORTH ATLANTIC SYSTEMS
PLANNING GROUP
(NAT SPG)**

2022 Annual Safety Report



International Civil Aviation Organization (ICAO) North Atlantic Region

2022 Annual Safety Report

Safety Policy

Safety is the NAT SPG's core business function. The NAT SPG is committed to developing, implementing, maintaining and constantly improving strategies and processes to ensure that all our aviation activities take place under a balanced allocation of organizational resources. The NAT SPG aims to achieve the highest level of safety performance and meet regional safety objectives in line with national and international standards, the Global Aviation Safety Plan (GASP), and the Global Air Navigation Plan (GANP).

Objective

The objective of the NAT SPG member States is to maintain and, where possible, improve the agreed safety standards in all activities supporting the provision of air navigation services in the NAT Region:

- All involved States are accountable for the delivery of the agreed level of safety performance in the provision of air navigation services in the North Atlantic Region.
- All involved States are accountable for the delivery of the agreed level of safety performance in aircraft operations in the North Atlantic Region.
- Safety in the NAT Region is managed through the organization and activities of the relevant implementation and oversight groups established by the NAT SPG, in coordination with the non-member States and observers, to achieve its Safety Objective.

Guiding Principles

The NAT SPG will act to:

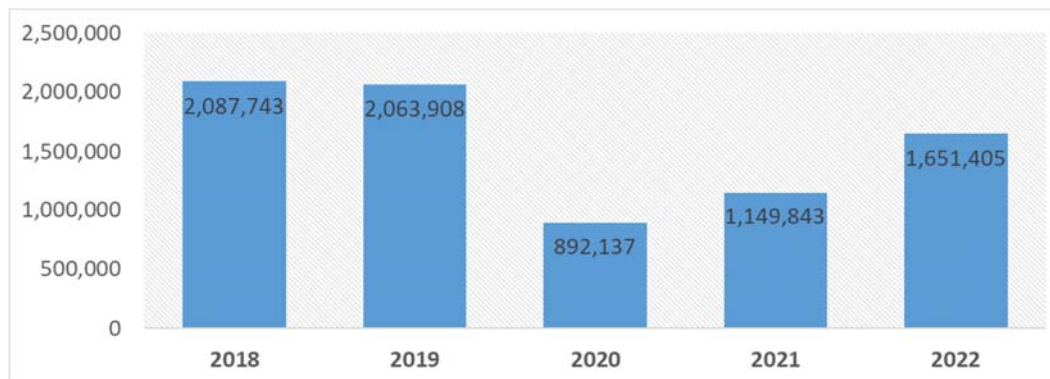
- **Clearly** define all accountabilities and responsibilities for the delivery of safety performance with respect to the provision of air navigation services and participation in the NAT SPG and its contributory bodies;
- **Support** the safety management activities that will result in an organizational culture that fosters safe practices, encourages effective safety reporting and communication, and actively manages safety within the NAT Region;
- **Share** safety related data, knowledge and expertise with concerned stakeholders;
- **Disseminate** safety information and NAT operating requirements to stakeholders;
- **Establish and implement** hazard identification and risk management processes in order to eliminate or mitigate the safety risks associated with air navigation services supporting aircraft operations in the North Atlantic Region;
- **Establish and measure** NAT Region safety performance against agreed safety standards; and
- **Continually improve** our safety performance through safety management processes.

All of the NAT member States contribute experts to the NAT SPG, or one or more of its various subgroups, and so support the overall management of safety in the Region. The NAT safety policy is enhanced by the agreement of member States to use the information shared at NAT SOG meetings for the purposes of education and for making safety improvements within the Region. This has paved the way for members to discuss and share information and act upon it within the framework of the NAT SPG.

Executive Summary

This North Atlantic Region's Annual Safety Report (APR) is issued by ICAO's North Atlantic (NAT) Systems Planning Group (SPG) and covers performance for calendar year 2022.

The NAT SPG structure is established to study, monitor, and evaluate the air navigation system in the NAT region taking into account changes to technology, changing traffic characteristics and traffic forecasts. The number of flight hours in the NAT HLA in 2022 was 1,651,405. This is an increase from that reported in 2021 (1,149,843 flight hours) and reflects the growth of traffic experienced in the NAT throughout the year as traffic begins its recovery to pre-pandemic levels. The busiest recorded week in 2022 (12,247) was approximately 90% of the busiest recorded week for 2019 (13,733).



Safety Performance in the NAT HLA continues to be monitored by the measures and targets associated with Safety Key Performance Indicators (SKPIs) with targets based on three years of rolling data.

While 9 out of 11 SKPIs were met in 2021, 2022 data indicates a reduction to 6 from the agreed set of SKPIs. The SKPIs indicate a reducing performance in the vertical dimension and an increase in the number of reported losses of separation. The SKPIs also indicate positive but stabilising performance in the lateral dimension.

The SKPI performance in the lateral dimension appears to be contradictory with the observed decrease in lateral performance when considering the CRE which indicates a mathematically significant change from 1.0×10^{-9} to 12.9×10^{-9} fatal accidents per flight hour (fapfh). The performance in the lateral dimension is similar to that reported prior to COVID-19.

A year-on-year increase was also observed in the vertical dimension marking an increase on the reported CRE since 2021 at 8.8×10^{-9} (although the 2022 CRE still remains better than pre-pandemic performance levels).

Both lateral and vertical performance metrics are sensitive and can be adversely affected by a single event. With the exclusion of two individual events (one lateral and one vertical) from the calculation, the CRE in both dimensions would be at, or marginally above the target of 5×10^{-9} fapfh. Work continues to identify root causes and implement relevant corrective actions.

As traffic recovers, the number of events reported in 2022 has doubled when compared to that reviewed in 2021 with the profile of root causes similar. The benefits of near, real-time surveillance capability in the NAT has delivered significant benefits in the early detection and mitigation of deviations in the vertical and lateral planes.

The North Atlantic Scenario

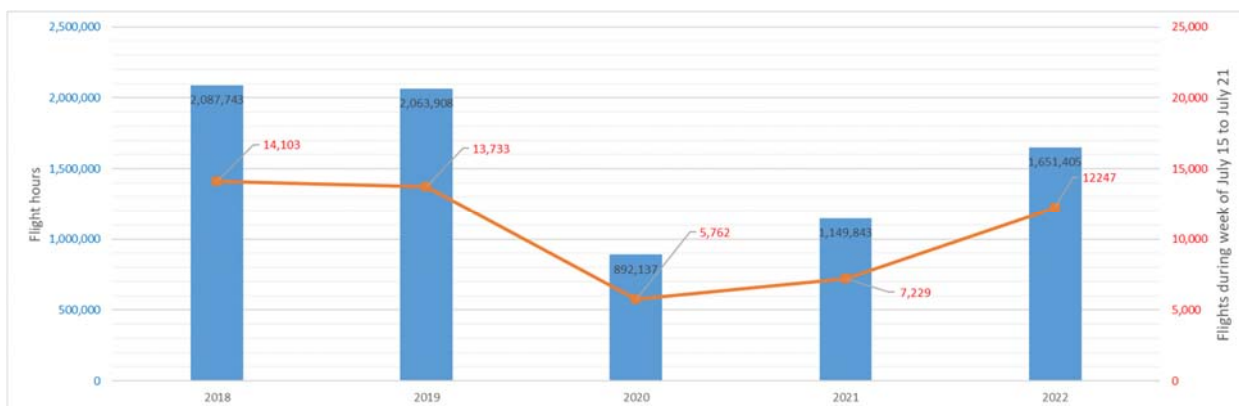
The airspace of the North Atlantic, which links Europe and North America, is the busiest oceanic airspace in the world. The NAT Region is a pioneer in the implementation of advanced procedures and technology supporting the progress of the global air navigation and aviation safety plans.

Traffic mainly flows in a broadly East-West orientation in a twice daily pattern where a daily organized track system takes account of airspace users' needs and weather patterns. NAT core traffic flow is almost exclusively jet transport aircraft that operate in the upper airspace in the en-route phase of flight.

Since March 2019, approximately 70% of the core NAT traffic has been able to make use of the surveillance capability offered by space based Automatic Dependent Surveillance-Broadcast (ADS-B) augmenting an increasing use of Automatic Dependent Surveillance-Contract (ADS-C). The number of flights eligible for the separation standards enabled by ADS-B has increased steadily since the capability was introduced.

Communication is, to a large extent, based on satellite-based data link, also referred to as Controller-Pilot Data Link Communications (CPDLC) with High Frequency radio being utilized less often. This leads to air traffic management and operation that is fundamentally different in concept to typical domestic operations, with a greater focus on strategic rather than tactical techniques although, as the NAT embraces new technologies this balance has begun to change.

The number of flight hours in the NAT HLA in 2022 was 1,651,405, which is an increase from the 1,149,843 in 2021. It is still below the flight hours before the COVID-19 pandemic. The NAT Economic, Financial and Forecast Group (NAT EFFG) estimates that in 2022, during the peak week of July 15 to July 21, approximately 12,247 flights crossed the North Atlantic. This actual figure was 7,229 for that same week in 2021.



Safety Performance Monitoring and Measurement

Collision Risk Estimates

The estimated risk of a mid-air collision, referred to as Collision Risk Estimate (CRE), is reported in terms of fatal accidents per flight-hour (fapfh) and is calculated in the lateral and vertical planes. The model used for computation essentially assumes each aircraft is a box having a fixed x, y, and z orientation and approximates the risk of collision by integrating the crossing rate over the period when two boxes are close to each other in each dimension.

Estimates of Vertical and Lateral Collision Risk for 2022 in the NAT HLA are based on risk bearing events reported to the NAT Central Monitoring Agency (CMA) for the period January to December 2022. Flight activity data from five NAT Oceanic Control Areas (OCAs) was used in deriving an estimate of Vertical and Lateral Collision Risk. The risk estimates were calculated for the Middle zone (Gander and Shanwick OCAs), the North zone (the Reykjavik OCA), and the South zone (the New York East and Santa Maria OCAs) and then combined to derive a risk estimate for NAT HLA.

As depicted in figure 1 below, the Vertical Collision Risk Estimate for 2022 was estimated to be 8.8×10^{-9} fapfh for all NAT HLA, which is higher in comparison to 2021 estimate (when taking into account SLOP). This increase in collision risk estimate in the vertical dimension is mostly attributed to one 60-minute event in the South zone. Removing this one event would bring the calculated vertical CRE down to 5.0×10^{-9} fapfh.

Figure 1 also presents the 2022 lateral risk estimate of 12.9×10^{-9} fatal accidents per flight hour. This represents a significant increase compared to 2021, when that CRE was only 1.0×10^{-9} fatal accidents per flight hour. The main contributor was a 16-minute event in the middle zone on OTS. If this event was removed, the calculated lateral CRE would reduce to 5.6×10^{-9} fapfh.

The vertical and lateral CREs are greater than the Target Level of Safety (TLS) for operational and technical errors of 5×10^{-9} fatal accidents per flight hour (fapfh).



Figure 1 - Collision Risk Estimates in the NAT HLA (2016-2022)

Safety Key Performance Indicators (KPIs)

The NAT SPG has established Safety KPIs and associated targets for the NAT HLA. The NAT HLA performance in 2022 is shown the table below. The 2022 figures are shown in green where the performance meets the targets and red otherwise.

Safety KPI		Target	Previous rolling three-year period of performance (2019-2020-2021)	2019 Performance	2020 Performance	2021 Performance	2022 Performance
NAT.SKI.01	Number of accidents	0	n/a	0	0	0	0
NAT.SPKI.02a	Number of LHD events divided by number of flight hours flown in the NAT HLA	Reduction over previous rolling three-year period of performance	4.30×10^{-5}	3.59×10^{-5}	4.71×10^{-5}	4.61×10^{-5}	5.87×10^{-5}
NAT.SKPI.02b	Overall time of LHDs at unprotected flight level divided by total duration of flights in minutes	Reduction over previous rolling three-year period of performance	0.697×10^{-6}	0.95×10^{-6}	0.52×10^{-6}	0.623×10^{-6}	1.01×10^{-6}
NAT.SKPI.03a	Number of Lateral deviations divided by number of flight hours flown in the NAT HLA	Reduction over previous rolling three-year period of performance	5.66×10^{-5}	5.71×10^{-5}	6.39×10^{-5}	4.87×10^{-5}	5.57×10^{-5}
NAT.SKPI.03b	Overall time of lateral deviations on an unprotected profile divided by total duration of flights in minutes	Reduction over previous rolling three-year period of performance	1.04×10^{-6}	1.70×10^{-6}	0.82×10^{-6}	0.61×10^{-6}	0.83×10^{-6}
NAT.SKPI.04	Number of losses of separation events divided by number of flight hours flown in the NAT HLA	Reduction over previous rolling three-year period of performance	0.91×10^{-5}	1.65×10^{-5}	0.56×10^{-5}	0.522×10^{-5}	1.27×10^{-5}
NAT.SKPI.05a	Number of coordination errors divided by number of flight hours flown in the NAT HLA	Reduction over previous rolling three-year period of performance	1.85×10^{-5}	0.82×10^{-5}	2.91×10^{-5}	1.83×10^{-5}	1.15×10^{-5}
NAT.SKPI.05b	Overall time of coordination errors spent at unprotected profile divided by total duration of flights in minutes	Reduction over previous rolling three-year period of performance	1.09×10^{-6}	0.16×10^{-6}	2.8×10^{-6}	0.30×10^{-6}	0.03×10^{-6}
NAT.SKPI.06a	Collision Risk Estimate (CRE) in the vertical dimension	5×10^{-9} fapfh	n/a	12×10^{-9}	5.5×10^{-9}	6.1×10^{-9}	8.8×10^{-9}
NAT.SKPI.06b	Collision Risk Estimate (CRE) in the lateral dimension	5×10^{-9} fapfh	n/a	13.6×10^{-9}	3.6×10^{-9}	1.0×10^{-9}	12.9×10^{-9}
NAT.SKPI.07	Regional Effective Implementation (EI) score in ANS for NAT provider States	-Maintain 85% or above until 2026 -Reach 95% by 2030	n/a	n/a	n/a	89.21%	88.58%

Table 1 – Safety Key Performance Indicators (SKPIs) and associated targets (2019-2022)

Scrutiny of events (numbers in brackets are 2021 figures)






The NAT SG carried out the scrutiny of 292 (166) events which were reported to the NAT CMA as occurring in the NAT High Level Airspace (HLA) of the Oceanic Control Area (OCA) of Shanwick, Santa Maria, Reykjavik, New York East, Gander and Bodo during the year 2022. These events were categorized as follows:

- 97 (53) Large Height Deviations (LHDs)
- 100 (56) actual lateral deviations, including:
 - 38 (23) GNEs and
 - 36 (5) ATC Interventions where when the Air Traffic Controller (ATCO) caught and corrected a lateral deviation before it developed into a GNE
- 19 (21) coordination events, where coordination between two Units has not been correctly carried out, leading to a vertical, lateral or time event.
- 6 (4) longitudinal loss of separation events.
- 100 (53) prevented events where the ATCO prevented a deviation or an uncoordinated flight profile entering the airspace of another ANSP.

Note : It is important to note that the sum of the values will not equal to the number of events as one event can be counted in one or more dimensions.

It is worth noting that ATC interventions and preventions are positive indicators that the ATC system has recognized an error, often through data link equipage capabilities, warning the controllers in sufficient time to take pre-emptive action. Underlying causes of all lateral deviations (incipient or actual) are often identical – the magnitude depends upon the timeliness of identification and corrective action.

The review of these 292 events of 2022 showed that the top 10 contributing issues allocated to all events were (Arrows indicate relative position from 2021 report):

1. *Flight Plan vs. Clearance* where flying, or intending to fly the planned route instead of the cleared route contributed in 85 (29%) of the events of 2022. In most cases (59 out of the 85), deviations did not actually occur as they were prevented by an ATCO. 
2. *Did not adhere to ATC clearances* in either the vertical or the lateral dimension where a crew, for no identifiable reason, operated a flight profile different to the ATC clearance (e.g. changed vertical profile or routed to a different waypoint which was not contained in the clearance or the filed flight plan or due to contingency) contributed to 40 (14%) of the 2022 events. 
3. *Weather* where weather conditions experienced during the flight contributed in 35 (12%) of the events of 2022. 
4. *ATC coordination* where an error occurring during the coordination between two ATC sectors or ANSPs contributed in 35 (12%) of the events of 2022. 
5. *ATC Clearance*, where a clearance issue contributed in 30 (10%) of the 2022 events. This can for example be caused by ATC not issuing a clearance to an aircraft to match the coordinated profile or by the lack of an appropriate clearance. 

6. *Crew CPDLC uplink message* where crew misunderstood or misread a CPDLC message, or indicated an issue with a CPDLC uplink message, or acknowledged a CPDLC uplink message but did not action it, contributed in 25(9%) of the events in 2022. ↑
7. *ATC Pertinent message not actioned* where ATC response, on receipt of a pertinent message, was not actioned or a message was erroneously discarded contributed in 25 (9%) of the events of 2022. ↔
8. *Crew-Other*, where a crew action contributed to 22 (8%) of the 2022 events but there is insufficient information or evidence to allocate any of the currently scrutinized causal factors. ↔
9. *Incorrect Weather Contingency action* where crew deviated from their assigned clearance to avoid adverse meteorological conditions, but did not follow the correct procedures for in-flight contingencies in Oceanic Airspace contributed to 14 (5%) of the 2022 events. ↔
10. *Truncated Display/ARINC 424* where the FMS does not display the full LAT/LONG waypoints contributed to 13 (4%) of the 2022 events.

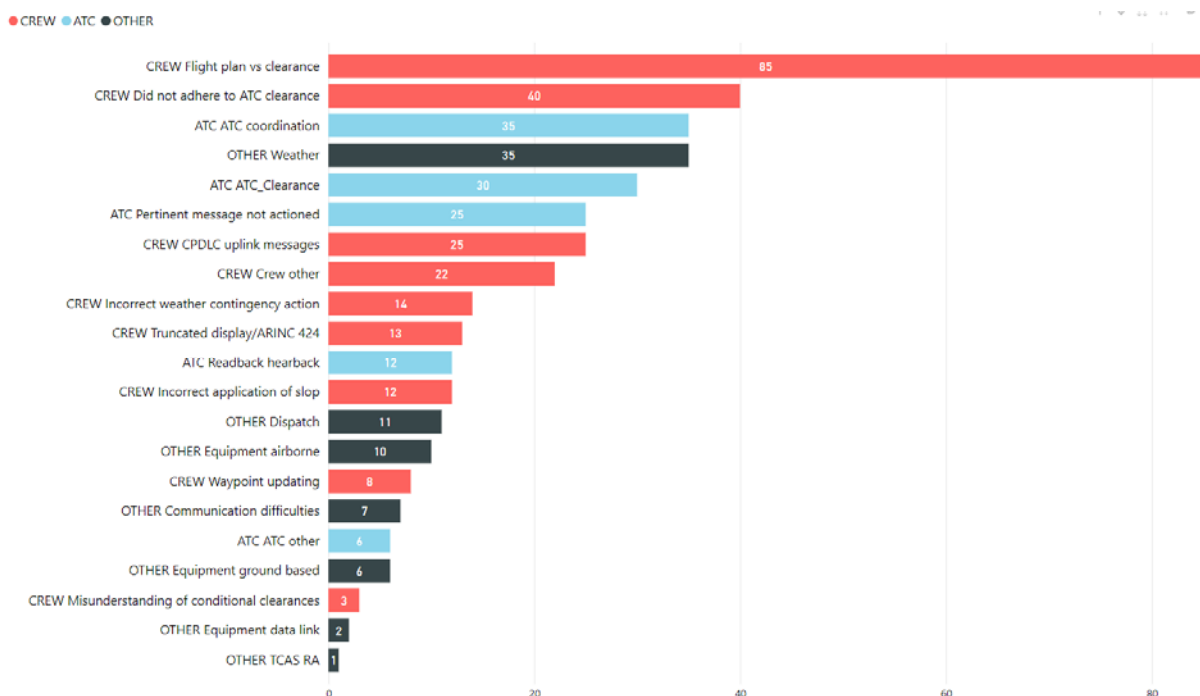


Figure 2: Contributing issues to events in the NAT HLA in 2022

Prevented deviations for all event types were classified according to the implemented mitigations used to avert a deviation. The results of this classification are presented in Figure 3, demonstrating that the practice of requiring position reporting of “NEXT and NEXT +1” and the “CONFIRM ASSIGNED ROUTE” CPDLC message sets (UM137/DM40) are proving to be of benefit.

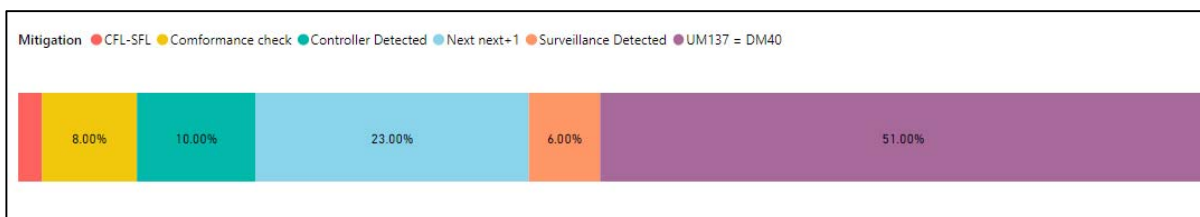


Figure 3: Mitigations used for prevented deviation events in 2022

NAT regional priorities

Early in 2023, a workshop held at the ICAO EUR/NAT office in Paris proposed to refine the NAT vision 2030 high level statement and update the goals and objectives contained therein. Noting that the Vision is now not timebound, it reflects the continued, but ever-changing priorities of the region to adapt to the needs of aviation and deliver a safe operating environment. The NAT Vision Statement is expected to be endorsed at the next meeting of the NAT Systems Planning Group held in mid-2023 and states: “Through collaboration and by leveraging innovation, the NAT SPG leads the way for the provision of safe, secure, efficient, sustainable and resilient Air Traffic Management Services to ensure an optimized seamless service.”

The NAT Vision is evidence of the willingness of all organisations within or bordering the region to work collaboratively to improve the operating environment. The Vision is sympathetic to the changing environment and allows the deliverables to be flexed and reprioritised to deliver the widest benefit for the region over the next decade.

The focus for 2022 has been to rebuild the operating environment and support the growth in traffic demand as the year progressed in its recovery from COVID-19 restrictions. However, the NAT has continued to seek leverage from the benefits that Space-Based ADS-B can offer, by reducing the OTS footprint and exploring innovate “target to target” separations in the Reykjavik CTA. The NAT is working towards the removal of Oceanic Clearances in early 2024 and its enhanced use of “user preferred routings” in its ambition to create seamless boundaries and make a positive impact on some of the causal factors.

Handling today’s traffic profile in more effective ways needs to be done at the same time as developing policies and procedures to facilitate new entrant operators into our system such as those seeking supersonic and hypersonic integration and those developing systems for access to space.

All of this needs to be done while continually seeking to reduce the environmental impacts of the NAT and building resilient and secure systems that can withstand natural and man-made interference while preparing for an ever-developing future.

The NAT vision provides the framework for the region to continue to adapt its services and develop new ways of working to leverage emerging and innovative technologies. The NAT SPG structure ensures that the region implements improvements to its airspace provision while building and enhancing the levels of safety the region has become accustomed to.

Appendix A

ADS-B	Automatic Dependent Surveillance - Broadcast
ADS-C	Automatic Dependent Surveillance – Contract
ANS	Air Navigation Service
ATC	Air Traffic Control
CPDLC	Controller-pilot data link communications (data link)
fapfh	Fatal Accidents per Flight Hour
GASP	Global Aviation Safety Plan
GNE	Gross Navigation Error
HLA	High Level Airspace
ICAO	International Civil Aviation Organization
KPI	Key Performance Indicator
LHD	Large Height Deviation
NAT	North Atlantic
NAT CMA	North Atlantic Central Monitoring Agency
NAT EFFG	North Atlantic Economic, Financial and Forecast Group
NAT MWG	North Atlantic Mathematicians Working Group
NAT SG	North Atlantic Scrutiny Group
NAT SOG	North Atlantic Safety Oversight Group
NAT SPG	North Atlantic Systems Planning Group
OCA	Oceanic Control Area
OTS	Oceanic Track System
SKPI	Safety Key Performance Indicator
SLOP	Strategic Lateral Offset Procedure

— **END** —

**International Civil Aviation Organization (ICAO)
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