



ICAO

SAFETY

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

2018 Annual Safety Report



2019 Edition

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Executive Summary

The North Atlantic Region's sixth annual safety report is issued by ICAO's North Atlantic (NAT) Systems Planning Group (NAT SPG). The NAT SPG continuously studies, monitors and evaluates the air navigation system in the NAT Region in light of changing traffic characteristics, technological advances and updated traffic forecasts. The number of flight hours in the North Atlantic (NAT) High Level Airspace (HLA) in 2018 was 2,087,743. The traffic in the Region is expected to grow at an average annual growth rate of 3.5% over the next 5 years.

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. The NAT SOG is responsible to the NAT SPG for safety oversight in the NAT Region.

Safety performance in the NAT HLA is measured and monitored by the use of 12 Safety Key Performance Indicators (SKPIs) and by two Collision Risk Estimates in the lateral and vertical domains. For the year 2018, seven (7) targets were met as the following SPKIs decreased when compared to the previous three-year period of performance (2015-2016-2017):

- The rate of Large Height Deviation (LHD) per flight hours flown in the NAT HLA involving operations with Data Link in use.
- The percentage of Long Duration LHD events
- Rate of minutes that aircraft, with Data Link not in use, spent at the wrong flight level
- Rate of losses of separation per flight hours flown in the NAT HLA in the vertical domain

The vertical collision risk for 2018 was estimated to be 76.4×10^{-9} fatal accidents per flight hour (fapfh) for all NAT HLA, which represents an increase of 66% compared to 2017. Incorporating the estimated benefits of Strategic Lateral Offset Procedure (SLOP) reduces the vertical collision risk by 78% to 16.9×10^{-9} fapfh. The use of SLOP should therefore be encouraged at all NAT related user forums. The lateral collision risk for the year is estimated to be 13.8×10^{-9} fapfh, which represents an increase of 8% compared to 2017. The biggest contribution to the lateral Collision Risk in 2018 was a total of 162 minutes spent on an incorrect track.

The scrutiny of the 263 events and prevented events that have occurred in the NAT HLA in 2018 showed that the top 5 contributing issues were related to flying, or intending to fly the planned route instead of the cleared route, Air Traffic Control (ATC) coordination errors, waypoint entry or deletion errors by flight crews, equipment failure/malfunction, and non-adherences to ATC clearances.

The top 2 human error types associated with these contributing issues were:

- Action, when an Air Traffic Controller (ATCO) or flight crew made a selection, timing or positioning error, and/or omitted a required action, and/or transmitted, recorded or entered unclear or incorrect information and/or did not transmit or record required information.
- Perception, when an ATCO or flight crew mis-saw or mis-heard information, and/or misunderstood visual information/auditory information, resulting in an erroneous mental representation of the situation.

Workload management and decision making error types were also identified as contributors to deviations in 2018, but to a lesser extent than Action and Perception error types.

The practices of requiring position reporting of "NEXT and NEXT +1" and of requiring the "CONFIRM ASSIGNED ROUTE" CPDLC message sets (UM137/DM40) proved to be of benefit again in 2018, as they were used for 59% and 35% respectively out of the 116 events for which either the Air Traffic Controller (ATCO) caught and corrected a lateral deviation before it developed into a Gross Navigation Error (GNE), or the ATCO prevented a deviation or an uncoordinated flight profiles entering the airspace of another ANSP.

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. This core traffic operates for a large part without radar surveillance and increasingly with the use of Automatic Dependent Surveillance-Contract (ADS-C) and Automatic Dependent Surveillance-Broadcast (ADS-B). 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.

The number of flight hours in the NAT HLA in 2018 was 2,087,743. The NAT Economic, Financial and Forecast Group (NAT EFFG) estimates that in 2018, during the peak week of July 15 to July 21, approximately, 14,103 flights crossed the North Atlantic. The NAT EFFG expects traffic in this Region to grow at an average annual growth rate of 3.5% over the next 5 years, as shown on Figure 1. The long-term average annual growth rate from 2018 to 2038 is expected to be somewhere between 2.3% and 3.3%.

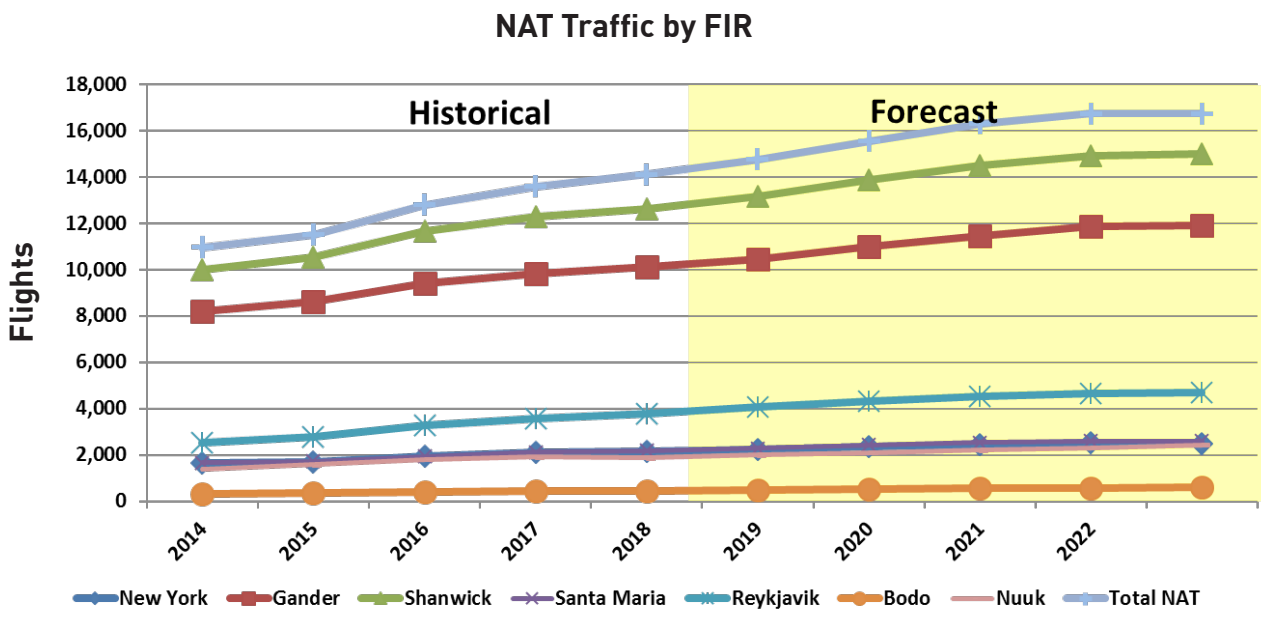


Figure 1: NAT Traffic by FIR

This continuously increasing demand in the busiest oceanic airspace in the world underlines the importance of the work conducted by the NAT Safety Oversight Group (SOG) to ensure that the highest level of safety performance is achieved in the NAT Region while maintaining a high level of capacity and efficiency.



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 will aim 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.

The NAT safety policy is aligned with the Global Aviation Safety Plan (GASP). All NAT provider States have met the near-term objective of the GASP, which was to achieve effective safety oversight by 2017 and are working towards State Safety Programme (SSP) implementation and predictive risk management, particularly in the areas of proactively managing risks through the identification and control of existing or emerging safety issues.

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.

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 2018 in the NAT HLA are based on risk bearing events reported to the NAT Central Monitoring Agency (CMA) for the period January to December 2018. 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.

The Vertical Collision Risk Estimate for 2018 was estimated to be 76.4×10^{-9} fapfh for all NAT HLA. Figure 2 shows that this reduces by 78% to 16.9×10^{-9} fapfh with SLOP. The Vertical Collision Risk Estimates in 2018 both with the SLOP effect incorporated and without SLOP are higher in comparison to 2017 estimates.

Figure 2 also presents the Lateral Collision Risk for the year 2018, estimated to be 13.8×10^{-9} fapfh, which represents an increase of 8% compared to 2017.

The increase in risk is in part due to a long duration event (52 minutes) which counted in both the vertical and lateral dimensions.

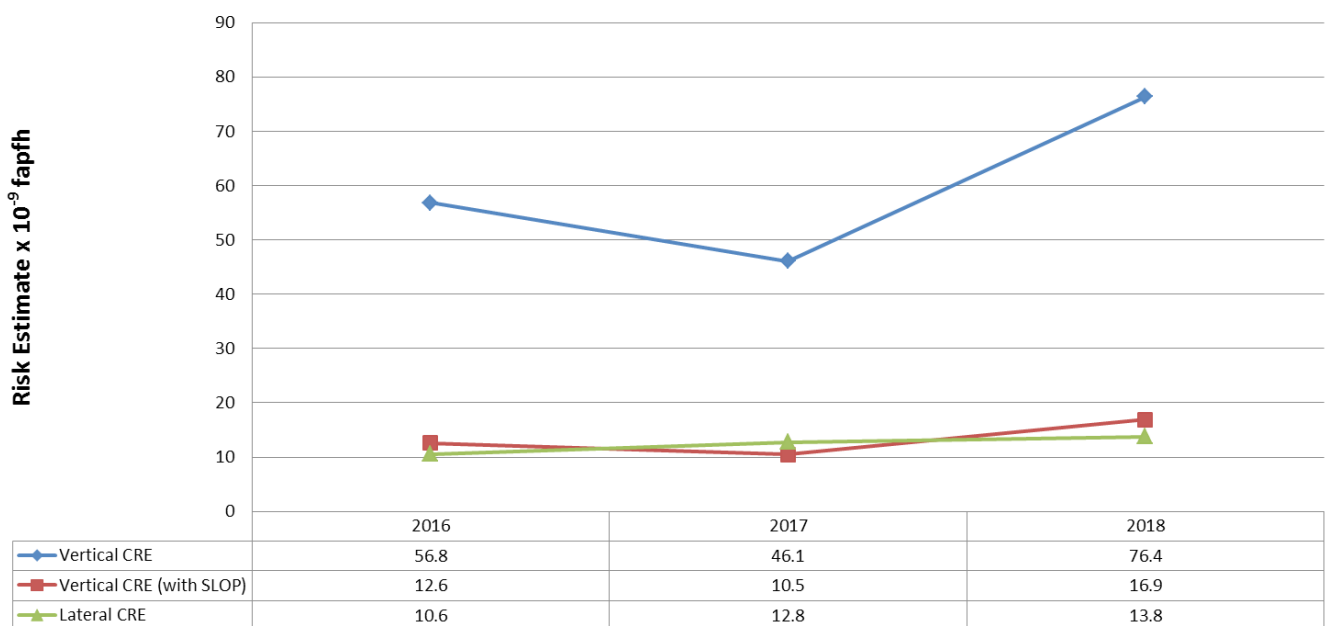


Figure 2: Collision Risk Estimates in the NAT HLA (2016-2018)

Safety Key Performance Indicators (Safety KPIs)

The NAT SPG has established Safety KPIs and associated targets for the NAT HLA. The NAT HLA performance in 2018 is shown the table below¹. The 2018 figures are shown in green where the performance meets the targets and red otherwise. For those where the information was not available to calculate the baseline, these are left in black.

Safety KPI		Target		2017 Performance	2018 Performance
i	Number of accidents	0		0	0
ii	Number of fatal accidents	0		0	0
iii	Number of fatalities related to aviation fatal accidents	0		0	0
		Target	Previous rolling 3 year period of performance (2015-2016-2017)	2017 Performance	2018 Performance
iv	Rate of LHD events (No of LHD events divided by No of flight hours flown in the NAT region), involving operations with Data Link in use	Reduction over previous rolling three-year period of performance compared to 2015-2016-2017 baseline	2.46×10^{-5}	2.67×10^{-5}	2.87×10^{-5}
v	Rate of LHD events (No of LHD events divided by No of flight hours flown in the NAT region), involving operations with Data Link not in use	Reduction over previous rolling three-year period of performance	1.36×10^{-5}	1.20×10^{-5}	7.18×10^{-6}
vi	Percent of Long Duration ² LHD events	Reduction over previous rolling three-year period of performance	3.88%	0.00%	2.67%
vii	Rate of minutes that aircraft, with Data Link in use, spent at the wrong flight level (Amount of minutes spent at the wrong flight level divided by total duration of flights in minutes)	Reduction over previous rolling three-year period of performance	6.63×10^{-7}	8.63×10^{-7}	6.95×10^{-7}
viii	Rate of minutes that aircraft, with Data Link not in use, spent at the wrong flight level (Amount of minutes spent at the wrong flight level divided by total duration of flights in minutes)	Reduction over previous rolling three-year period of performance	1.48×10^{-6}	4.91×10^{-7}	1.05×10^{-6}
ix	Rate of GNE events (No of GNE events divided by No of flight hours flown in the NAT region) , involving operations with Data Link in use	Reduction over previous rolling three-year period of performance	N/A	6.54×10^{-6}	1.72×10^{-5}
x	Rate of GNE events (No of GNE events divided by No of flight hours flown in the NAT region), involving operations with Data Link not in use	Reduction over previous rolling three-year period of performance	N/A ³	5.45×10^{-6}	4.79×10^{-6}
xi	Rate of losses of separation (vertical) (No of losses of separation events divided by No. of flight hours flown in the NAT region)	Reduction over previous rolling three-year period of performance compared to 2015-2016-2017 baseline	1.13×10^{-5}	1.14×10^{-5}	9.58×10^{-6}
xii	Rates of losses of separation (lateral) (No of losses of separation events divided by No. of flight hours flown in the NAT region)	Reduction over previous rolling three-year period of performance compared to 2015-2016-2017 baseline	N/A ³	4.91×10^{-6}	3.83×10^{-6}

Table 1: Safety KPIs and associated targets

¹ The flight hours flown value for 2018 calculations use the actual flight hours, whereas, for the previous years, the figures were calculated using the estimated flight hours of 3.25 hours per aircraft.

² Long Duration LHD event means an event unprotected by ATC for 20 minutes or more, based on a threshold established after review of historical data reported to the NAT CMA.

³ For Safety KPIs in the lateral dimension, it is not appropriate to calculate values for 2015 and 2016 due to changes in methodology and data capture, therefore, there is no baseline for the lateral SKPIs.

Scrutiny of events

The NAT SG reviewed and scrutinized a total of 263 events 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 2018. These events were categorized as follows:

- 85 Large Height Deviations (LHDs)
- 96 actual lateral deviations, including:
 - 47 GNEs and
 - 34 ATC Interventions where when the Air Traffic Controller (ATCO) caught and corrected a lateral deviation before it developed into a GNE
- 82 prevented events where the ATCO prevented a deviation or an uncoordinated flight profile entering the airspace of another ANSP.

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 scrutiny of these 263 events of 2018 showed that the top 5 contributing issues were:

1. **Flight Plan vs. Clearance** where flying, or intending to fly the planned route instead of the cleared route contributed in 53 (20%) of the events of 2018. In most cases (31 out of the 53), deviations did not actually occur as they were prevented by an ATCO.
2. **ATC coordination** where an error occurring during the coordination between two ATC sectors or ANSPs contributed in 38 (14%) of the events of 2018. In almost half of those cases, deviations did not actually occur as they were prevented by an ATCO.
3. **Waypoint updating** involving waypoint entry or deletion errors by flight crews contributed to 37 (14%) of the events of 2018.
4. **Equipment**, where the failure/malfunction of a ground-based, airborne, Data-Link or other equipment contributed in 35 (13%) of the events of 2018. This contributing issue affected equally LHDs and lateral deviations.
5. **Non-adherences to ATC clearances** in either the vertical or the lateral dimension contributed to 25 (10%) of the 2018 events.

Additional contributing issues were newly identified during the scrutiny of the 2018 deviations. One is related to the issuance of Controller-Pilot Data Link Communications (CPDLC) uplink messages where pilots, upon receiving UM79/UM80/UM83 messages, erroneously route directly to the point displayed in the message. This issue could be related to how the messages are displayed to the crew. This contributed to 10 (4%) of the 2018 deviations. Another new contributing issue identified in 2018 is related to pertinent message not actioned by ATC, where a message that could have been useful to prevent or mitigate a deviation was presented to the ATCO, but not actioned, sometimes because it was perceived as a nuisance message that could be disregarded. This contributed to 24 (9%) of the 2018 deviations.

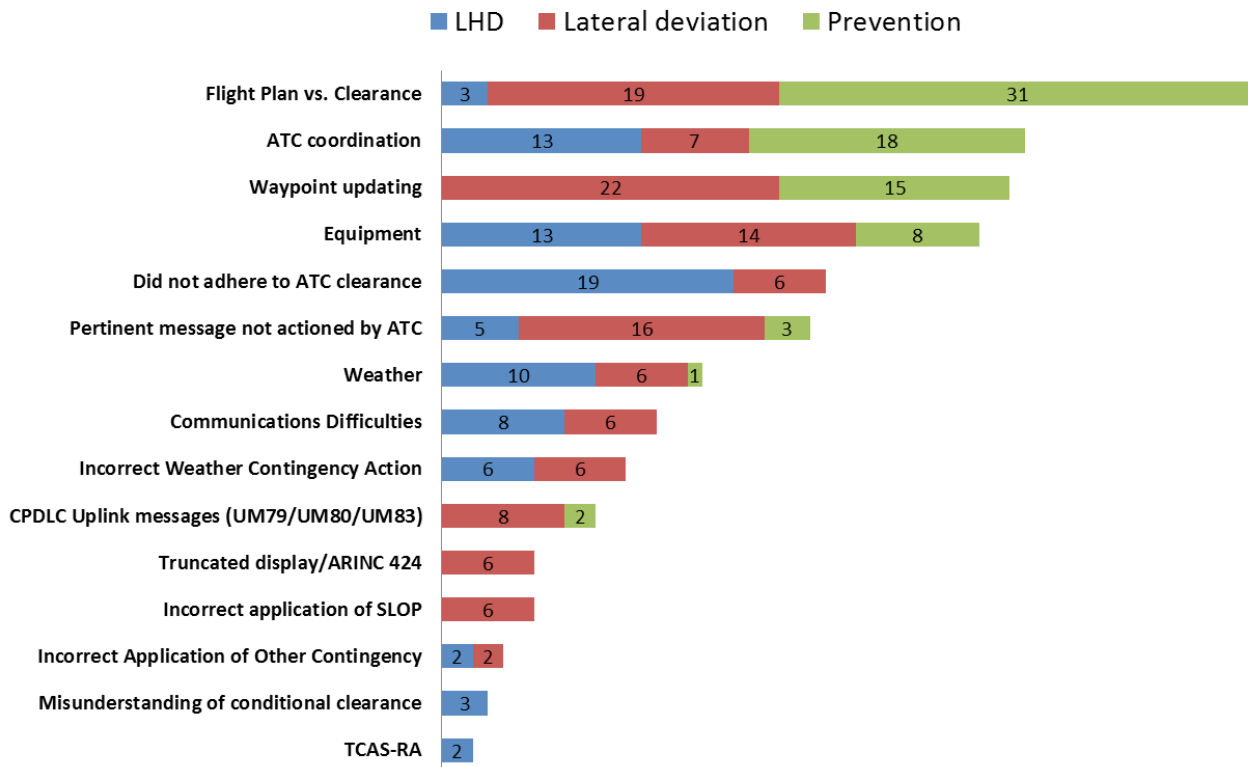


Figure 3: Contributing issues to events in the NAT HLA in 2018 reported to NAT CMA and scrutinized by NAT SG

Prevented deviation events and ATC Interventions events were classified according to the implemented mitigations used to avert a deviation. The results of this classification are presented in Figure 4, 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.

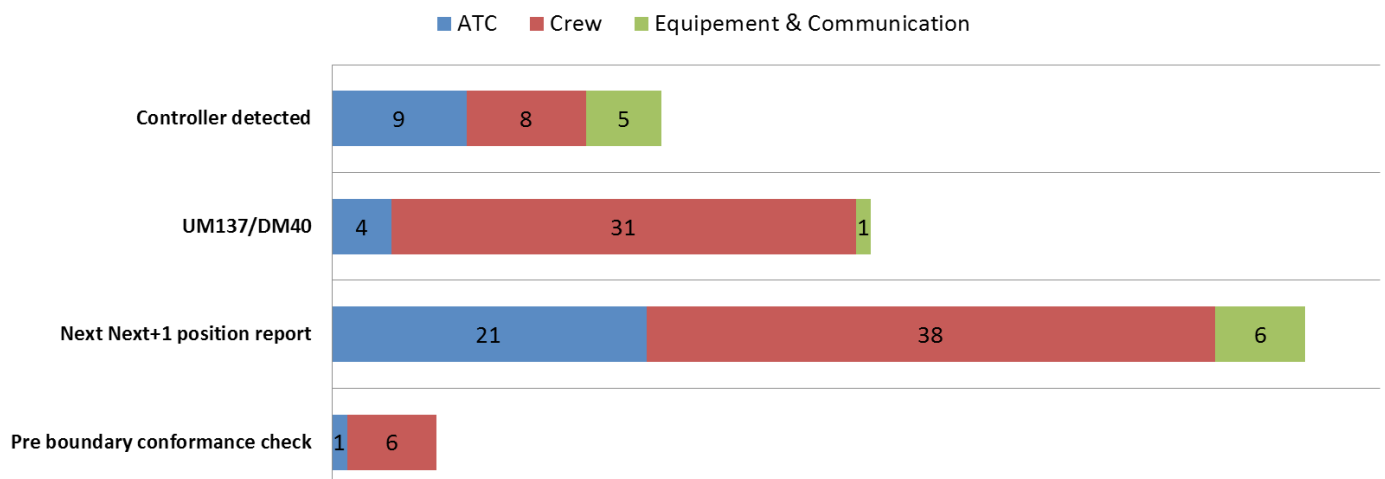


Figure 4: Mitigations used for prevented lateral deviations and ATC interventions in 2018

In addition, 22 LHDs in 2018 could have potentially been prevented through the use of Selected Flight Level-Cleared Flight Level (SFL-CFL) Conformance Checking via Space-Based ADS-B.

The following high-level human error types were used to record the contribution of human factors in each deviation and prevention in 2018. An error is defined as “an action or inaction by an operational person that leads to deviations from organizational or the operational person’s intentions or expectations”. The following error types are applicable to all aviation personnel (flight crew, ATC, dispatchers...).

Error Type	When the operational person...
Action	Made a selection error Made a timing/positioning error Omitted a required action Transmitted, recorded or entered unclear or incorrect information Did not transmit or record required information Did not observe or check the progress or correctness of the flight or systems
Workload management	Was unable to or did not adequately prioritize, schedule, initiate, execute, monitor, and terminate multiple concurrent tasks Was unable to or did not properly allocate attention, time, or workload
Non conformance	Intentionally deviated from established regulations, procedures, norms or practices. <i>Note: intentional acts are not always acts of malicious intent and should not automatically result in disciplinary measures. Individuals may knowingly deviate from norms, in the belief that the violation facilitates mission achievement without creating adverse consequences.</i>
Perception	Mis-saw or did not see visual information Mis-heard or did not hear auditory information Misunderstood visual information/auditory information, resulting in an erroneous mental representation of the situation
Decision making	Misjudged aircraft/object projection Made an incorrect or insufficient decision or plan Made a late decision or plan Made no decision or plan when required
Memory	Forgot previous action Forgot planned action Had no or inaccurate recall of temporary information Miscalled or had no recall of information in long-term memory

The scrutiny of the 2018 events in the NAT HLA shows a predominance of action and of perception error types, which can help in determining what type of mitigation measures to establish and implement to mitigate the type of errors and their effects on deviations in NAT HLA.

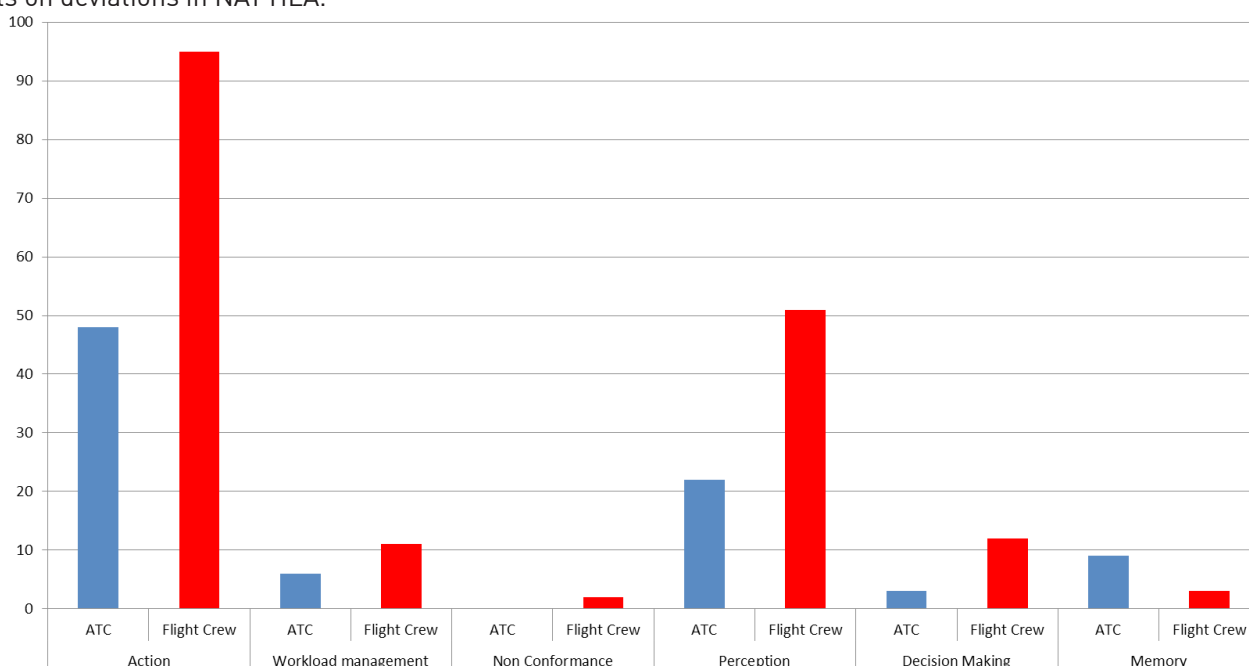


Figure 5: Contribution of Human Error for events in the NAT HLA for January-December 2018



NAT Regional Priorities

A number of Air Navigation Service (ANS) initiatives are on-going in the NAT Region. In line with the safety policy and as stipulated in the terms of reference and the work structure of the NAT SPG, it is imperative that acceptable safety arguments are provided in relation to system developments in the NAT Region. The agreed policy is as stated above, to maintain and where possible improve the agreed safety standards in all activities. In this regard, the safety work that provides confidence that upcoming initiatives do not negatively affect the safety of the ICAO NAT Region, is ongoing.

Space-based ADS-B

In 2018, the NAT Region spent considerable resources to prepare to the trial implementation of Space Based ADS-B in support of separation minima using ATS surveillance where VHF voice communication is not available. SB ADS-B enables a breakthrough in the overall NAT concept of operations by providing radar-like ATS surveillance in the areas where such surveillance was not feasible in the past. It brings safety and efficiency gains in ATM and also Search and Rescue by allowing surveillance capability of any ADS-B transponder equipped aircraft. The trial, which has started in March 2019, was preceded by extensive work on developing and coordinating the trial concept of operations, an implementation plan and a task list, and associated safety cases. Prior to that, the NAT Region also had completed a Business Case Assessment (BCA) that indicated that implementing the reduced oceanic separation standards based on SB ADS-B in the NAT would represent a positive business case. Furthermore, there are potential benefits in terms of significant reduction in tactical conflicts to be gained through SB ADS-B implementation. The trial will continue until November 2020 when the related Procedures for Air Navigation Services - Air Traffic Management (PANS-ATM, Doc 4444) provisions on ATS surveillance separation in the areas without VHF communications become applicable. The trial is initially conducted in the longitudinal dimension, to be further expanded to the lateral, once all preparatory safety and planning work has been completed and approved by the NAT SPG.

Separation minima based on PBCS/PBN

On 29 March 2018, the NAT Region implemented the separation minima based on PBCS/PBN, initially on 3 core tracks within the Organised Track System (OTS). The implementation was preceded with work on preparing the concept of operations, implementation plan and task list as well as safety documentation. Two parallel trials were run, reduced lateral and longitudinal separation minima implementation, to gain sufficient confidence and support the global work on the development of Annex 6, Annex 11, Annex 15 and PANS-ATM provisions to enable a globally harmonised implementation. The NAT implementation programme was closely coordinated with the APAC Region. The reduced separation minima bring additional efficiency and safety benefits. This is also an operational improvement that contributes to ICAO's strategic objective of reducing the environmental impact of civil aviation through providing more capacity and efficient trajectories. The PBCS and PBN component of this implementation provides safety assurances that the air and ground systems, on which the application of the reduced separation minima is dependent, are performing in accordance with the expected performance levels. This also enables a monitoring system to be in place, based on collaboration with the global network of regional monitoring agencies, to follow up on non-performing fleets and continuously improve the data link performance.

Conclusion

The NAT Region continues to make progress toward achieving its safety targets, although LHDs and vertical risk continue to be of specific concern. At the same time, the Region also continues to conduct the safety analyses and operational trials necessary to introduce new technologies and procedures intended to increase the efficiency of the busy oceanic airspace.

Appendix A - Glossary

ADS-B	Automatic Dependent Surveillance - Broadcast
ADS-C	Automatic Dependent Surveillance - Contract
ANS	Air Navigation Service
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATS	Air Traffic Service
CPDLC	Controller-Pilot Data Link Communications (data link)
DLM	Data Link Mandate
FANS	Future Air Navigation System
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
LD LHD	Long Duration LHD
LHD	Large Height Deviation
MNPS	Minimum Navigation Performance Specification
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	Organised Track System
RVSM	Reduced Vertical Separation Minimum
SLOP	Strategic Lateral Offset Procedure
SSP	State Safety Programme
TLS	Target Level of Safety

— END —



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