ICAO

SAFETY

NORTH ATLANTIC SYSTEMS PLANNING GROUP (NAT SPG)

2019 Annual Safety Report

2020 Edition

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**.**

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

The North Atlantic Region's seventh annual safety report is issued by ICAO's North Atlantic (NAT) Systems Planning Group (NAT SPG). This report covers calendar year 2019, but is written at a time when the global traffic picture in 2020 has been decimated by a global health crisis. While the report will stand as a record of 2019's performance, the integrity of the contributing data may not fully reflect the actual performance and will be subject to review once the health picture allows a level of "normal" business to resume. As such, those reading this report may need to take that into account, when using the data contained within.

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 2019 was 2,063,908, a slight reduction in that reported in 2018. Until the onset of SARS COVID-19, traffic had predicted to grow at a rate of 2.4% between 2020 and 2024. Although the impacts of COVID-19 on our industry are not fully understood, it is not expected that a return to traffic levels seen in 2019 will be seen again for some years.

Safety performance in the NAT HLA is monitored by the measures and targets associated with a set of 12 Safety Key Performance Indicators (SKPIs). The targets are typically set using three years of rolling data. Six (6) of the SKPIs have met their target in 2019. Improvements were seen in the following SKPIs:

- The percentage of long duration large height deviations (LHDs) events has reduced steadily.
- The rate of LHDs where datalink was not in use has reduced.
- The number of minutes spent at the wrong flight level for aircraft not using datalink has also reduced.

The measures supporting the SKPIs are benchmarked against a three-year rolling average resulting in the associated targets being adjusted year on year. In some instances, where data link was in use, safety performance appears degraded in 2019 when comparing with previous years. No specific operational causes have been identified that could result in the change in performance status. The change is primarily attributed to refinements and improvements in the measurement of flight hours and other supporting mathematical processes, data analysis and the increased operational use of data link. The NAT Safety Oversight Group will continue to monitor trends and contributory factors identified by the NAT Scrutiny Group.

The vertical collision risk estimate (CRE) for 2019 was calculated to be 52.6 x 10^{-9} fapfh for all NAT HLA. In 2018 this figure was 76.4 x 10^{-9} fapfh and represents an improvement of approximately 30%. This year's CRE can be reduced further by 77% to 12.0 x 10^{-9} fapfh by taking into account the use of the strategic lateral offset procedure (SLOP).

The lateral CRE for 2019 marginally reduced in 2019 compared to 2018 at 13.6 x 10^{-9} fapfh

The number of scrutinized events in 2019 and the type of event being scrutinized were similar in volume to those reported in 2018. In 2019, Flight plan vs clearance remained at the top of the list of contributors at 30% of the total although of the 80 reported, 49 were prevented by ATC. Remaining in the top five contributing factors are ATC coordination errors (11% vs 14% in 2018) and not adhering to ATC clearances (13% vs 10% in 2018). Weather premieres in the top five (17%)

While the use of "NEXT and NEXT +1" and "CONFIRM ASSIGNED ROUTE" again showed their worth as powerful mitigations, the introduction of ADS-B in the NAT in March 2019 also introduced benefits through enhanced controller conformance monitoring tools such as Cleared Flight Level vs Selected Flight Level (CFL/SFL) alerts and Route Assignment Monitoring (RAM) giving controller tools to intervene to reduce risk where errors occur. Performance in the 2nd half of 2019 was demonstrably improved as a result.

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) and utilization averaged out across the NAT at 83% in 2019 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 2019 was 2,063,908. The NAT Economic, Financial and Forecast Group (NAT EFFG) estimates that in 2019, during the peak week of July 15 to July 21, approximately, 13,733 flights crossed the North Atlantic.

Traffic forecast: The latest traffic forecast released prior to the COVID-19 pandemic pointed out to an annual average growth of 2.4% in the period 2020-2024. The NAT EFFG released a preliminary forecast of total NAT traffic for the period 2020-2025 and also a Reykjavik CTA forecast. The ad-hoc methodology used for this forecast was a weighted average of each ANSP's forecast for traffic through their respective FIR and foresees the recovery of 2019 traffic volumes only by 2024.

Safety Performance Monitoring and Measurement

Note 1: In 2020, the organization and conduct of all meetings of NAT SPG and its contributing bodies were heavily impacted by the consequences of the COVID-19 pandemic. Because of this, the events that occurred in the NAT HLA between July and December 2019, even though scrutinized in 2020 by a small group of experts, could not be reviewed by the usual full NAT Scrutiny Group (NAT SG) membership during a face-to-face meeting. The values for safety performance presented in this report for 2019 could therefore be revisited when full face-to-face NAT SG meetings can be reconvened, and are subject to change.

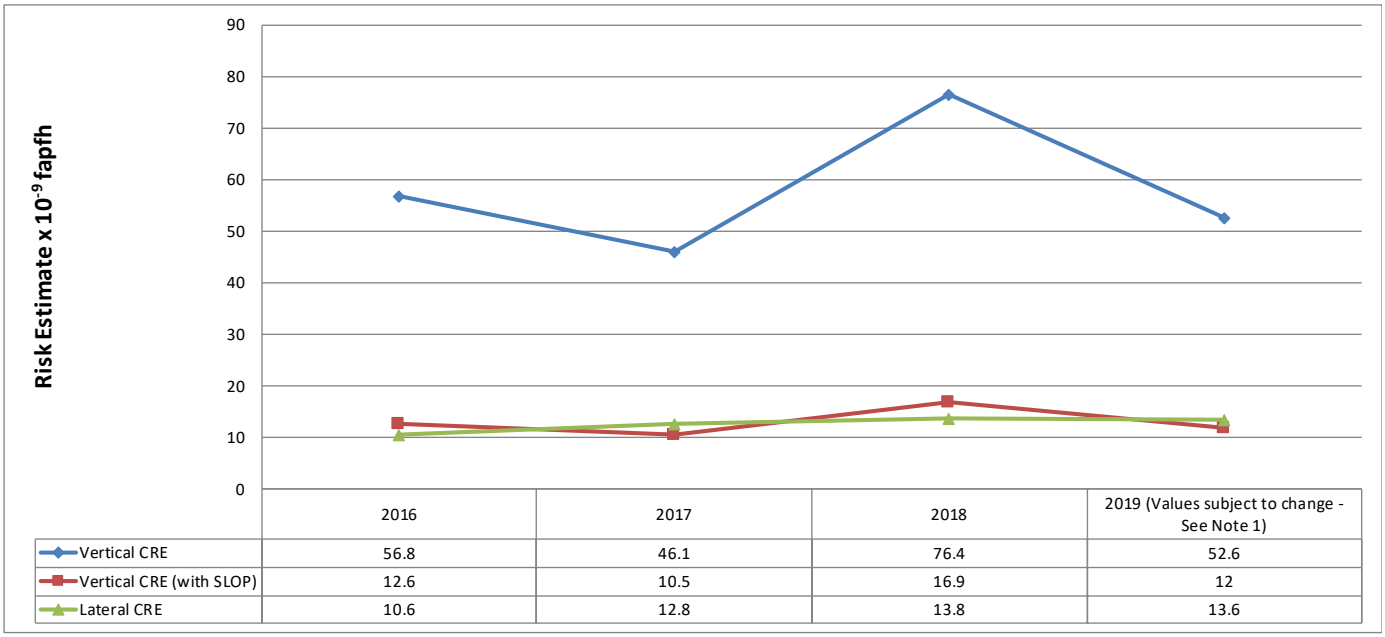
Collision Risk Estimates

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 2019 in the NAT HLA are based on risk bearing events reported to the NAT Central Monitoring Agency (CMA) for the period January to December 2019. 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 2019 was estimated to be 52.6 x 10^{-9} fapfh for all NAT HLA. Figure 1 shows that this reduces by 77% to 12.0 x 10^{-9} fapfh with SLOP. The Vertical Collision Risk Estimates in 2019 both with the SLOP effect incorporated and without SLOP are lower in comparison to 2018 estimates.

Figure 1 also presents the Lateral Collision Risk for the year 2019, estimated to be 13.6 x 10^{-9} fapfh, which represents a decrease of 1% compared to 2018.



	2016	2017	2018	2019 (Values subject to change - See Note 1)
Vertical CRE	56.8	46.1	76.4	52.6
Vertical CRE (with SLOP)	12.6	10.5	16.9	12
Lateral CRE	10.6	12.8	13.8	13.6

Figure 1: Collision Risk Estimates in the NAT HLA (2016-2019)

Safety Key Performance Indicators (KPIs)

The NAT SPG has established Safety KPIs and associated targets for the NAT HLA. The NAT HLA performance in 2019 is shown the table below. The 2019 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	2019 Performance
i	Number of accidents	0		0	0	0
ii	Number of fatal accidents	0		0	0	0
iii	Number of fatalities related to aviation fatal accidents	0		0	0	0
	Safety KPI	**Target**	**Previous rolling 3 year period of performance (2016-2017-2018)**	**2017 Performance**	**2018 Performance**	**2019 Performance (Values subject to change – See Note 1)**
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	1.85×10^{-5}	2.67×10^{-5}	2.87×10^{-5}	**3.59×10^{-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	1.09×10^{-5}	1.20×10^{-5}	7.18×10^{-6}	**3.39×10^{-6}**
vi	Percent of Long Duration[2] LHD events	Reduction over previous rolling three-year period of performance	3.36%	0.00%	2.67%	**2.47%**
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	6.44×10^{-7}	8.63×10^{-7}	6.95×10^{-7}	**9.45×10^{-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	1.22×10^{-6}	4.91×10^{-7}	1.05×10^{-6}	**2.34×10^{-7}**
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}	$^{1}.72 \times 10^{-5}$	**1.11×10^{-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}	**6.78×10^{-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	9.99×10^{-6}	1.14×10^{-5}	9.58×10^{-6}	**1.02×10^{-5}**
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}	**8.72×10^{-6}**

Table 1: Safety Key Performance Indicators (SKPIs) and associated targets (2017-2019)

1 - The flight hours flown value for 2019 and 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 - The 2016-2018 rolling 3-year baseline targets for lateral SKPIs are not available because of changes in methodology and data capture that occurred in 2017, rendering 2016 SKPIs not comparable to the ones of 2017 and 2018..

Scrutiny of events

The NAT SG reviewed a total of 266 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 2019. These events were categorized as follows:

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

Note 2: 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.

During 2019, the NAT CMA transitioned from using multiple data sources to the NAT Event Reporting Application (NERA) as the single repository for the reporting, review and analysis of operational occurrence reports.

The NERA database was developed and is maintained by Isavia on behalf of the NAT CMA. The new application has given the NAT CMA and the NAT SG greater accuracy in recording data and improved flexibility in identifying causal and human factors which contributed to the cause and magnitude of operational events, in addition to the mitigations applied to prevent or reduce the magnitude of a deviation.

The review of these 266 events of 2019 showed that the top 10 contributing issues were:

1. *Flight Plan vs. Clearance* where flying, or intending to fly the planned route instead of the cleared route contributed in 80 (30%) of the events of 2019. In most cases (49 out of the 80), deviations did not actually occur as they were prevented by an ATCO.
2. *Weather* where weather conditions experienced during the flight contributed in 46 (17%) of the events of 2019.
3. *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 35 (13%) of the 2019 events.
4. *ATC coordination* where an error occurring during the coordination between two ATC sectors or ANSPs contributed in 29 (11%) of the events of 2019. In more than a third of those cases, deviations did not actually occur as they were prevented by an ATCO.
5. *Pertinent message not actioned by ATC*, where ATC inaction on receipt of a pertinent message contributed in 25 (9%) of the events of 2019 (e.g. a system-generated conformance alert was not actioned or erroneously discarded).
6. *CPDLC Uplink messages*, where crew misunderstood or misread a CPDLC uplink message, or indicated an issue with their CPDLC contributed in 23 (9%) of the 2019 events. In almost half of those cases (10 out of 23), deviations did not actually occur as they were prevented by an ATCO.
7. *Equipment*, where a ground-based, an airborne or a datalink system equipment issue contributed in 18 (7%) of the 2019 events.
8. *Waypoint updating* involving waypoint entry or deletion errors by flight crews contributed to 15 (6%) of the events of 2019.

9. *Dispatch*, where a flight plan issue contributed in 14 (5%) of the 2019 events. This can for example be an arrival route into an FIR or airport not filed as per the national AIP or flight plans filed incorrectly, causing the existence of multiple flight plans with different routes for one flight.
10. *Readback/Hearback*, where incorrect read back or hear back of a clearance contributed in 13 (5%) of the 2019 events. This can for example be when crew readback an incorrect clearance which was not picked up by the receiving ATC Unit.

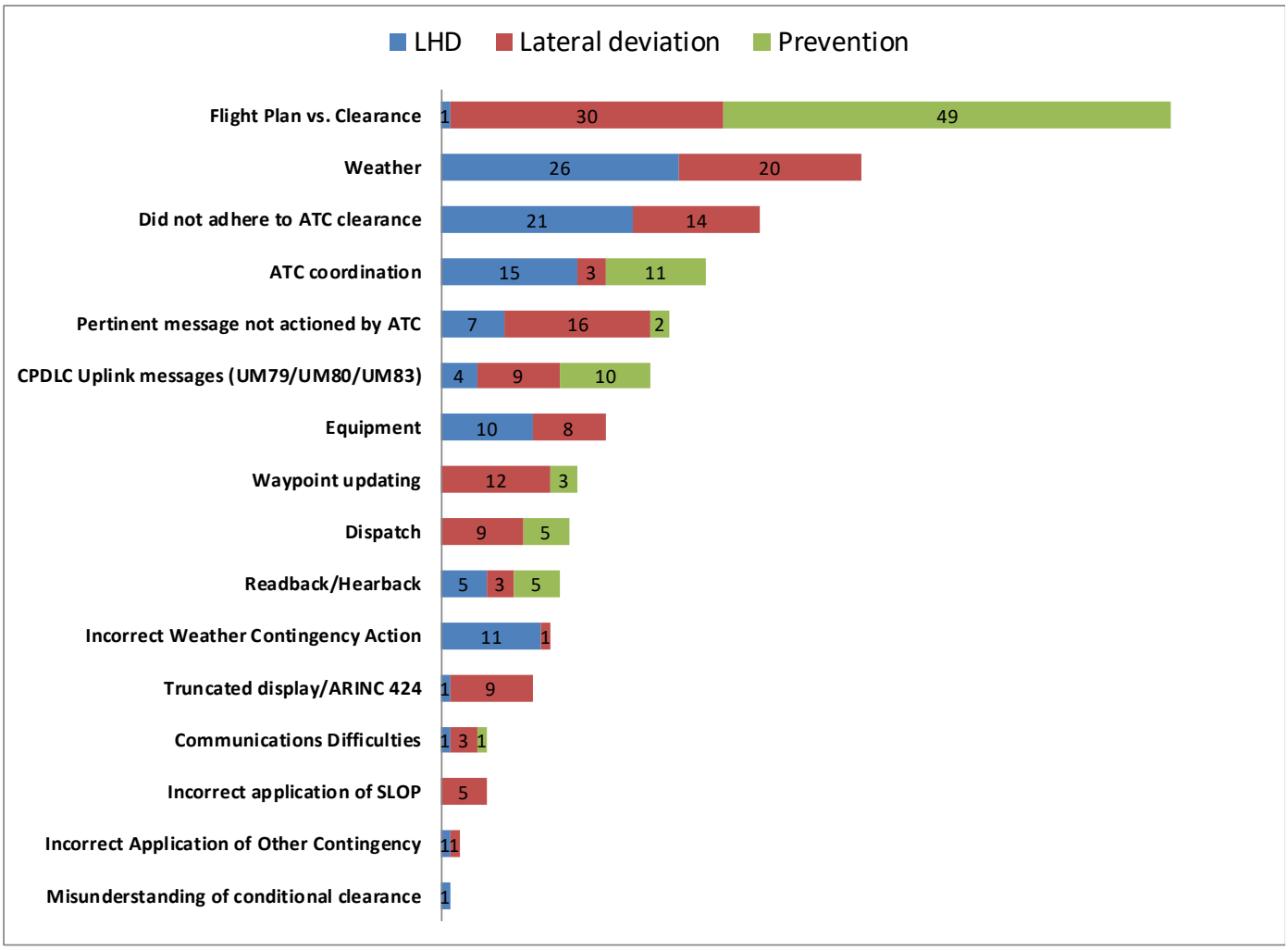


Figure 2: Contributing issues to events in the NAT HLA in 2019 (subject to change – see Note 1)

Prevented deviation events 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.

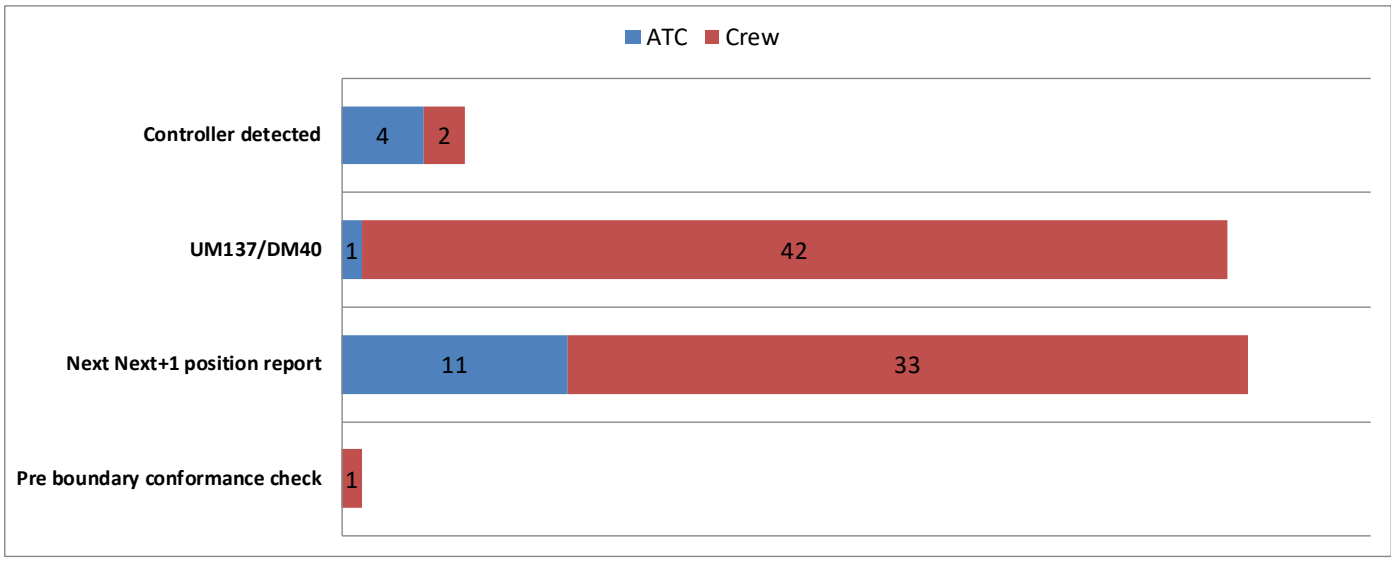


Figure 3: Mitigations used for prevented deviation events in 2019 (subject to change – see Note 1)

NAT Regional Priorities

In the NAT, 2019 was defined by significant operational transitions that not only delivered immediate positive impacts in safety performance in the North Atlantic as evidenced in the safety performance measures, and immediate service performance improvements as evidenced through the regular service updates, but also delivered a platform from which future benefits can be enabled.

In March 2019, the widespread availability and use of Spaced-based Automatic Dependent Surveillance – Broadcast (SB ADS-B) was deployed through Aireon's low Earth orbit (LEO) technology and delivered a "radar-like" capability to enhance extant procedural controlling techniques in large parts of the North Atlantic. The technology enabled a significant reduction in longitudinal separation between equipped aircraft from March and then reduced the required lateral separation in October.

During 2019, the NAT continued its' efforts in evaluating the Performance Based Communication Surveillance (PBCS) implementation and performance monitoring in the NAT region by measuring and assessing data link performance against the RSP180/RCP240 requirements. The aggregated actual surveillance performance (ASP) and actual communication performance (ACP) within the NAT region, combining the SAT, VHF, HF and transition area performance together, has remained stable for several years. It is noted that the majority of the data is delivered via SATCOM. During 2019, the 95% criteria were met for RSP 180 and RCP240 for the aggregate NAT and for the individual NAT FIRs; and the 99.9% criteria were met for RSP 180 and RCP240 at the currently accepted level of 99.0% for the aggregate NAT and for the individual NAT FIRs. To improve data link network performance in the region, the NAT is working to measure and assess availability by identifying outage impacts through analysis of the ADS-C downlinks and message failures, in conjunction with the notifications received from the CSPs. The NAT member States continue to work with the NAT CMA on the processes involved for monthly non-compliance reporting, coordinating with the regional monitoring agencies (RMAs) and States to develop and refine their processes in the full reporting and corrective action chain.

Separation was reduced as a consequence of significant improvements in the quality and frequency of aircraft position update information from eligible flights allowing controllers to intervene with confidence to prevent a deviation from a protected level or route through the utilization of controller tools only previously available in a radar environment, such as Selected vs Cleared Flight Level alerts (SFL/CFL) or through Route Adherence Messages (RAM).

In successfully delivering the improvements described above, the NAT has begun to leverage emerging technologies in order to realize efficiencies and optimize seamless airspace provision. It has laid the platform for a series of possible improvements over the coming decade as part of the NAT2030 vision.

The NAT 2030 vision is designed to deliver a proportionate series of improvements prioritized and deployed, utilizing the available technology but delivering benefits in terms of both safety and service. The global and industry context and environment will drive the deliverables, but

- It will seek to improve operational flexibility, by reducing the OTS footprint, discontinue the use of oceanic clearances and introduce procedures for the "dynamic airborne rerouting".
- It will strive to improve operational resilience through the development of its contingency procedures and improvements in communication performance all within the context of a developing cyber threat.
- It will embrace emerging technologies and techniques such as formation flights or self-separation and ready itself for new market entrants such as unmanned flight, supersonic or space flight and balloon operations.
- In delivering these priorities, it intends to meet, and where possible exceed safety, service and environmental targets while developing the available metrics to improve their relevance

Conclusion

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 newly deployed technology along with the combined capability of those within the region to make the best use of it, conspire to make this a pivotal time in the evolution of the NAT in service of that objective.

Appendix A - Glossary

ADS-B	Automatic Dependent Surveillance - Broadcast
ADS-C	Automatic Dependent Surveillance – Contract
ANS	Air Navigation Service
ATC	Air Traffic Control
ATS	Air Traffic Service
CPDLC	Controller-pilot data link communications (data link)
EFFG	Economic, Financial and Forecast Group
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
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
RVSM	Reduced Vertical Separation Minimum
SKPI	Safety Key Performance Indicator
SLOP	Strategic Lateral Offset Procedure

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