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SPACE WEATHER CONTINGENCY PROCEDURES

NORTH ATLANTIC REGION

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FOREWORD

This guidance gives a brief overview on how space weather phenomena may affect the NAT Region and its constituent Flight Information Regions and Control Areas, and information on common / specific ANSP contingency processes applied to minimize operational impacts of space weather events occurring in the NAT Region.

For more detailed guidance, refer to the *Manual on Space Weather in Support of International Air* Navigation (ICAO Doc 10100).

Edited by European and North Atlantic Office of ICAO
3 bis, Villa Emile Bergerat
92522 Neuilly-sur-Seine Cedex – France

Tel: +33 1 4641 8585
Fax : +33 1 4641 8500
Email: icaoeurnat@icao.int
http://www.icao.int/EURNAT/

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RECORD OF AMENDMENTS

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1. Introduction

1.1 Space Weather is a phenomenon associated with solar activity events such as Geomagnetic Storms, X-ray Flares, Solar Radiation Storms, Ionospheric Storms and Sunspot which present a recognised risk to air transport. Typically, the amount of solar radiation detected increases with increasing altitude but during a severe space weather event, increased levels of solar radiation can be experienced globally by aircraft both at altitude and at ground level.

1.2 Severe space weather events may cause degradation or loss of multiple ATC Systems, Aircraft Systems including GNSS, Microwave Links, Satellite reliant communications, RF issues (i.e., VHF Datalink) and may cause National Power Grid outages. Effects can be localized to only one FIR or may affect multiple FIRs, including the whole of the North Atlantic Region (NAT) and beyond.

1.3 Various space weather types are predictable to variable extents; however, the operational impact of these phenomena is hard to quantify both in severity and in location. ANSPs are well aware of HF issues and have many years of experience mitigating the operational impacts. GNSS uncertainties are more significant in the NAT Region and may require contingency processes such as greater spacing between aircraft as a function of phase of flight or the use of alternative means of communication, navigation and/or surveillance.

1.4 ANSPs and Operators should be aware of the range of potential difficulties that space weather phenomena can cause and should monitor space weather forecasts and have in place contingency measures to mitigate possible negative effects.

1.5 Although peaks in space weather events are cyclical (approximately every 11 years), incidences of significant events may occur at any time.

1.6 In extreme cases aircraft occupants, especially those in high level flight, can be exposed to increased levels of solar radiation. Aircraft operators should consider the impact of space weather prior to filing a flight plan. However, space weather can change rapidly, and severe space weather events occur without warning.

1.7 ICAO Document 10100, *Manual on Space Weather Information in Support of International Air Navigation*, provides more detail on what constitutes Space Weather, its nature, effects upon Air Navigation, and how Space Weather information should be promulgated by Space Weather Centres (SWXC) that users can employ for decision-making.

2. Hazards in the NAT Region

2.1 The following hazards may be expected during (severe) space weather events:

a) Unexpected loss of communication (HF / SATVOICE and CPDLC / SATCOM).

b) Degraded performance of navigation and surveillance that rely on GNSS (such as ADS-B and / or ADS-C).

c) Unanticipated non-standard performance of on-board electronics resulting in reboots and anomalies.

d) Issues related to radiation exposure by aircrew and passengers.

e) Increased frequency of flight crews adopting contingency procedures that may result in level change, re-routes, turn-backs and diversions.

3. Common NAT Region Space Weather Contingency Plans

3.1 OBJECTIVE

3.1.1 The objective of this section is to provide an overview of the common contingency procedures that NAT Region ANSPs will adopt in response to a space weather event, to enable operators to make informed decisions when the event occurs in the North Atlantic Region.

3.1.2 Specific ANSP contingency processes are detailed in Section 4 where required.

3.2 INITIAL ACTIONS (REACTIVE PHASE)

3.2.1 Timely availability of reliable and consistent space weather information (observations and forecasts) is essential to mitigate safety risk of aircraft losing key in-flight functionality. These forecasts also enable operators and ATC the opportunity to be situationally aware and to formulate / implement alternative (contingency) plans that minimize operational impacts of space weather occurring in the NAT Region.

3.2.2 Each NAT Region ANSP has processes that ensure space weather information is presented to ATC to permit operational planning.

3.2.3 The reactive phase can be considered to be a relatively short period when ATC become aware of the space weather event and plan / implement appropriate measures to minimize the risk. The associated actions by ATC will be dependent on the pre-notification period, severity and expected duration of the event.

3.3 AIRCRAFT NOT OPERATING OUTSIDE THE NAT REGION (PRIOR TO ENTRY)

3.3.1 ATC will not know the expected duration of the event. Flight Crews will be advised of the situation with as much information as possible being passed, which may include (but not restricted to) the following:

a) Confirmation of where no reliable air traffic control service will be available until contact with another VHF facility.

b) Information of where communications with adjacent ATSUs can be maintained.

c) Confirmation of where alerting service may be negatively impacted due to lack of communications.

d) Details of all other communications facilities and satellite navigation that, may be or become completely unavailable.

e) Confirmation that aircraft may be adopting contingency procedures and making level and route changes without reference to ATC.

f) Details of any route and level allocation scheme implemented in the NAT Region which will inevitably have economic consequences due to the need to reserve flight levels for opposite direction and crossing traffic.

3.3.2 When there is a significant space weather event reported in the NAT Region, ATC will expect a number of aircraft to elect to avoid the area of the event which may result in level changes, re-routes, turn-backs or diversions.

3.3.3 ATC will expect a significant increase in workload by managing profile change requests and relaying information to flight crews who require the latest update to make operational decisions.

3.4 AIRCRAFT OPERATING WITHIN THE NAT REGION

3.4.1 A severe space weather event may black out HF communications and degrade satellite navigations systems or render them inoperable. SATCOM is also likely to be unavailable.

3.4.2 ATC expect aircraft to continue in accordance with their ATC clearance but anticipate an increased likelihood of operators electing to adopt contingency procedures which may result in level changes, re-routes, turn-backs or diversions.

3.4.3 Receiving adjacent ATSUs will be advised that flight estimates, and data received may be inaccurate if contingency manoeuvres have been adopted by aircraft.

3.4.4 Receiving adjacent ATSUs will be alert to the possibility of flights entering their area of responsibility not following their originally cleared profile. Overdue estimates may be used by domestic agencies as a prompt to carry out land-based coordination / communications with adjacent ATSUs to account for any missing flights.

3.4.5 Aircraft which have rerouted of their own accord may contact adjacent ATSUs without any flight data having been transferred and communications difficulties are anticipated by ATC because flights may be unsure of appropriate contact frequencies.

3.4.6 Position reports may not be received in the NAT so multiple aircraft could be considered overdue. ATC will co-ordinate with adjacent ATSUs to ensure all aircraft are accounted for.

3.5 AIR TRAFFIC FLOW MANAGEMENT ACTIONS

3.5.1 Workload is likely to rise considerably during the reactive phase and therefore Air Traffic Flow Management measures will be considered as an immediate action. A minimal flow rate may be necessary until more comprehensive information is available on the status of communications and navigation systems.

3.5.2 As much detail as possible will be issued to operators via all communication means possible to allow them to make informed decisions on their actions.

3.6 SUBSEQUENT ACTIONS (PROACTIVE PHASE)

3.6.1 Actions will be dependent on the severity of the event and expected duration.

3.6.2 During a severe space weather event, all HF communications could be out of service for a significant time period. Other communications means may be negatively affected, and therefore it may not be possible to provide an air traffic control service and clearance through the impacted OCAs.

3.6.3 Regular updates will be communicated to operators using all means possible.

3.7 FACTORS CONSIDERED BY ATC WHEN RE-ESTABLISHING THE TRAFFIC FLOW

a) Communications, navigation and surveillance services may come back into service geographically.

b) Many commercial aircraft will be able to navigate to NAT HLA standards using INS.

c) Performance based separation minima will be unavailable until satellite navigational systems are guaranteed, resulting in potential for reduced capacity / profile flexibility.

d) Degraded communications capability may lead to ongoing Air Traffic Flow Management (ATFM) regulations and application of increased separation minima, again leading to reduced capacity / profile flexibility.

e) Systems / procedures may need to be tactically modified.

f) ATC will take into consideration that pilots may react unexpectedly due to heightened state or alert.

g) The OTS may be published to take advantage of communications availability (geographically) rather than operator preferred routes.

h) A bi-directional OTS will be considered as a temporary measure to get the traffic moving again as aircraft will be out of position.

3.8 LONGER TERM CONTINGENCY PLANS

3.8.1 Satellite services may be out of commission for extended periods. Long term contingency arrangements will take account of known infrastructure availability and reliability such as VHF coverage areas. NAT ANSPs will work with communications and navigation service providers to establish a longer-term plan and promulgate accordingly.

3.9 REPORTING AND FEEDBACK

3.9.1 NAT Region ANSPs will provide updates on the operational effects of space weather events to MET Offices and/or Space Weather Operating Centres to ensure the communication of accurate ongoing advisories.

3.9.2 All methods of communication will be used to keep operators informed of the operational situation.

4. NAT Region ANSP Specific Contingency Procedures

NAT Region ANSP	Specific Contingency Procedures
Bodo	Reserved
Gander	Reserved
New York East	Reserved
Reykjavik	Reserved
Santa Maria	Reserved
Shannon	Reserved
Shanwick	Reserved

5. References

5.1 Further information on the procedures in respect to operations in areas forecast to be affected by space weather is available in the following ICAO publications:

- Doc 10100 – *Manual on Space Weather Information in Support of International Air Navigation*.
- Annex 3 – *Meteorological Service for International Air Navigation*.
- Annex 10 – *Aeronautical Telecommunications.*
- Annex 15 – *Aeronautical Information Services*.
- Doc 9377 – *Manual on Coordination between Air Traffic Services, Aeronautical Information Services, and Aeronautical Meteorological Services*.
- Doc 8896 – *Manual of Aeronautical Meteorological Practice*.
- Doc 9849 – *Global Navigation Satellite System (GNSS) Manual*.

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