FEASIBILITY STUDY
FOR
TRANSITION ALTITUDE CHANGE IN NORTHERN EUROPE

Version 1.0

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ABBREVIATIONS

AIC	Aeronautical information circular
AIP	Aeronautical information publication
AIRAC	Aeronautical information regulation and control
ANS	Air navigation services
ANSP	Air navigation service provider
ASR	Altimeter setting region
ATC	Air traffic control
ATM	Air traffic management
ATS	Air traffic services
CDA	Continuous descent approach
ECAC	European Civil Aviation Conference
ESARR	EUROCONTROL Safety Regulatory Requirement
FDPS	Flight data processing system
FIR	Flight information region
FIS	Flight information service
FL	Flight level
hPa	hectopascal
ICAO	International Civil Aviation Organization
IFR	Instrument flight rules
ISA	International standard atmosphere
LoA	Letter of Agreement
Mode C	Transponder signal of encoded altitude
NOTAM	Notice to airmen
QFE	Atmospheric pressure at aerodrome elevation (or at runway threshold)
QNE	*In the context of the document* -Altimeter setting at ISA giving flight level reference
QNH	Altimeter sub-scale setting to obtain elevation when on the ground
RDPS	Radar data processing system
SARPs	Standards and recommended practices
SID	Standard instrument departure
STAR	Standard instrument arrival
TA	Transition altitude
TL	Transition level
TMA	Terminal control area
VFR	Visual flight rules

Executive Summary

In accordance with ICAO Annex 13 – *Accident and Incident Investigation*, 8.6 – *Analysis of Data – Preventive Action*, "A State having established an accident and incident database and an incident reporting system shall analyse the information contained in its accident/incident reports and the database to determine any preventive actions required." In this context it is noted that the Norwegian Accident Investigation Board, in a recommendation resulting from an investigation regarding an aircraft that failed to set the altimeter to QNE following a missed approach, stated that: "From a flight operational point of view, a standardised transition altitude for as large as possible geographical area is desired."

In acting on this recommendation, the Civil Aviation Authority – Norway (CAA-N) was of the opinion that the optimal solution would be to establish a harmonised transition altitude for parts of northern Europe. The CAA-N invited Denmark, Finland and Sweden to participate; however, Denmark chose not to be part of the group. Later, Estonia and EUROCONTROL joined; Iceland was also invited but declined to participate. The group, consisting of representatives from CAA Estonia, Finland, Norway and Sweden, the Norwegian and Swedish Service Providers and EUROCONTROL agreed that a feasibility study be developed.

It was noted that several studies confirmed the requirement to change the present values of the transition altitudes to higher levels would better reflect today's operational environment by moving the required change of altimeter setting from the most critical phase of flight. Three major options were discussed; area wide common transition altitude, common transition altitude in all controlled airspace or common transition altitude in all terminal control areas. The altitudes discussed were: 10 000 ft, 18 000 ft and 10 000 ft with selected TMAs using 18 000 ft.

The number of incidents caused by an incorrect altimeter setting was investigated and it was found that, in Finland there had been 31 reported safety occurrences from 2006 to 2008, two of which had been categorized as "near mid-air collision"; in Norway there had been 18 reported occurrences and in Sweden 18, the extent of the level busts/too low altitude during approach varying from 350 ft to 1 100 ft.

It was agreed that a higher transition altitude in northern Europe would improve flight crew awareness regarding these procedures and consequently increase safety. As regards capacity it was noted that a higher transition altitude might result in capacity improvement in the TMA. There would be an increase in workload for ACC sectors and a decrease in workload for APP; however, any increase in the *overall* workload for ATC would be insignificant. As regards the flight crew workload, there would be a reduction during the critical phases of flight whilst flight crews of aircraft using altitudes for cruising would have to reset the area QNH when transiting from one QNH setting region to another.

The group agreed that a 10 000 ft area wide TA was the most viable solution and agreed that a safety assessment on this option should be performed. The group recognised that there were important safety and capacity considerations that needed to be addressed by the safety case. The introduction of Point Merge system, the border to high sea areas, and the issue of the Malmoe/Copenhagen area, amongst others, were issues that needed to be addressed.

Based on the findings of the first safety assessment the group proposes two possible second steps. If the safety assessment is positive, it is recommended that an implementation plan is developed and agreed. If the safety assessment should show that the selected option is not feasible, the group proposes that a safety assessment is conducted on another option: 18 000 ft area wide TA.

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1. INTRODUCTION

The purpose of this document is to provide conclusions and recommendations regarding the implementation of a common, higher transition altitude in Norway and neighbouring States. The document provides essential information for enabling a decision to be taken on whether and how to proceed with the implementation of the project.

1.1 Background

1.1.1 On 26 April 2007 the Norwegian Accident Investigation Board (Statens Havarikommisjon for Transport) published its report (SL Rapport 2007/16) on an incident involving loss of separation due to the incorrect setting of the altimeter. From the report a recommendation can be noted that "*From a flight operational point of view, a standardised transition altitude for an as large as possible geographical area is desired. IFALPA recommends the transition altitude to be set at 10000 feet to make the adjustment of QNH at the same time with other regular routines in cockpit. Aaib of Norway recommends CAA-N to consider introduction of a common transition altitude higher than those established today in airspace where Norway is in charge of air traffic services.*"

1.1.2 In acting on this recommendation, the Civil Aviation Authority of Norway (CAA-N), taking into account close cooperation and cross-country agreements concerning airspace with neighbouring States, was of the opinion that the optimal solution would be to establish a harmonised transition altitude for parts of the northern area of Europe. This was also based on recommendations from EUROCONTROL ANT, giving three options for harmonising transition altitude: ECAC-wide, Sub-Regional or Nation wide, (SCG/5, AP/9, paragraph 3.2 refers). It was considered that this could also be seen in relation to the on-going work between air navigation service providers (ANSPs) in the North European En-route Optimisation Working Group (NEEOP) and the NEAP project. The proposed functional airspace blocks, NUAC and NEFAB, will also have the goal to harmonise rules and procedures within the FAB. Taking this into account, CAA-N invited Denmark, Estonia, Finland and Sweden to participate in a project with the purpose of establishing a harmonised Transition Altitude in Northern Europe.

1.1.3 In a first meeting CAA-N invited Denmark, Finland and Sweden to participate; however, Denmark chose not to participate. In the first meeting it was decided to also invite Estonia to participate in the mutual project of harmonising transition altitude in parts of Northern Europe. A second meeting was held which appointed a working group with delegates from the national CAA's, and it was decided to invite EUROCONTROL to assist in the project. In a third meeting EUROCONTROL was present, and the representatives from CAA Estonia, CAA Finland, CAA Norway, CAA Sweden and the Norwegian and Swedish Service Providers (AVINOR and LFV) agreed that EUROCONTROL should be asked to provide a feasibility study taking into account the various options that had been discussed. Also, the third meeting agreed to invite Iceland to participate in the mutual project, but Iceland declined to participate for the reason that the Icelandic authorities and service provider were focusing on issues relating to the ICAO North Atlantic (NAT) Region. Furthermore, Denmark had again been approached with an invitation to participate.

1.1.3.1 Three major options were discussed:

- Area wide common TA; and
- Common TA in all controlled airspace; or
- Common TA in all terminal control areas (TMAs).

1.1.3.2 As regards the altitude at which to establish the common TA the following options were discussed:

- 10 000 ft;
- 18 000 ft;
- 10 000 ft with selected terminal control areas (e.g. Oslo TMA) using 18 000 ft.

2. PRESENT SITUATION

2.1 The proliferation of transition altitudes within the European Airspace is a result of the application by States of the ICAO provisions related to the establishment of a transition altitude. In this context it must be recognized that the ICAO provision stating "the height above the aerodrome of the transition altitude shall be as low as possible but normally not less than 900 m (3 000 ft) " reflect the operational environment as it existed in the fifties and early sixties of the previous century.

2.2 The ICAO procedures are dating from 1958 and were based on the principle that a transition altitude should be as high as required for the purpose of terrain clearance but as low as possible to obtain a common reference (i.e. 1013.2 hPa) for separation purposes for aircraft cruising above the transition altitude. There were, at that time, several reasons for this principle on which the ICAO procedures were developed.

2.3 One of the important reasons was the lack of air navigation services facilities; some areas of the world did not have the ground based services and facilities to provide current pressure information to en route traffic. Therefore, to accommodate a worldwide application, the provisions that are still applicable today, i.e. the use of QNH for take-off and landing and a standard setting of 1013.2 hPa (QNE) for en route, were adopted in order to obtain a common reference for providing vertical separation during the en route phase of flight.

2.4 It is obvious that the then established ICAO provisions have been overtaken by time. Important changes happened to the ATC operational environment, such as, to mention but a few:

- the introduction of high-performance aircraft: performance characteristics of modern aircraft are totally different compared to aircraft operated at the time the present ICAO provisions were developed

- the use of cruising levels well above the cruising levels used in the fifties and sixties

- introduction of standard instrument departure (SID) and standard instrument arrival (STAR) routes: SIDs and STARs often use altitudes as reference (step and stop levels) although part of the SIDs and STARs might be flown above the TA, i.e. in a FL environment; consequently, there is a requirement to change the vertical reference when flying on a SID or a STAR, which introduces complexity, which in turn also might induce errors.

- the introduction of often complex noise abatement procedures where references are expressed in altitudes

- QNH values readily and automatically available: in northern European States there is an extensive network of QNH sources and the values are readily available

- the ratio between aircraft in level flight and aircraft climbing and descending at lower levels has significantly changed The fundamentally changed ATC operational environment, without having changed the procedures for the establishment of a transition altitude, result in the requirement to change altimeter settings during the most critical phase of flight when flight deck workload is at its highest. There are a number of examples indicating that this can result in the flight crew omitting to execute the change in altimeter setting such as:

  - an aircraft climbing to a flight level without changing from QNH to 1013.2 hPa at the transition altitude could result in a loss of vertical separation, in the worst case leading to near-misses

  - an aircraft descending to an altitude without changing from 1013.2 hPa to QNH at the transition level may not have the required terrain clearance which in the worst case may lead to a controlled flight into terrain (CFIT) accident.

3. HIGHER COMMON TRANSITION ALTITUDE

3.1 Introduction

3.1.1 The transition altitude is an integral part of airspace design and operational procedures. It therefore follows that a change to the TA may necessitate changes to the airspace structure, the operational air traffic control (ATC) procedures used in that airspace and the flight procedures.

3.1.2 The degree and complexity of change will be dictated, in part, by the magnitude of the change of the TA value. An equally, and perhaps larger factor would be a change in the TA application concept. When the application of TA is changed from an aerodrome/terminal control area application to an airspace wide application, the changes will be more pronounced and numerous to accomplish the transition to the new concept than will be the case for only a change in the altitude. That is not to say that a change in application concept is necessary with a change in the altitude. The two can be made independently if only one change is contemplated

3.1.3 It is self evident that changes in altitude and concept, as may be agreed, would be less disruptive to the overall operating environment and no doubt more economical to implement, in the longer term, if both are done simultaneously rather than in a two step process.

3.1.4 It is also important to not only consider the current operational environment but also how planned or forecast developments in technology and associated procedures, airspace design, traffic forecasts and regulatory mandates, may affect the future ATM environment.

3.1.5 Again, the economies of a concurrent change of the value and applicability compared to additional future changes will have to be weighed as an integral part of the process.

3.1.6 Regardless of the concept contemplated, all the factors in the proposed change and its impact on the neighbouring airspace must be considered through coordination and consultation with all adjacent jurisdictions and with the user community.

3.1.7 The use of a transition altitude which is "as low as possible but not less than 3 000 ft reflects an era where the performance of aircraft was considerably lower than that of today's aircraft in terms of rate of climb/descent. An amendment to ICAO provisions to reflect the change in performance should therefore be considered, at least at the regional level.

3.1.8 It should be kept in mind that the ICAO provisions are published for global application and consequently aimed at the lowest common denominator in terms of the minimum facilities required for their application. Accordingly, areas such as the northern European States where advanced facilities are available should be more easily adaptable to a sub-regional agreement on the applicability and selection of TA.

3.1.9 The ICAO references for TA selection are at Appendix A.

3.2 Justification

3.2.1 In accordance with ICAO Annex 13 – *Accident and Incident Investigation*, 8.6 – *Analysis of Data – Preventive Action*, "A State having established an accident and incident database and an incident reporting system shall analyse the information contained in its accident/incident reports and the database to determine any preventive actions required." In this context it is noted that the Norwegian Accident Investigation Board, in a recommendation resulting from a investigation regarding an aircraft that failed to set the altimeter to QNE following a missed approach, stated that: "From a flight operational point of view, a standardised transition altitude for as large as possible geographical area is desired." Furthermore, "AAIB of Norway recommends CAA-N to consider introduction of a common transition altitude higher than those established today in airspace where Norway is in charge of air traffic services.

3.2.2 ICAO Annex 13 further recommends (paragraph 8.7 refers) that: "If a State, in the analysis of the information contained in its database, identifies safety matters considered to be of interest to other States, that State should forward such safety information to them as soon as possible." Hence, Norway invited other northern European States to participate in this activity with a view to achieve a common, higher transition altitude.

3.2.3 In addition to the global requirements in Annex 13, the following extracts from the EUROCONTROL Safety Regulatory Requirement 2 – *Reporting and Assessment of Safety Occurrences in ATM* (ESARR 2) were considered by the CAA-N in its pursuance of the issue:

> "4. Safety objective
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> The overall safety objectives are to ensure that, at national and ECAC levels, formal means exist to:
>
> 4.1 Assess safety performance and related trends over time;
>
> 4.2 Identify key risk areas where the ATM system could contribute to safety improvement, and to take appropriate actions;
>
> 4.3 Investigate, assess and draw conclusions on the extent of the ATM system contribution to the cause of all types of safety occurrences and to take corrective measures, whether regulatory or not;
>
> 4.4 Draw conclusions on how the ATM system could improve safety even in areas where it is not involved in accidents or incidents;
>
> 4.5 Assess and monitor over time whether technical and operational changes introduced to the ATM system meet their predetermined safety requirements, and take appropriate actions.
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> **5. Safety Requirement**
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> 5.1 Requirements for safety occurrence reporting and assessment at national level:
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> Each State shall ensure that:-
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> . . .
>
> 5.1.8 Safety recommendations, interventions and corrective actions are developed, recorded where necessary, and their implementation monitored;
>
> 5.1.9 To the extent possible, safety experience, based upon collected safety occurrence data and assessment, is exchanged between States in order to develop a more representative and common awareness of typical hazards and related causes, as well as safety trends and areas where changes to the ATM system could improve safety."

3.2.4 In view of the above, other safety occurrences that have been reported in northern European States need to be considered. For example, information provided by Finland indicates that there had been 31 safety occurrences relating to the incorrect setting of the altimeter from 2006 to 2008, some of which could have had catastrophic consequences. Fifteen of these aircraft were climbing while sixteen were descending for approach. The extent of the level busts shown varies from 200 ft to 950 ft and two of the occurrences are categorized as "Near Mid-Air Collisions".

3.2.4.1 In Norway there had been 18 incidents regarding incorrect setting of the altimeter from 2006 to 2008, involving level busts with subsequent loss of separation, and descent to altitudes below the cleared level. Furthermore, from Sweden 18 reports were received on the same issues. The extent of the level busts/too low altitude during approach vary from 350 ft to 1 100 ft.

3.2.4.2 It should be noted that ATC will assume that an SSR derived level will be within the required tolerance when it is within 300 ft (200 ft RVSM airspace) of the reported level. The incorrect altimeter settings reported involve occasions where the difference between QNH and QNE will result in a level bust/too low approach of 300 ft or more (11 hPa or more), (200 ft and 7 hPa in RVSM airspace), i.e. those that will result in an intervention by ATC. Consequently, it can be expected that the actual number of incorrect settings of the altimeter are considerably higher.

3.2.5 Several studies confirm the requirement to change the present values of the transition altitudes to higher levels to better reflect today's operational environment thereby moving the required change of altimeter setting from the most critical phase of flight:

- The EUROCONTROL "**Common Transition Altitude-A Flight Deck Perspective**" Study stated in one of its conclusions: "The conducted survey on flight deck workload indicates that a transition altitude at 10 000 ft or above is acceptable. This is valid for the climb and descent profile. Furthermore, as these altitudes are situated above most IFR flight procedures, there is no conflict between critical flight deck actions and the altimeter setting procedure."

- The EUROCONTROL "**Common Transition Altitude-An ATC Perspective**" study considers that: "Low TAs are incompatible with the intended objective of SIDs and STARs. The change from altitude reference to flight level reference at various points during either procedure introduces complexity, which in turn also induces errors." "The future introduction of precision area navigation procedures in both the horizontal and vertical plane will make it necessary to adjust TAs for their efficient implementation."

- The Flight Safety Foundation (FSF) **Approach and Landing Accident Reduction (ALAR)** project concluded that "the incorrect setting of the altimeter reference often is the result of high workload." This high workload in the cockpit often coincides, due to the low values of most transition altitudes in ECAC airspace, with the moment in flight when the change in altimeter setting has to take place.

3.2.6 The above mentioned studies did not only look at operational issues but also at meteorological issues. In this context it is important to note that, the consequences of low temperature and wind speed, as far as terrain clearance is concerned, are less critical with higher transition altitudes.

3.2.7 The justification for harmonization is multiple:

- ICAO PANS-OPS already advocates establishing a common transition altitude to the extent possible:

  As far as possible, a common transition altitude should be established: "…..for States of two or more adjacent flight information regions or one ICAO region" and "for aerodromes of two or more ICAO regions when agreement can be obtained between these regions." Several regions in the world have already established a common transition altitude: North America, parts of Asia and Australia

- IFATCA Policy states that: "Standardization of Transition Altitudes on a region wide basis be implemented where applicable"

- Harmonization is supported by IFALPA policy "This diversity [of transition altitudes] is operationally unsatisfactory for IFALPA and gives rise to serious operational problems. IFALPA recommends the establishment of a common altitude within each state and, where possible within each ICAO region"

- Most of the answers provided by operators in response to the questionnaire were positive to a change to a higher, area wide transition altitude. Among the reasons stated the following should be noted:

  - Avoid misunderstanding as the whole area would be under one rule
  - Reduce risk associated with level busts at low altitudes
  - Reduce risk associated with terrain separation as 18000ft is above most terrain in the region
  - Provide unambiguous altitude resolution for CDA approaches at an early stage and at a higher altitude, avoiding that "all happens" at FL100

- Harmonization of the transition altitude would be in line with the objectives of the Single European Sky (SES)

- Functional Airspace Blocks (FABs): when implementing FABs there would be a need to harmonize not only procedures, but also airspace structures, which may have an impact on transition altitudes within a FAB

- As indicated in the ICAO and ESARR provisions referred to above, States are obliged to take preventive action when a safety problem has been identified.

3.2.8 There is no ATC procedure or other reminder that triggers a change from QNH to standard setting during the departure and climb phases of the flight, whereas such a procedure exists for descending aircraft. In this context it should be recognised that it should not be incumbent on individual action by flight crews to ensure safety when it is possible to introduce procedures which to a great degree would eliminate a problem. Therefore, the implementation of a transition altitude at a higher level where the change of the altimeter setting could be included in the standard operating procedure would benefit safety.

3.2.9 It is universally accepted by all safety experts that non-standard procedures, i.e. procedures that are not common, constitute a safety risk. Common standards and procedures, as a means to enhance transparency in ATC procedures and structures for the benefit of pilots, significantly reduce the risk for error and as a result, contribute to a higher level of safety in aviation.

SID/STAR

3.2.10 To avoid the potential for error or level bust induced by a change of vertical reference and adjustment as well as reducing pilot workload during the work intensive departure phase, it is generally accepted that SID step and stop levels should be at an altitude and not a flight level.

3.2.11 The implementation of continuous descent approaches (CDAs) for improved environmental sensitivity in the future may be more problematic for aerodromes with a low TA because such flight profiles may introduce a greater mix of flight level/altitude during approaches.

3.2.12 Similarly to SIDs, most STARs are designed so that the vertical reference is in altitudes from the initial approach fix inbound. STARs that do not conform to this norm require pilot conversions of flight levels to altitudes to ensure adequate obstacle clearance when the atmospheric pressure is lower than ISA. Ideally, the vertical reference should remain the same from the beginning of the STAR until landing.

3.2.13 With the introduction of the new arrival procedures such as the point merge system, a higher transition altitude as compared with the present systems would be preferable. This is the case with e.g. Oslo TMA where it is planned that the point merge system[1] will be implemented in April 2011, and it is strongly recommended by the project that the transition altitude should be above the point merge system sequence legs which are planned to be at 10 000 to 12 000 ft.

Missed approach

3.2.14 When conducting a missed approach procedure the workload in cockpit is extremely high and any additional duty such as resetting the altimeter to QNE due to a low transition altitude is easily forgotten. This can be illustrated by e.g. the Norwegian Accident Investigation Board Report SL 2007/16 wherein an aircraft that was cleared to FL80 climbed to 8 000 ft on QNH 994 hPa thereby reducing separation to an aircraft in holding to less than half of the applicable minimum.

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[1] The point merge system is a means of merging arrival flows. It associates a dedicated P-RNAV route structure with a systemised operating method to integrate arrival flows into one sequence while keeping aircraft on FMS lateral navigation mode, thus allowing efficient use of FMS advanced functions and consequent optimisation of vertical profiles.

3.3 Altimeter setting regions

3.3.1 *Option 1.*

3.3.1.1 For a certain altimeter setting region (ASR) several values of the QNH are measured. The lowest value of the QNH will be used as the ASR QNH. This value will be taken in order to provide the best margin for terrain clearance.

3.3.1.2 When the aircraft uses the ASR QNH and is flying at an altitude determined by the semi-circular system, it will apply the same reference as the other aircraft thus ensuring vertical separation.

3.3.1.3 When transitioning between ASRs that apply different QNH settings, the flight crew needs to obtain the ASR QNH value before, or upon entry into the designated area, in order to have the same reference setting to ensure vertical separation with the other traffic flying along the levels determined by the semi-circular system.

3.3.2 *Option 2*

3.3.2.1 A system whereby the flight crew uses the altimeter setting provided by ATC along the route could also be used. It is a straightforward system and does not induce separation infringements. The ATS unit would issue the setting of the nearest reporting station along the route of the flight, normally not exceeding 100nm from the position of the aircraft.

3.3.2.2 It is also normal that the setting of an adjacent station would be communicated to the flight crew during periods that a steep pressure gradient exists. This means that the flight crew can use the most current setting for their position.

3.3.3 With the extensive network of QNH sourcing now available within the northern European States' airspace, Option 2 may prove to be the most beneficial option for most States. However, it is considered that option 1 could also work satisfactorily.

3.3.4 *Option 3*

3.3.4.1 An alternative system is to utilise, where large areas have little or no sources of reliable pressure settings, forecast altimeter setting regions (ASRs). As such, ASRs are managed on the basis of a validity period of 3 hours normally applied throughout an ASR. ASRs are subdivided, if necessary, to meet the following standards of accuracy:

- ASR forecasts are to be +/-5 hPa of the actual QNH at any low point (below 1000'AMSL) within or on, the boundary of the appropriate area during the period of validity of the forecasts
- A specific ASR must not differ from any adjoining ASR by more than 5hPa. Studies have shown that, from a flight crew perspective it is preferable to make small changes while transiting the ASR QNH setting airspace than to change from a QNH to a QNE setting when en route and transiting between ASRs that have a different transition altitudes. This would require cross border agreements defining the point to change altimeter settings.

- Within ECAC airspace, the number of flights at lower cruising altitudes is very low compared with the total amount of traffic (see 3.3.7 below). Nevertheless the effect of a common transition altitude on flight deck workload has to be considered.

3.3.4.2 It should be recognised that Option 3 is suitable in areas where there are few QNH reporting stations. An example of national provisions relating to ASR (Australia) is at Appendix B.

3.3.5 Flight crews cruising below the transition altitude have to deal with altimeter setting changes when transiting through different pressure gradients. While the average pressure gradient in Europe is rather low, there are cases where it can reach higher values. In particular along the western and northern parts of the Norwegian coastline in the winter season, substantial pressure gradients must be regarded as a common phenomenon.

3.3.6 For low flying traffic, the ASR QNH procedure can decrease the number of altimeter setting changes along the route.

3.3.7 CFMU data from the peak day of 2002 with a total traffic count of 27796 flight plans for the day indicate that, of the total number of flights 7.1 per cent of the flights were between FL 30 and FL 100 (1976 flights). The raw data indicate that most of these flights are between city pairs that are less than 200 nm apart. As such, these flights are well within range of a departure and arrival QNH without requiring en route updates. From the data it was not possible to determine the actual number of these aircraft which might transit boundaries with different TAs.

3.3.7.1 In the week of 23-29 June 2008 (the busiest week in 2008) there were an average of 4300 flights per weekday with 261 flights (6 per cent) between FL50 and FL100 and 947 flights (22 per cent) between FL50 and FL180 in the four States. In a more recent sample from the week of 20-26 April 2009, there were an average of 3 522 flights per weekday with 150 flights (4 per cent) between FL50 and FL100 and 612 flights (17 per cent) between FL50 and FL180.

3.3.8 In order to provide all necessary justification and to exploit all the possibilities it is considered necessary that all options are covered in the safety assessment.

3.3.9 *Other considerations regarding QNH*

3.3.9.1 Some jurisdictions, notably North America and Australia accept that an altimeter setting may normally be considered valid for en route use for a distance of 100 nm from the aircraft location after which the altimeter setting should be refreshed from the next available source either along or adjacent to the route of flight within the stated distance. As can be noted from Appendix B, Australia makes use of area QNH due to vast expanses where no local sources are available.

3.3.9.2 A review of QNH data in one ECAC State of some 25 000 QNH reports in 2001 showed the average difference between all reporting stations used to derive the area altimeter settings was 2.8 hPa. This tends to support the notion that the validity and usefulness of regional or area QNH might be questionable in airspace where there are adequate QNH reporting stations and adequate means of communications to obtain the desired setting. Most of the airspace in the northern European States meets the latter criteria.

3.3.9.3 The variations in QNH between different areas of the four northern European States concerned are shown at Appendix C.

3.3.9.4 The altimeter setting for instrument approaches should of course be the local QNH in order to give the most precise altitude indications.

3.3.10 *Conclusions*

3.3.10.1 There are two general methods of QNH use. One is to use local QNH in designated airspace such as CTR and TMA and an area QNH or regional pressure setting elsewhere based on actual or forecast pressure. The other is to use the QNH at or near the location of the aircraft, as available. This appears to offer proven simplicity where it can be applied.

3.3.10.2 The application of mid and higher level TAs over a wide area is a viable concept which has been proven over time in airspace with both low and high-density traffic. There are no apparent or compelling operational reasons why a similar concept cannot be applied in northern European airspace.

3.4 Traffic coordination

3.4.1 Coordination altitudes or flight levels, whether *ad hoc* or by agreement, between ATC sectors or units need special attention. Since the transition or lowest useable flight level is subject to change with a fall in pressure, such structured levels should of course be avoided for the coordination of traffic.

3.4.2 For reasons of consistency and safety, procedures should be designed so as to avoid the use of variable levels. Similarly, variable levels are normally avoided for holding.

3.4.3 Whether it is best to sterilise levels for consistency of procedures for ATC or the use of other methods depends on the ATC elements involved. The crucial factor is that whatever the procedures selected they should be transparent to the flight crews.

3.5 Boundary issues

3.5.1 Unless a common TA is adopted there will continue to be such problems at boundaries between adjacent airspaces with differing TAs. The reality is also that there will always be a boundary somewhere, whether within the northern European States or on the edge. In this context it is noted that, in accordance with ICAO Annex 2 – *Rules of the Air*, 5.3.1, "An IFR flight operating in level cruising flight outside of controlled airspace shall be flown at a cruising level appropriate to its track as specified in:

a) the tables of cruising levels in Appendix 3, except when otherwise specified by the appropriate ATS authority for flight at or below 900 m (3 000 ft) above mean sea level; …".

Consequently, in all jurisdictions where a transition altitude is applied locally in a TMA and an altitude higher than 3000 ft is selected as the TA, there is an issue as regards separation in the boundary area already now.

3.5.2 Notwithstanding the above, in cases where e.g. the transition altitude in one area is 5 000 ft and the adjacent area applies a transition altitude of 18 000 ft, the number of aircraft affected by the different TAs will be considerably higher. In this context the issue of using different tables of cruising levels should be mentioned. In the Eastern part of Finland aircraft entering from Russia are applying a table of cruising levels significantly different from ICAO Annex 2. This is dealt with by the Finavia in a transition area. Similarly, there are transition areas between airspaces where reduced vertical separation minimum (RVSM) is applied and other areas.

3.5.3 As regards the high seas airspace it should be noted that it is at the discretion of the State having accepted responsibility for the provision of air traffic services over such areas to "*apply the Standards and Recommended Practices in a manner consistent with that adopted for airspace under its jurisdiction*" (ICAO Annex 11, Foreword and paragraph 2.1.2, Note 2 refers). Consequently, there is no impediment to the application of a common transition altitude also over the high seas.

3.5.4 In addition to the issue dealt with in paragraph 3.5.2 above, the issue of "delegated airspace" would need to be considered in detail and in a number of cases specific procedures would need to be developed.

3.5.5 The development of procedures for transition between Copenhagen and Malmö TMAs is of particular importance due to the amount of traffic climbing and descending at this boundary.

3.6 Mitigation options against boundary issues

3.6.1 *Option 1*: Design specific ATC procedures to obtain a safe transition

3.6.1.1 Specific ATC procedures to accommodate the safe transition between areas with different altimeter settings must be developed. In this context it is noted that, in the case of the northern European States concerned, this transition would in most cases be in an environment where surveillance services are provided.

3.6.2 *Option 2*: Unidirectional routes

3.6.2.1 Unidirectional routes appropriately designed could provide lateral separation for opposite direction traffic to accommodate transition to/from FL/alt airspace.

- No regulatory change required. Transition done at the boundary.
- Cost dependant on number of routes needed, relocation or additional nav-aids, publication etc.
- Possible airspace design problems due to restricted airspace blocks, terrain clearance limitations etc.
- Possibly work intensive for controllers
- Same direction traffic with minimum vertical separation (one above the other) would need simultaneous altimeter setting changes and altitude/FL adjustment to maintain separation.

3.6.3 *Option 3*: Designate transition airspace on one side or the other.

3.6.3.1 Airspace blocks of suitable size could be designated for use to transition to/from FL/alt. This would require regulatory changes to permit flight at FL/alt where currently not allowed. Agreement required between all States sharing common boundaries where different TA exist. The transition area would need to be designated such that only one control agency has the responsibility to effect the transition. This option is very difficult to apply in non-surveillance area environment.

3.6.4 *Option 4* : Provide a nominal 3 000 ft separation between opposite direction aircraft.

3.6.4.1 This would, in theory, provide the required 1 000 ft minimum IFR vertical separation for opposite direction traffic but only to a pressure differential of 35 hPa which admittedly would rarely be reached or exceeded.

3.6.4.2 To apply this successfully the controller first needs to consider if the pressure is higher or lower than standard. The planning and execution of minimum vertical separation in this kind of scenario has too many variables to be of practical operational use.

3.6.5 In order to limit the technical issues between two adjacent airspaces when, on one side, the division between controlled and uncontrolled airspace is FL95 while the other side is uncontrolled, the use of a lower limit of the controlled airspace of 9 500 ft in lieu of FL95 should be considered. This would make it necessary to designate the lowest available flight level at all times, but would also ensure separation between aircraft using flight levels entering an area where 9 500 ft is the division between controlled and uncontrolled airspace.

3.7 Harmonisation

3.7.1 The need to ensure, to the extent possible, that the development of strategies for harmonised TA implementation be undertaken with a view to:

- reduce complexity of ATC and pilot procedures
- simplify and standardise cross border working arrangements

3.7.2 The APDSG studies undertaken addressing the flight crew perspective and ATC perspective both clearly annunciate the situation of non-standard procedures, complexity of procedures, and lack of harmonisation, to be untenable and unsafe.

3.7.3 In addition to harmonization of TA values, it would be beneficial if northern European States also harmonize the application of transition level. In today's environment with rapidly climbing and descending aircraft it would be beneficial if the system where the transition level was located at least 300 m (1 000 ft) above the transition altitude to permit the transition altitude and the transition level to be used concurrently in cruising flight with vertical separation ensured, was pursued. This would make it possible for pilots to change from one pressure setting to the other while actually passing through the transition layer since the layer would be 1 000 ft or more. This should be further investigated in a safety assessment.

4. EVALUATION OF TRANSITION ALTITUDES

4.1 In order to conclude the best choice for a common TA it is necessary to compare the advantages and disadvantages of having first, a common TA, and then to similarly compare the sample low, medium and high altitudes. The advantages and disadvantages of a common transition altitude as well as a TA of 10 000 ft and 18 000 ft was identified in the study "A Common European Transition Altitude – An ATC Perspective", see attachment.

4.2 Based on the findings of that study, the group has agreed the following issues of favour and issues to be considered for the implementation of a common, higher transition altitude in northern Europe:

	Issues in favour of higher TA		**Issues to consider**
1	There is a significant number of safety occurrences relating to the incorrect setting of the altimeter. These occurrences must be considered in order to ensure compliance with ICAO[2] and ESARR 2[3] requirements	1	Implementation of change, including training and adjustment period, regulatory amendments, operations changes and publication amendments and military issues. The requirement for system changes.

[2] ICAO Annex 13 Chapter 8 Accident Prevention Measures, 8.6: A State having established an accident and incident database and an incident reporting system shall analyse the information contained in its accident/incident reports and the database to determine any preventive actions required.

[3] ESARR 2, 4. Safety Objective
The overall safety objectives are to ensure that, at national and ECAC levels, formal means exist to:
4.2 Identify key risk areas where the ATM system could contribute to safety improvement, and to take appropriate actions ;

2	Standardisation and common procedures reduce potential for error, and as a result contribute to a higher level of safety in aviation	2	Transfer of some workload from TMA to en route sectors. *Note.– This will in many cases be beneficial through a reduction in the workload in busy TMA Sectors.*
3	Allows for the task of changing altimeter setting to become part of standard operating procedures and included in check lists where appropriate	3	May have an impact on traffic in holding areas
4	Compatible with agreed ANS Safety Policy	4	More issuing of actual QNH, and every read back includes a potential risk for misunderstandings. *Note.– The repetition on the frequency of the correct QNH could also contribute to the elimination of such misunderstandings.*
5	Compatible with SID/STAR, avoiding the need for altitude restrictions being expressed in feet when above the transition altitude.	5	Potential complexity with airspace divisions and silent transfer of control procedures.
6	Recommended by IFALPA, IFATCA, ICAO and IAOPA. Also recommended in the Flight deck and ATC perspective studies.	6	The possible introduction of ASRs *Note.– Procedures for the assurance of separation between aircraft using QNH in the boundary regions between different ASRs must be considered.*
7	Minimises terrain clearance issues		
8	More preferable for flight operations through removing the task to change altimeter setting from the most workload intense phase of flight.		
9	Allowing for optimal use of CDAs		
10	Facilitating implementation of new concepts and technologies such as Point Merge.		

4.3 The EUROCONTROL ATM Procedures Development Sub-group (APDSG) as well as the Airspace and Navigation Team (ANT) agreed to the advantages and disadvantages as presented in Appendix D. In addition, a checklist to be used for a change in the TA was agreed and is presented in Appendix E.

5. IMPACT RESULTING FROM IMPLEMENTATION OF A COMMON, HIGHER TRANSITION ALTITUDE IN NORTHERN EUROPE

5.1 Impact on safety

5.1.1 A higher transition altitude in Northern Europe would improve flight crew awareness regarding these procedures and consequently increase safety.

5.1.2 A higher transition altitude would entail a change from setting the altimeter immediately after departure at a level where flight deck workload is at its highest to a more convenient altitude where the flight crew workload is considerably reduced, thereby reducing the risk of pilots omitting to change the altimeter setting.

5.1.3 A higher transition altitude would allow for the incorporation of the altimeter setting procedure (i.e. the change from QNH to standard setting and vice versa) into a flight deck standard operating procedure (SOP) thus eliminating to a great extent the potential for flight crews forgetting to execute the change in altimeter setting.

5.2 Impact on capacity

5.2.1 In all environments were a transition altitude and a transition level is used, there will be a level that is not usable when the QNH is lower than the standard setting regardless of the level of the transition altitude but, such loss has the greatest impact in a TMA environment at low altitudes. Consequently, a higher transition altitude might result in capacity improvement in the TMA.

5.2.2 In an ATC environment where flight levels are used for silent transfer procedures there might be a need to amend the present procedures and change the flight level at which silent transfers are performed.

5.2.3 From the simulations relating to the introduction of the point merge system in Oslo TMA it has been concluded that the introduction of this system would improve the capacity by approximately 30 per cent.

5.3 Impact on flight crew workload

5.3.1 During climb and descent, the workload involved in changing from QNH to standard setting and vice versa will not change; however, there will be a reduction in flight crew workload during those critical phases of flight where the workload is at its highest. Therefore, Pilots will be able to focus more on the setting of correct values.

5.3.2 With a higher, area wide transition altitude, flight crews of aircraft at cruising altitudes will have to reset the area QNH when transiting from one ASR to another. This increase in workload would be minimal and proportional to the lateral extent of the ASR.

5.4 Impact on ATC workload

5.4.1 Basically, there should be no increase in overall ATC workload; however, the requirement to issue the QNH and transition level during descent would in many cases be moved from an APP sector to an ACC sector. This would result in less workload for APP but an increase in workload for ACC sectors, but not a change in the overall ATC workload.

5.4.2 ATC would have to issue the area QNH to flight crews of aircraft at cruising altitudes transiting from one ASR to another. This increase in workload should be minimal and will be proportional to the lateral extent of the ASRs.

5.4.3 A fast time simulation on a common transition altitude concluded that the controller workload should not represent an impediment to the implementation of a common TA. (The Report of the "Initial Real-Time Simulation, in support of the implementation feasibility assessment of a European common Transition Altitude", carried out in March 2003, concluded that *The simulation outcome indicated that there were some workload implications for ATS providers as the TA is raised but that such workload should be manageable with sound planning*.)

5.5 Impact on environment

5.5.1 In addition to the safety aspects, a higher transition altitude would facilitate the implementation of continuous descent approaches which to some degree would mitigate the adverse environmental effects of global civil aviation activity through reduced fuel burn and aircraft engine emissions, and reduced noise exposure/levels.

6. ACTIVITIES REQUIRED IN ORDER TO ESTABLISH A COMMON TRANSITION ALTITUDE IN NORTHERN EUROPE

Note 1.– An initial study (Study on the Justification for Harmonising the Transition Altitude in ECAC Airspace) *indicated that the activities required to implement a common transition altitude are mainly restricted to changes to publications (AIPs, Charts, etc), awareness and training. Depending upon the transition altitude value selected, new working methods (ACC versus APP) might have to be introduced and limited ATC training might be required.*

Note 2.– It should be mentioned that the activities listed below are in any case required to implement a higher value of the transition altitude, even if not implementing a common harmonized value. The listing of activities required is not sequential and is not exhaustive.

6.1 ATC Procedures

- Determine appropriate QNH sources.

- Determine what type of QNH source will be used: area QNH or a QNH source close to the route of flight.

- Define area QNH zones or regional QNH zones.

- Determine validity (time frame) of the area QNH or regional QNH.

- Draft definitions for area QNH and local QNH (e.g. area QNH is the forecast value of the lowest mean sea level pressure within the Area QNH Zone, valid for a period of x hours)

- Provide for ATC procedures for exceptional circumstances where steep pressure gradients occur requiring more frequent QNH updates.

- Introduce area QNH and local QNH in RTF.

- Develop procedures to change from local QNH to area QNH for departure.

- Develop procedures to change from area QNH to local QNH on arrival.

- Develop procedures to change between QNH areas

- Identify flight levels used for silent transfer procedures within ACCs and between ACCs and APPs.

- Consider interaction between the new transition altitude and division flight levels (DFLs)

- Consider impact of using, as may be required by the new transition altitude, altitudes and flight levels in holding areas

- Consider impact on coordination procedures between adjacent ACCs as defined in the Letters of Agreement.

- Consider impact on military operations and develop procedures as necessary.

- Review coordination procedures with airspace adjacent to ECAC airspace.

6.2 Publications

- Issue an Aeronautical Information Circular (AIC) to announce planned change to the transition altitude.

- Amend Aeronautical Information Publications (AIPs) as required (mainly section ENR 1.7)

- Amend Letters of Agreement as required, mainly level restrictions, Flight level allocation schemes and coordination procedures using predetermined flight levels.

- Consult in due time with chart providers so that aeronautical charts can be amended as required.

- Issue a NOTAM 24 hours before implementation as a reminder to the change of the transition altitude.

- After implementation, broadcast a concise message on ATIS for some period of time to draw the attention of flight crews to the change in transition altitude.

6.3 Systems

- Surveillance data processing systems: the information pulses are automatically selected by an analogue-to-digital converter connected to a pressure-altitude data source in the aircraft referenced to the standard pressure setting of 1013.25 hPa. The requirement would be to modify software as required for the new altitude/flight level division (conversion from standard pressure to QNH so that Mode C read-outs are expressed in altitude at and below the transition altitude).

- Presentation of area QNH information on surveillance situation display: For every QNH area a QNH presentation on the surveillance situation display should be considered. This presentation could be highlighted when QNH is changing. Presentation in the label for area QNH reference has to be considered.

- The number of QNH areas in the surveillance system must be defined

6.4 Safety assessment

6.4.1 In accordance with ICAO Annex 11, 2.27.5, the implementation of a new procedure "*shall only be effected after a safety assessment has demonstrated that an acceptable level of safety will be met and users have been consulted*". This is also reflected in the EUROCONTROL Safety Regulatory Requirement (ESARR) documentation.

6.4.2 Based on the above it can be concluded that a safety assessment made in accordance with ESARR4 of a change to a higher transition altitude would be necessary. Such a safety assessment would be conducted by Norway with the support of participating States (at present Estonia, Finland and Sweden) and EUROCONTROL.

6.4.3 It is envisaged that the risk assessment should include a functional hazard assessment (FHA) and a preliminary system safety assessment (PSSA) and that it should be conducted by an outside source with the support of EUROCONTROL in house expertise and participation by the States concerned. The advantages and disadvantages with each feasible scenario should be covered by the safety assessment.

As regards the costs for implementing the different solutions, this should only be investigated as regards the difference between the solutions.

7. ATC ISSUES

7.1 Departures

7.1.1 Departing aircraft from any aerodrome use the local QNH as provided by ATS or as otherwise obtained where no ATS facilities are present. Current QNH delivery procedures for departures would therefore be compatible with higher TA. No changes from current procedures would be anticipated for departures.

7.2 En route

7.2.1 For aircraft cruising at altitudes, a current and proximate QNH setting is needed not only for terrain clearance awareness but also for vertical separation purposes. These aircraft need to be provided with updated QNH values as the flight progresses en route.

7.2.2 For such en route flights some States provide area altimeters derived from the lowest QNH value of designated reporting stations within the defined area. For example, Denmark has 2 such areas; Belgium 1, The Netherlands 4 and the UK has 21.

7.2.3 The merit of using the area altimeter concept is arguable; however, when all aircraft flying at altitudes within a defined airspace use a common altimeter setting, the vertical separation provided will be based on the same altimeter reference value. This is in effect equivalent to the QNE concept on a smaller scale.

7.2.4 It must be emphasised that, although the indicated altitude may be not be entirely accurate, it is not unsafe because, by using the lowest QNH setting within the defined area, any pressure errors will be on the high side and therefore, terrain clearance will be greater than indicated.

7.2.5 The negative is that the boundaries of these altimeter areas are defined by geographic coordinates and, although charted, may not be readily apparent to the pilot during flight. The safety risk here is that aircraft could arrive from adjacent altimeter areas at a common boundary point on substantially different altimeter settings.

7.3 Arrivals

7.3.1 For the best flight profile arriving jet aircraft at, for example, FL 330 will normally start descent at approximately 100 nm from the destination assuming no wind component or ATC constraints.

7.3.2 Under the current airspace structure, the upper ACC sectors are generally above FL 195 or FL 245. Since all current TLs are well below these levels, no QNH settings are required to be provided by these sectors although they must have them available, for use in the event of e.g. an emergency descent.

7.3.3 The lower airspace en route sectors in the current structure, again depending on the jurisdiction, are not normally involved with providing QNH settings unless requested, or required for e.g. emergency descents.

7.3.4 In northern European airspace, the provision of QNH settings and the TL is primarily effected by approach control units. Under normal conditions the flight crew will have obtained this information from ATIS well before entering the TMA.

7.3.5 If the TA is raised to a medium or high altitude in the 10000 ft or 18000 ft range, the lower ACC en route sectors will become more involved in the provision of altimeter settings.

7.3.6 Even with a high TA in the 18 000 ft range only one altimeter setting, that of the destination aerodrome needs to be issued since high level descending aircraft will be well within range at that point.

8. AIRSPACE MANAGEMENT

8.1 The loss of usable FLs holds true no matter how low or how high the TA is set. If the TA is 10 000 ft or 18 000 ft or any other value there will be a corresponding loss when the QNH drops to the trigger values. The determination to be made is in what altitude layer this is the least disruptive to ATC and the users. The traffic distribution data reviewed shows that the loss of airspace in a terminal area, where the traffic is more intense and concentrated, would have a greater negative impact than at higher levels.

8.2 SIDs and STARs were developed to take advantage of the capabilities of advanced airborne navigation systems. They allow more efficient use of terminal airspace and ATC capacity by reducing communications and standardising flight profiles. Low TAs are incompatible with the intended objective of SIDs and STARs. The change from altitude reference to flight level reference at various points during either procedure introduces complexity, which in turn also induces errors.

8.3 A suitable higher TA would improve the efficiency and safety of these procedures by making all altimeter references to QNH for ATC, the flight crews and the airborne flight management systems. It would also avoid the loss of usable vertical airspace in a terminal area due to variable TLs. The introduction of precision area navigation procedures in both the horizontal and vertical plane will make it necessary to adjust TAs for their efficient implementation.

9. QUESTIONAIRE

9.1 Responses have been received from Estonia, Finland, Norway and Sweden as follows:

9.1.1 *Estonia preferences*

- Area – a common area wide transition altitude covering all airspace in participating countries
- Altitude – 10 000 ft

9.1.2 *Finland preferences*

- Area – a common area wide transition altitude covering all airspace in participating
- Altitude – 5 000 ft (two responses; Finavia and Finnish Military Authority). 10 000 ft (three responses; Finnair, Finncomm and FATCA). 18 000 ft (one response; Finnish Aeronautical Association)

9.1.3 *Norway preferences*

- Area – a common area wide transition altitude covering all airspace in participating countries (nine out of ten responses; ANSPs Avinor and ENSO; AOPs SAS, WIF, Norwegian, LTR; Organisations NLF, NFF and NF). One response (Norwegian Military Authority) preferring a common transition altitude in all CTA
- Altitude – 18 000 ft (six responses); 10 000 ft (two responses); 10 000/18 000 ft (two responses)

9.1.4 *Sweden preferences*

If there is a need to change, the Swedish ANSP's preferences are as follows:

- Area – a common transition altitude established in all TMAs of participating countries (one response, LFV). No change (one response, Swedish Military Authority)
- Altitude – 10 000 ft (one response, LFV). No change (one response, Swedish Military Authority)

9.2 From the responses it can be noted that, if a change is agreed, the Swedish ANSP would prefer a transition altitude of 10 000 ft applied in TMAs only. On the other hand, Estonia, Finland and a majority of responses from Norway (all except the military) indicate a preference for an area wide transition altitude. In the case of Finland the indicated preferred value of the TA varies with half of the respondents preferring 5 000 ft and the other half preferring a change to either 10 000 ft or 18 000 ft. In Norway the altitude preference is 18 000 ft while Estonia would prefer a TA of 10 000 ft.

9.3 A summary of the responses received is presented at Appendix F in a tabular format.

10. INCIDENT INFORMATION

10.1 Information regarding incidents resulting from incorrect altimeter setting has been provided by Finland, Norway and Sweden. The information provided by Finland lists 31 occurrences that took place 2006 – 2008, Norway lists 12 incidents from 2005 to 2008 and Sweden lists 18 occurrences.

10.1.1 From the information provided by Finland it can be noted that 14 of the altitude deviations involve a failure to set the altimeter to standard setting of 1013.2 hPa after departure. The altitude deviations listed were between 200 ft and 800 ft. There were 17 altitude deviations listed in the approach phase when the flight crew failed to change the altimeter setting to QNH during descent. The deviations listed were between 110 ft and 950 feet.

10.1.2 From the information provided by Norway it can be noted that 9 of these occurred when there was a failure to change to standard setting whilst 3 incidents involved a failure to set QNH during approach. From the information provided that the altitude deviations were up to 1 000 ft.

10.1.3 From the information provided by Sweden it is noted that 12 of the altitude deviations involved a failure to set the altimeter to standard setting after departure. The altitude deviations listed were up to 1 100 ft. Six of the incidents involved failure to set the altimeter to QNH during descent through the transition level.

10.2 Further to the above, it can be noted from the UK CAP 710 (Level Bust Working Group 'On the Level' Project Final report) that, during the 18 month data collection period (July 1998 to December 1999) there were a total of 68 reports of incorrect settings of the altimeter.

11. CONCLUSIONS

11.1 The study "Towards a Common Transition Altitude – A Flight Deck Perspective" conclusively determined that a low TA is not conducive to flight safety. The study on the ATC perspective also supports that finding.

11.2 The IFALPA policy states: IFALPA recommends the establishment of a common transition altitude within each State and, where possible, within each ICAO region. Given that standardisation is an essential goal in itself and having regard to the basic requirement to apply the standard altimeter setting of 1013,2 hPa in the maximum possible airspace, a standard transition altitude must, of necessity, take account of the appropriate terrain configuration, availability of reliable area QNH, character of air traffic and performance characteristic of modern aircraft. To reduce diversity and introduce a rational system that respects of the performance and modes of operation of present aircraft equipment, the choice of transition altitudes should be limited to 10.000 or 20.000 feet.

11.3 The study "Justification for higher transition altitudes in ECAC airspace" indicates a clear requirement, in the interest of safety, to change in most cases the transition altitudes presently established within the ECAC airspace to higher values.

11.4 In view of the results of the various studies and the IFALPA policy indicating a need for higher transition altitudes, the group was of the opinion that ICAO should be approached with a request that relevant paragraphs of Doc 8168 should be reviewed with a view to reflect more accurately present day operations.

11.5 Higher TAs allow for more efficient use of the available airspace and create the potential for capacity improvements in TMAs.

11.6 There are compelling safety reasons for higher TAs such as reducing complexity, reduced risk for errors through the use of standard operating procedures, terrain clearance and reduction of flight crew work load during critical phases of flight. There are also substantial ATM operational benefits such as: facilitate structural airspace changes, more adaptable to accommodate evolving technology, more efficient RNAV/BARONAV flight procedures as well as more efficient use of CDAs. New ATM systems under development, e.g. the Point Merge system, will also benefit from higher TA provided that sufficient considerations of the system specifications are taken while determining the actual altitude of the TA. This is applicable not only in the current environment, but also in the preparation for structural changes which will inevitably come with evolving technology.

11.7 A higher transition altitude will allow for the implementation of more efficient and economical CDAs which would have environmental benefits in the form of less noise and lower fuel burn.

11.8 A higher, common TA should facilitate the further development of common ATC procedures which should, in turn, permit more standardised flight operations procedures. This simplification and standardisation of procedures would in turn reduce complexity; the confusion and the risk of error inherent in using non-standardised procedures, and therefore eliminate one source of mistake by pilots which will contribute to improved flight safety.

11.9 A higher common TA in the region of northern European States would, in addition to the benefits of standardising procedures, prepare for harmonisation of rules and procedures within the proposed FAB in Northern Europe.

11.10 A medium altitude TA provides significant improvements in safety. The 10 000 ft TA is preferable from a flight operations perspective. It also provides a number of benefits to ATM operations, capacity and airspace structure elements.

11.11 A high altitude TA is also acceptable from a flight operations perspective. It provides most of the flight operations benefits of a medium altitude.

- From an ATM perspective it will facilitate structural airspace changes and classification changes more readily than the others.
- A high TA will be more adaptable to procedural changes designed to accommodate the evolution of more efficient and economical future RNAV/BARONAV flight profiles.
- The implementation of a high TA would allow a full EUR regional agreement without exceptions for those States with high terrain.

11.12 Below the TL the altimeter setting of a station close to the route of flight provides the better option for the combination of accurate altitude indications and a common reference for vertical separation to proximate aircraft. The validity of the area or regional altimeter concept should be reconsidered.

12. RECOMMENDATIONS

12.1 The group carefully assessed all issues related to a change in the value of the transition altitude for northern Europe. It based its findings on studies and investigations already conducted on this matter, but more importantly, compared the findings of these studies against the environment in the area concerned.

12.2 The group has considered six different options. These were:

1. 18 000 ft, area wide
2. 18 000 ft, in TMAs only
3. 10 000 ft, area wide
4. 10 000 ft, in controlled airspace
5. 10 000 ft, in TMAs only
6. 10 000 ft, area wide with selected TMAs at 18 000 ft

12.3 The group agreed that the two options involving TMAs only were not feasible due to, *inter alia*, the differences in vertical dimensions of TMAs in the area. Furthermore, although the answers received in response to the questionnaire sent out to stakeholders in the States concerned indicated that the preference by Norwegian stakeholders was 18 000 ft, the group came to the conclusion that it would be difficult to reach consensus on that altitude. Therefore, it would appear that option 3, 10 000 ft would be the only viable solution for a common transition altitude. Therefore, the group agreed that a general safety assessment was required and should be conducted on that option (see paragraph 6.4).

12.4 The group realised that a value of 10 000 ft was not optimal in view of the impending implementation of the point merge concept in Oslo TMA. Therefore the group decided this had to be addressed in the safety assessment. Other areas that needed to be addressed were e.g. the issue of the airspace in the Malmoe/Copenhagen area, and the high sea areas.

12.5 The group considers it important that any decision taken should ensure a harmonisation of the value, provided that this will not affect other systems or procedures in a negative way.

12.6 Based on the findings of the first safety assessment, the group proposes two possible second steps. If the safety assessment is positive, it is recommended that an implementation plan is developed and agreed. If the safety assessment should show that option 3, 10 000 ft area wide is not feasible; the group proposes that a safety assessment is conducted on option 1, 18 000 ft area wide.

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APPENDIX A

ICAO PROVISIONS

PANS-OPS (Doc 8168) Volume I, Part III, Section 1

Chapter 1

INTRODUCTION TO ALTIMETER SETTING PROCEDURES

1.1 These procedures describe the method for providing adequate vertical separation between aircraft and for providing adequate terrain clearance during all phases of a flight. This method is based on the following basic principles:

a) States may specify a fixed altitude known as the transition altitude. In flight, when an aircraft is at or below the transition altitude, its vertical position is expressed in terms of altitude, which is determined from an altimeter set to sea level pressure (QNH).

b) In flight above the transition altitude, the vertical position of an aircraft is expressed in terms of flight levels, which are surfaces of constant atmospheric pressure based on an altimeter setting of 1 013.2 hPa.

c) The change in reference from altitude to flight levels, and vice versa, is made:

   1) at the transition *altitude*, when climbing; and

   2) at the transition *level*, when descending.

d) The transition level may be nearly coincident with the transition altitude to maximize the number of flight levels available. Alternatively, the transition level may be located 300 m (110 ft) above the transition altitude to permit the transition altitude and the transition level to be used concurrently in cruising flight, with vertical separation ensured. The airspace between the transition level and the transition altitude is called the transition layer.

e) Where no transition altitude has been established for the area, aircraft in the en-route phase shall be flown at a flight level.

f) The adequacy of terrain clearance during any phase of a flight may be maintained in any of several ways, depending upon the facilities available in a particular area. The recommended methods in the order of preference are:

   1) the use of current QNH reports from an adequate network of QNH reporting stations;

2) the use of such QNH reports as are available, combined with other meteorological information such as forecast lowest mean sea level pressure for the route or portions thereof; and

3) where relevant current information is not available, the use of values of the lowest altitudes or flight levels, derived from climatological data.

g) During the approach to land, terrain clearance may be determined by using:

1) the QNH altimeter setting (giving altitude); or

2) under specified circumstances (see Chapter 2, 2.4.2 and Chapter 3, 3.5.4), a QFE setting (giving height above the QFE datum).

1.2 This method provides flexibility to accommodate variations in local procedures without compromising the fundamental principles.

1.3 These procedures apply to all IFR flights and to other flights which are operating at specific cruising levels in accordance with the *Rules of the Air* (Annex 2) or the *Procedures for Air Navigation Services, Air Traffic Management* (PANS-ATM, Doc 4444) or the *Regional Supplementary Procedures* (Doc 7030).

Chapter 2

BASIC ALTIMETER SETTING REQUIREMENTS

2.1 GENERAL

. . .

2.1.2 Transition altitude

2.1.2.1 A transition altitude shall normally be specified for each aerodrome by the State in which the aerodrome is located.

2.1.2.2 Where two or more closely spaced aerodromes are located so that coordinated procedures are required, a common transition altitude shall be established. This common transition altitude shall be the highest that would be required if the aerodromes were considered separately.

2.1.2.3 As far as possible, a common transition altitude should be established:

a) for groups of aerodromes of a State or all aerodromes of that State;

b) on the basis of an agreement, for:

1) aerodromes of adjacent States;

2) States of the same flight information region; and

3) States of two or more adjacent flight information regions or one ICAO region; and

c) for aerodromes of two or more ICAO regions when agreement can be obtained between these regions.

2.1.2.4 The height above the aerodrome of the transition altitude shall be as low as possible but normally not less than 900 m (3 000 ft).

2.1.2.5 The calculated height of the transition altitude shall be rounded up to the next full 300 m (1 000 ft).

2.1.2.6 Despite the provisions in 2.1.2, "Transition altitude", a transition altitude may be established for a specified area on the basis of regional air navigation agreements.

2.1.2.7 Transition altitudes shall be published in aeronautical information publications and shown on the appropriate charts.

2.1.3 Transition level

2.1.3.1 States shall make provision for the determination of the transition level to be used at any given time at each of their aerodromes.

2.1.3.2 Where two or more closely spaced aerodromes are located so that coordinated procedures and a common transition altitude are required, a common transition level shall also be used at those aerodromes.

2.1.3.3 Appropriate personnel shall have available at all times the number of the flight level representing the current transition level for an aerodrome.

Note.— The transition level is normally passed to aircraft in the approach and landing clearances.

2.1.4 References to vertical position

2.1.4.1 The vertical position of aircraft operating at or below the transition altitude shall be expressed in terms of altitude. Vertical position at or above the transition level shall be expressed in terms of flight levels. This terminology applies during:

a) climb;

b) en-route flight; and

c) approach and landing (except as provided for in 2.4.3, "References to vertical positioning after approach clearance").

Note.— This does not preclude a pilot using a QFE setting for terrain clearance purposes during the final approach to the runway.

2.1.4.2 *Passing through the transition layer*

While passing through the transition layer, vertical position shall be expressed in terms of:

a) flight levels when climbing; and

b) altitude when descending.

2.2 TAKE-OFF AND CLIMB

A QNH altimeter setting shall be made available to aircraft in taxi clearances prior to take-off.

t

2.3 EN ROUTE

2.3.1 When complying with the specifications of Annex 2, an aircraft shall be flown at altitudes or flight levels (as applicable) corresponding to the magnetic tracks shown in the table of cruising levels in Appendix 3 to Annex 2.

2.3.2 Terrain clearance

2.3.2.1 QNH altimeter setting reports should be provided from sufficient locations to permit determination of terrain clearance with an acceptable degree of accuracy.

2.3.2.2 For areas where adequate QNH altimeter setting reports cannot be provided, the appropriate authorities shall provide the information required to determine the lowest flight level which will ensure adequate terrain clearance. This information shall be made available in the most usable form.

2.3.2.3 Appropriate services shall at all times have available the information required to determine the lowest flight level which will ensure adequate terrain clearance for specific routes or segments of routes. This information shall be made available for flight planning purposes and for transmission to aircraft in flight, on request.

2.4 APPROACH AND LANDING

2.4.1 The QNH altimeter setting shall be made available to aircraft in approach clearances and in clearances to enter the traffic circuit.

2.4.2 A QFE altimeter setting, clearly identified as such, should be made available in approach and landing clearances. This should be available on request or on a regular basis, in accordance with local arrangements.

2.4.3 References to vertical positioning after approach clearance

After approach clearance has been issued and the descent to land is begun, the vertical positioning of an aircraft above the transition level may be by reference to altitudes (QNH) provided that level flight above the transition altitude is not indicated or anticipated.

Note.— This applies primarily to turbine engine aircraft for which an uninterrupted descent from a high altitude is desirable and to aerodromes equipped to control such aircraft by reference to altitudes throughout the descent.

2.5 MISSED APPROACH

The relevant parts of 2.2, “Take-off and climb”, 2.3, “En route”, and 2.4, “Approach and landing” shall apply in the event of a missed approach.

. . .

PANS-ATM (Doc 4444)

Chapter 4; General Provisions for Air Traffic Services

4.10 ALTIMETER SETTING PROCEDURES

4.10.1 Expression of vertical position of aircraft

4.10.1.1 For flights in the vicinity of aerodromes and within terminal control areas the vertical position of aircraft shall, except as provided for in 4.10.1.2, be expressed in terms of altitudes at or below the transition altitude and in terms of flight levels at or above the transition level. While passing through the transition layer, vertical position shall be expressed in terms of flight levels when climbing and in terms of altitudes when descending.

. . .

4.10.1.3 For flights en route the vertical position of aircraft shall be expressed in terms of:

a) flight levels at or above the lowest usable flight level;

b) altitudes below the lowest usable flight level;

except where, on the basis of regional air navigation agreements, a transition altitude has been established for a specified area, in which case the provisions of 4.10.1.1 shall apply.

4.10.2 Determination of the transition level

4.10.2.1 The appropriate ATS unit shall establish the transition level to be used in the vicinity of the aerodrome(s) concerned and, when relevant, the terminal control area (TMA) concerned, for the appropriate period of time on the basis of QNH (altimeter subscale setting to obtain elevation when on the ground) reports and forecast mean sea level pressure, if required.

4.10.2.2 The transition level shall be the lowest flight level available for use above the transition altitude established for the aerodrome(s) concerned. Where a common transition altitude has been established for two or more aerodromes which are so closely located as to require coordinated procedures, the appropriate ATS units shall establish a common transition level to be used at any given time in the vicinity of the aerodrome and, when relevant, in the TMA concerned.

Note. — See 4.10.3.2 regarding the determination of the lowest usable flight level(s) for control areas.

4.10.3 Minimum cruising level for IFR flights

4.10.3.1 Except when specifically authorized by the appropriate authority, cruising levels below the minimum flight altitudes established by the State shall not be assigned.

4.10.3.2 ATC units shall, when circumstances warrant it, determine the lowest usable flight level or levels for the whole or parts of the control area for which they are responsible, and use it when assigning flight levels and pass it to pilots on request.

Note 1.— Unless otherwise prescribed by the State concerned, the lowest usable flight level is that flight level which corresponds to, or is immediately above, the established minimum flight altitude.

Note 2.— The portion of a control area for which a particular lowest usable flight level applies is determined in accordance with air traffic services requirements.

Note 3.— The objectives of the air traffic control service as prescribed in Annex 11 do not include prevention of collision with terrain. The procedures prescribed in this document do not therefore relieve the pilots of their responsibility to ensure that any clearance issued by air traffic control units is safe in this respect. When an IFR flight is vectored or is given a direct routing which takes the aircraft off an ATS route, the procedures in Chapter 8, 8.6.5.2 apply.

ATSPM (Doc 9426)

Part II, Section 5, Chapter 1

1.2 Establishment of the transition altitude

1.2.1 The basic principles for the establishment of the transition altitude are contained in Doc 8168, Volume I, Part VI. [Editorial comment: Volume I, Part III, Section 1 in the current edition of PANS-OPS.] Preferably a common transition altitude should be established for groups of aerodromes, aerodromes in adjacent States or for a specified area when so determined on the basis of a regional air navigation agreement.

1.2.2 The selection of a transition altitude will be governed by the following factors:

a) the amount of traffic operating in the lower airspace;

b) the types and performance categories of aircraft;

c) the ratio of level flights to those climbing and descending in the same airspace;

d) the terrain configuration;

e) the departure and arrival procedures including noise abatement procedures;

f) variation in the route distances involved and thus variation in cruising levels required;

g) the rate of change in barometric pressures and the range of fluctuation along air traffic services (ATS) routes within a certain area;

h) the infrastructure for the provision of area QNH; and

i) the existence of other aerodromes in the vicinity.

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APPENDIX B

AUSTRALIA

CHAPTER 8 AERONAUTICAL SERVICES HANDBOOK
August 2002
Area QNH Zones

AREA QNH FORECASTS

Purpose

58. Aircraft cruising at or below 10,000 feet maintain altitude according to the indication of a pressure operated altimeter, the sub-scale of which has been set to area QNH.

Accuracy and Limitations

59. The definition of area QNH requires forecasts to be within plus or minus 5 hPa of the actual QNH at any low level point (below 1,000 feet above MSL) within or on the boundary of the area QNH zone, during the period of validity of the forecast. The difference between adjacent zones is not to exceed 5 hPa.

60. This specified accuracy makes it necessary in some circumstances to provide separate forecasts for sub-divisions of the primary area QNH zones.

61. Area QNH forecasts apply to low level stations. Generally air temperatures in Australia are higher than those for corresponding levels for the International Standard Atmosphere and the force of gravity is always less than the value used in computation of the International Standard Atmosphere. Therefore pressure altitudes, using QNH as a sub-scale setting on the altimeter, are less than the actual altitudes in most cases. When actual temperatures are lower than in the International Standard Atmosphere, the reverse applies. These differences normally become increasingly significant with increasing altitude and area QNH forecasts should not be regarded as applying to high level stations.

Offices Responsible for Origination

62. Individual MWO originate area QNH forecasts on the same basis as area forecasts.

63. Perth MWO prepare area QNH forecasts for areas 87 and 88, Sydney MWO for area 24.

64. An area QNH zone is a defined airspace for which area QNH forecasts are prepared routinely. The zones are shown in Figure 8.1 at the end of this Chapter and correspond to area forecast boundaries. Areas 24, 87 and 88 are only designated for the purpose of Area QNH.

Times of Issue and Periods of Validity

65. Area QNH forecasts are valid for three hours commencing forty five minutes after the scheduled time of issue. Scheduled times of issue are 0015 UTC and each three hours thereafter except that particular issues may be omitted at the discretion of the Regional Director.

Sub-division of Forecasts

66. In order to satisfy the accuracy standards, it is often necessary to issue forecasts for sub-divisions of the primary area QNH zones. These sub-divisions should be as simple as possible preferably a straight line between two points or a straight line orientated either north-south or east-west through a point.

67. On some occasions it is also necessary to sub-divide the period of validity of the forecast in order to satisfy the accuracy standards.

68. Sub-divisions of forecasts may also be necessary to co- ordinate forecasts for adjoining areas.

Co-ordination between Meteorological Watch Offices

69. The forecast area QNH must not differ by more than five hectopascals from the forecast value for an adjoining area. Co-ordination between MWO is necessary to ensure that this criterion is satisfied.

70. If a difference of more than five hectopascals in area QNH across the border of adjoining zones appears possible, the shift supervisor of the MWO responsible for the zone in which the QNH values are highest, initiates a telephone call to other MWO concerned to discuss joint action to ensure that the criterion is satisfied.

71. This type of situation is illustrated by the Area 22 and Area 30 zones in strong northwesterlies with the pressure at the northeastern edge of the Area 22 zone 1018 hPa; at 35°S in the south of Area 22 1010 hPa; and at the edge of the southwestern part of the Area 30 zone 1002 hPa. Area 22 area QNH 1014 hPa and Area 30 area QNH 1006 hPa both satisfy requirements for their respective zones but give a jump at the boundary of the two zones of eight hectopascals. Under these conditions when preparing the forecast of area QNH the forecasters should take account of the fact that the highest possible area QNH in Area 30 area would be 1007 hPa and the lowest area QNH in Area 22 would be 1013 hPa unless the zones are sub-divided. Sub-division is therefore necessary.

Amendment

72. Area QNH forecasts are amended if the actual QNH of any point, below 1,000 feet above MSL, within or on the boundary of the zone becomes, or is expected to become, different from the area QNH by more than five hectopascals during the period of validity of the forecast.

73. The period of validity of the amendment is the unexpired period of validity of the forecast being amended.

Preparation of Area QNH Forecasts

74. **Identifier** is 'AREA QNH' unless the forecast is an amendment. In this case 'AMD AREA QNH' is used.

75. **Period of Validity** is written 'G1G1/G2G2' where GG is the time in hours UTC.

76. **Designation of Area**. The term AREA is followed by the area number. (The area QNH numbers coincide with that for low level area forecasts).

77. **Area QNH** forecast is given in whole hectopascals and is determined by averaging expected values for stations below 1000 feet above MSL over the area concerned for the specified period of validity of the forecast.

CANADA (as of 2009)

Altimeter-setting and Operating Procedures in the Altimeter-setting Region

602.35 When an aircraft is operated in the altimeter-setting region, each flight crew member who occupies a flight crew member position that is equipped with an altimeter shall

(a) immediately before conducting a take-off from an aerodrome, set the altimeter to the altimeter setting of the aerodrome or, if that altimeter setting is not obtainable, to the elevation of the aerodrome;

(b) while in flight, set the altimeter to the altimeter setting of the nearest station along the route of flight or, where the nearest stations along the route of flight are separated by more than 150 nautical miles, to the altimeter setting of a station near the route of flight; and

(c) immediately before commencing a descent for the purpose of landing at an aerodrome, set the altimeter to the altimeter setting of the aerodrome, if that altimeter setting is obtainable.

Altimeter-setting and Operating Procedures in the Standard Pressure Region

602.36 (1) When an aircraft is operated in the standard pressure region, each flight crew member who occupies a flight crew member position that is equipped with an altimeter shall

(a) immediately before conducting a take-off from an aerodrome, set the altimeter to the altimeter setting of the aerodrome or, if that altimeter setting is not obtainable, to the elevation of the aerodrome;

(b) before reaching the flight level at which the flight is to be conducted, set the altimeter to 29.92 inches of mercury or 1,013.2 millibars; and

(c) immediately before commencing a descent for the purpose of landing at an aerodrome, set the altimeter to the altimeter setting of the aerodrome, if that altimeter setting is obtainable.

(2) Notwithstanding paragraph (1)(c), when a holding procedure is being conducted before landing at an aerodrome located in the standard pressure region, each flight crew member who occupies a flight crew member position that is equipped with an altimeter shall set the altimeter to the altimeter setting of the aerodrome immediately before descending below the lowest flight level at which the holding procedure is conducted.

Altimeter-setting and Operating Procedures in Transition between Regions

602.37 Except where otherwise authorized by an air traffic control unit, each flight crew member who occupies a flight crew member position that is equipped with an altimeter shall

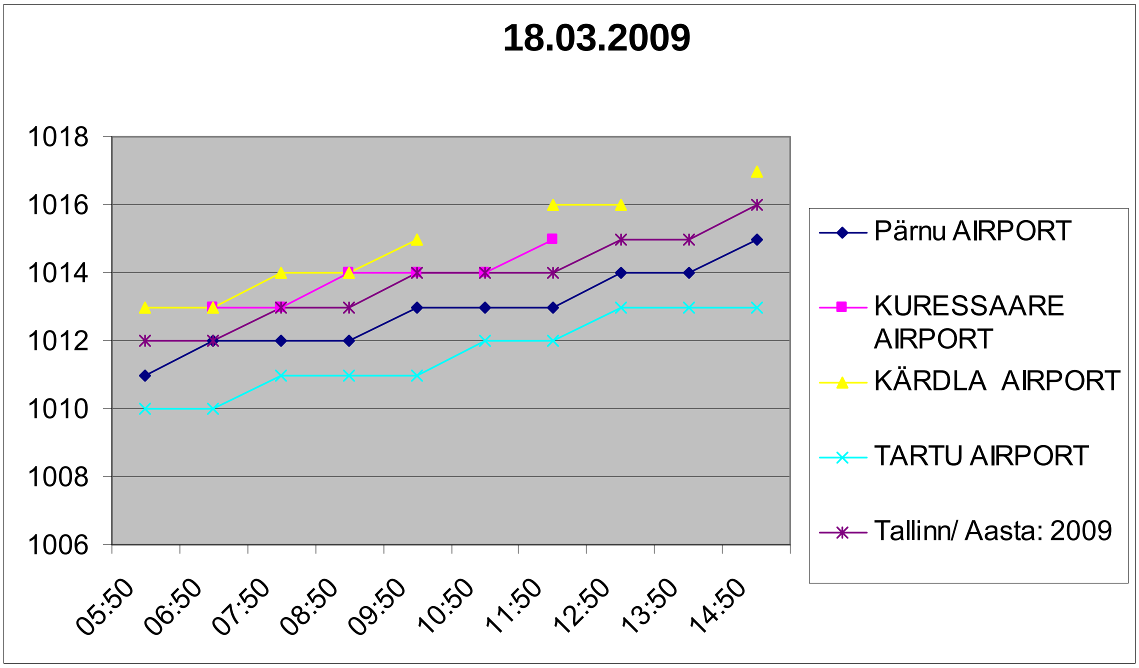
(a) when flying from the altimeter-setting region into the standard pressure region, set the altimeter to 29.92 inches of mercury or 1,013.2 millibars immediately after the aircraft's entry into the standard pressure region; and

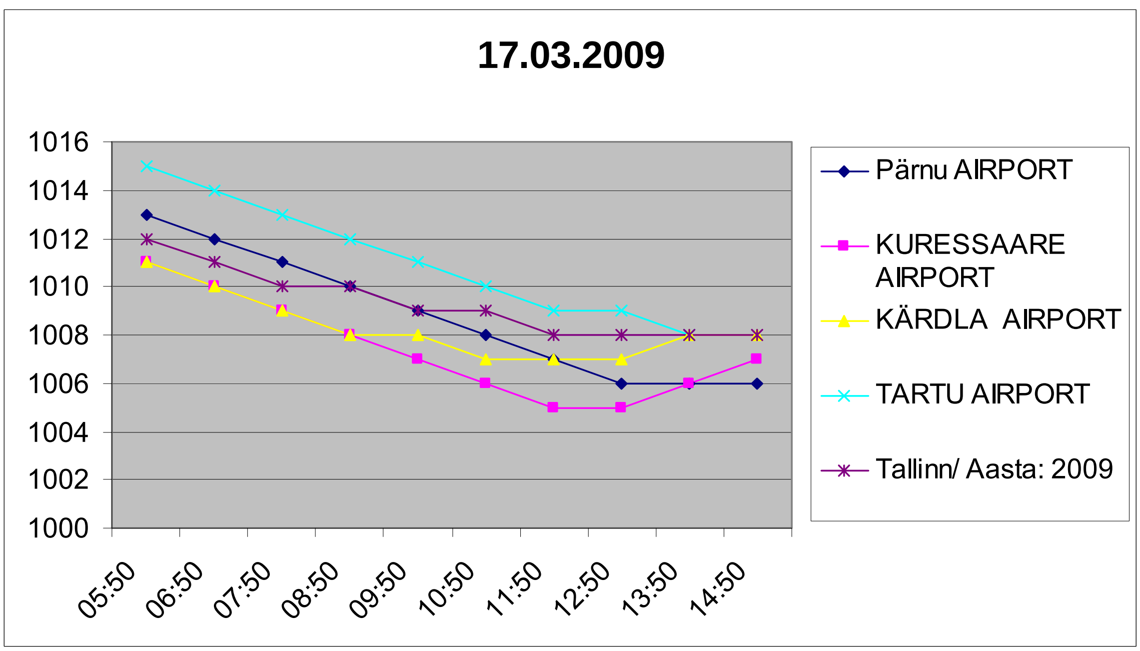
(b) when flying from the standard pressure region into the altimeter-setting region, set the altimeter to the altimeter setting of the nearest station along the route of flight or, where the nearest stations along the route of flight are separated by more than 150 nautical miles, the altimeter setting of a station near the route of flight immediately before the aircraft's entry into the altimeter-setting region.

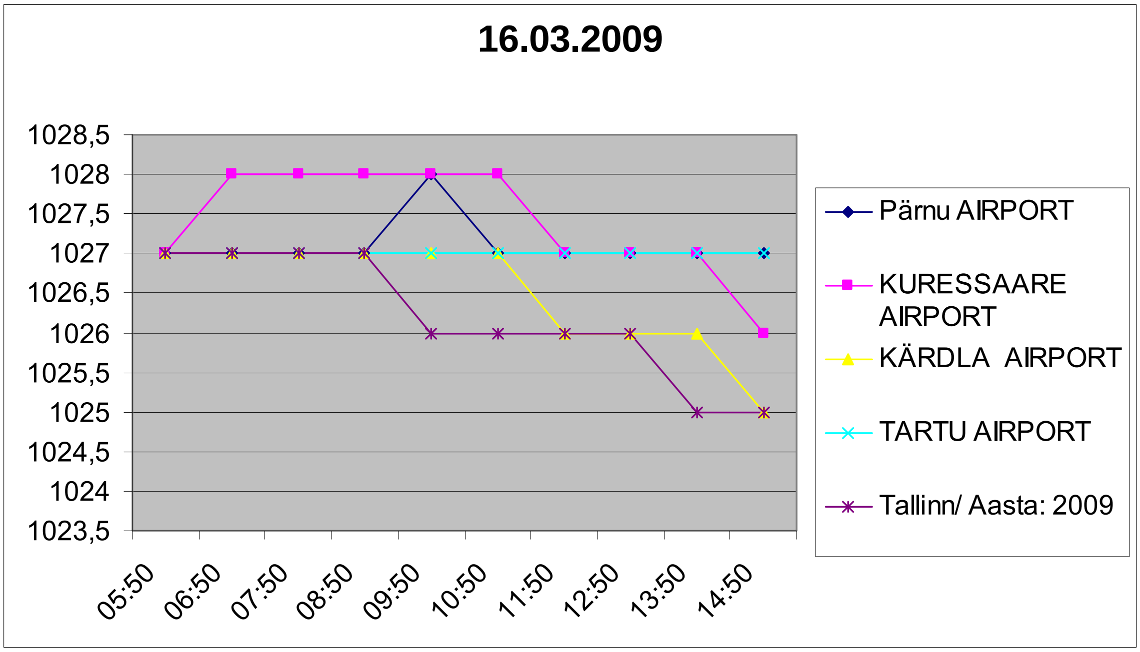
APPENDIX C

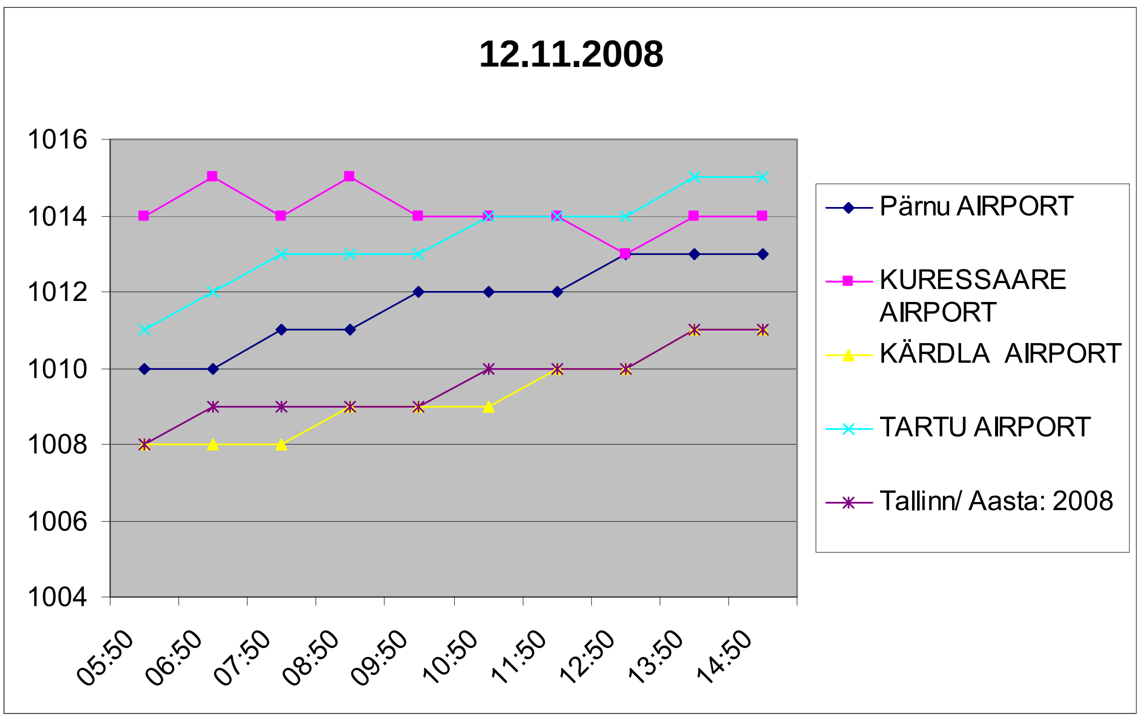
QNH variations in Estonia, Finland, Norway and Sweden

ESTONIA






16.03.2009
1028,5
1028
1027,5
1027
1026,5
1026
1025,5
1025
1024,5
1024
1023,5
05:50
06:50
07:50
08:50
09:50
10:50
11:50
12:50
13:50
14:50
Pärnu AIRPORT
KURESSAARE AIRPORT
KÄRDLA AIRPORT
TARTU AIRPORT
Tallinn/ Aasta: 2009


12.11.2008
1016
1014
1012
1010
1008
1006
1004
05:50
06:50
07:50
08:50
09:50
10:50
11:50
12:50
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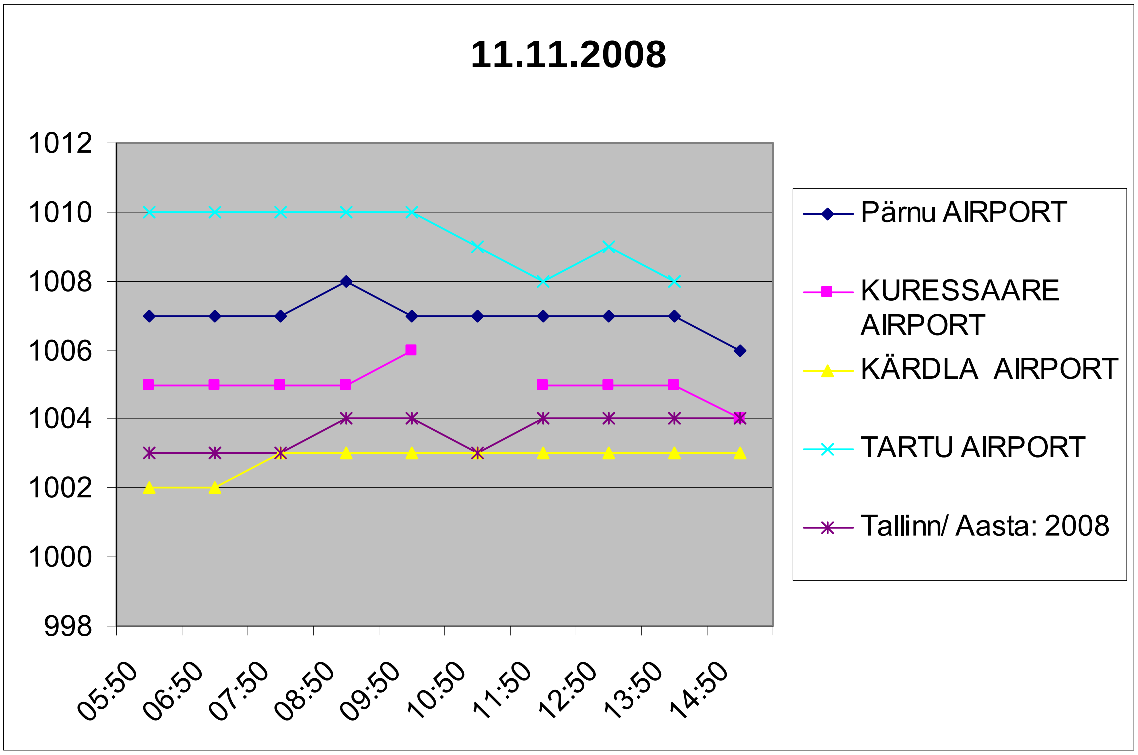
Pärnu AIRPORT
KURESSAARE AIRPORT
KÄRDLA AIRPORT
TARTU AIRPORT
Tallinn/ Aasta: 2008


11.11.2008
1012
1010
1008
1006
1004
1002
1000
998
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06:50
07:50
08:50
09:50
10:50
11:50
12:50
13:50
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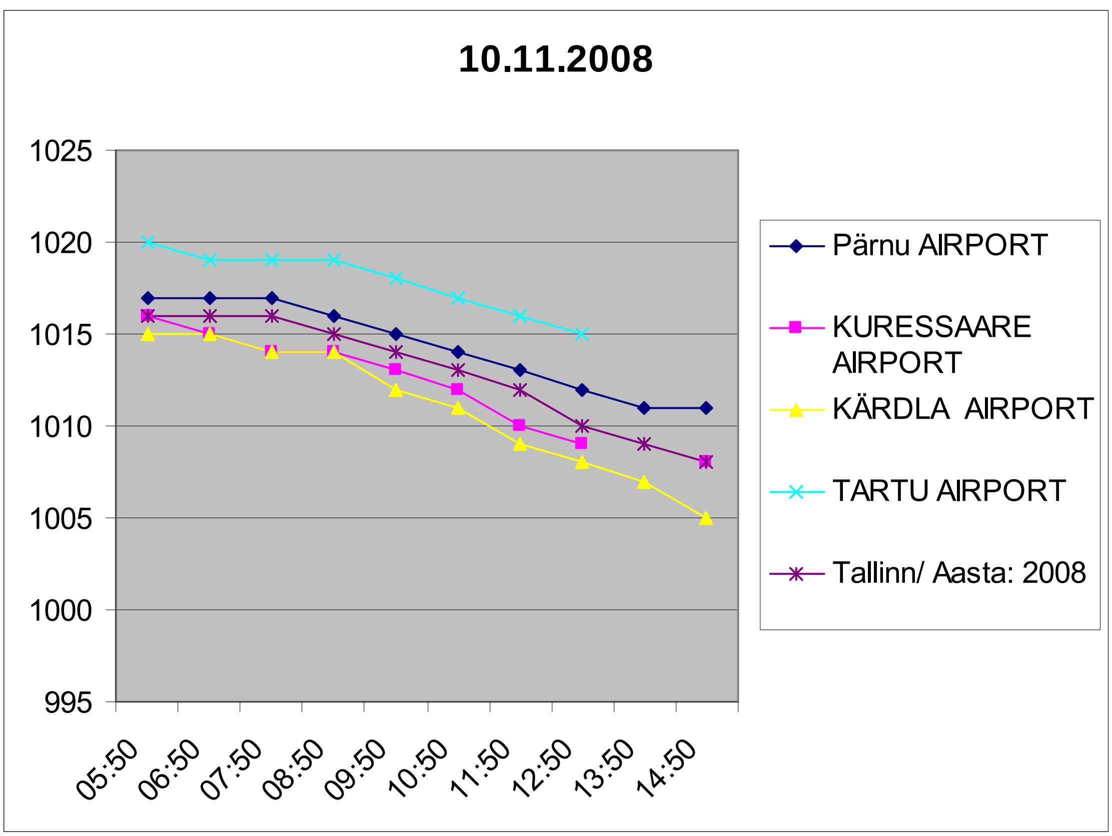
Pärnu AIRPORT
KURESSAARE AIRPORT
KÄRDLA AIRPORT
TARTU AIRPORT
Tallinn/ Aasta: 2008


10.11.2008
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1020
1015
1010
1005
1000
995
05:50
06:50
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12:50
13:50
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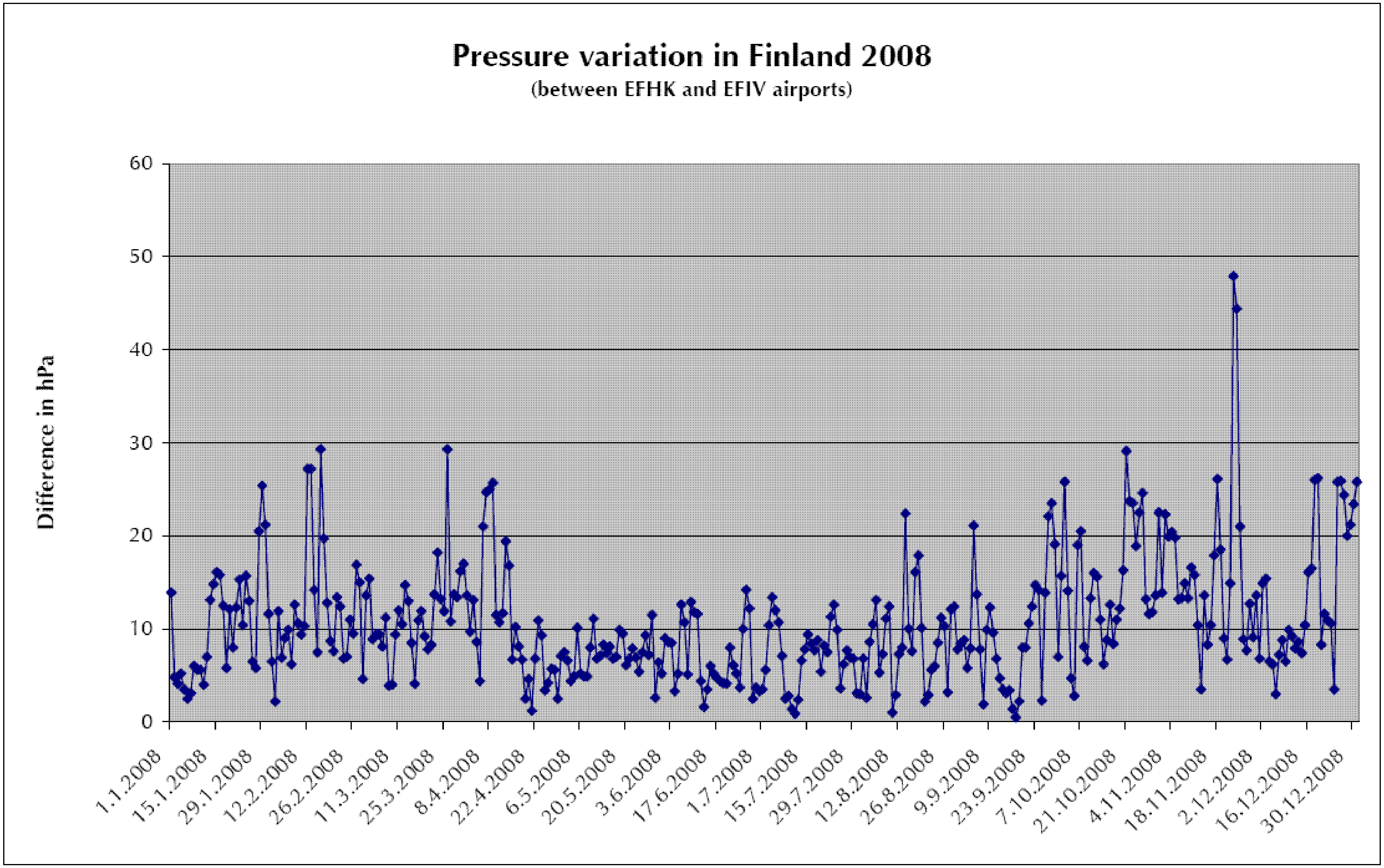
Pärnu AIRPORT
KURESSAARE AIRPORT
KÄRDLA AIRPORT
TARTU AIRPORT
Tallinn/ Aasta: 2008

	10-11-2008			11-11-2008			12-11-2008			16-11-2008			17-11-2008			18-11-2008		
	Max	Min	Vahe	Max	Min	Vahe	Max	Min	Vahe	Max	Min	Vahe	Max	Min	Vahe	Max	Min	Vahe
05:50	1020	1015	5	1010	1002	8	1014	1008	6	1027	1027	0	1015	1011	4	1013	1010	3
06:50	1019	1015	4	1010	1002	8	1015	1008	7	1028	1027	1	1014	1010	4	1013	1010	3
07:50	1019	1014	5	1010	1003	7	1014	1008	6	1028	1027	1	1013	1009	4	1014	1011	3
08:50	1019	1014	5	1010	1003	7	1015	1009	6	1028	1027	1	1012	1008	4	1014	1011	3
09:50	1018	1012	6	1010	1003	7	1014	1009	5	1028	1027	1	1011	1007	4	1015	1011	4
10:50	1017	1011	6	1009	1003	6	1014	1009	5	1028	1027	1	1010	1006	4	1014	1012	2
11:50	1016	1009	7	1008	1003	5	1014	1010	4	1027	1026	1	1009	1005	4	1016	1012	4
12:50	1015	1008	7	1009	1003	6	1014	1010	4	1027	1026	1	1009	1005	4	1016	1013	3
13:50	1011	1007	4	1008	1003	5	1015	1011	4	1027	1026	1	1008	1006	2	1014	1013	1
14:50	1011	1005	6	1006	1003	3	1015	1011	4	1027	1025	2	1008	1006	2	1017	1013	4
Daily average			5,5			6,2			5,1			1			3,6			3
Daily deviation max			7			8			7			2			4			4

FINLAND



Pressure variation in Finland 2008
(between EFHK and EFIV airports)
Difference in hPa
60
50
40
30
20
10
0
1.1.2008
15.1.2008
29.1.2008
12.2.2008
26.2.2008
11.3.2008
25.3.2008
8.4.2008
22.4.2008
6.5.2008
20.5.2008
3.6.2008
17.6.2008
1.7.2008
15.7.2008
29.7.2008
12.8.2008
26.8.2008
9.9.2008
23.9.2008
7.10.2008
21.10.2008
4.11.2008
18.11.2008
2.12.2008
16.12.2008
30.12.2008

NORWAY

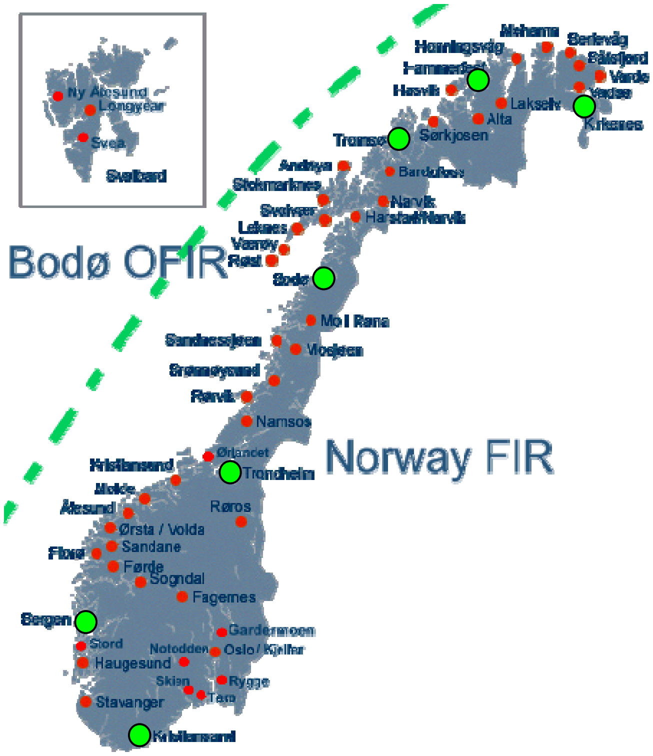


Table 1: Occurrence of difference in QNH observations at 12 UTC between airports in Norway FIR during winter (December to February) from 2004 to 2008.

QNH Difference (hPa)	Kirkenes – Hammerfest (143 nm)	Hammerfest – Tromsø (114 nm)	Tromsø – Bodø (177 nm)	Bodø – Trondheim (244 nm)	Trondheim – Bergen (251 nm)	Bergen – Kristiansand (153 nm)	Kirkenes – Kristiansand (900 nm)
< 5	65,4 %	8,6 %	70,3 %	55,9 %	57,9 %	41,9 %	15,7 %
5-10	27,1 %	47,7 %	19,1 %	27,1 %	27,7 %	38,8 %	15,7 %
10-15	4,0 %	34,1 %	4,7 %	10,0 %	11,3 %	16,6 %	13,7 %
15-20	0,4 %	5,3 %	0,0 %	2,7 %	1,6 %	1,1 %	14,0 %
20-25		0,2 %	0,0 %	0,2 %	0,7 %	0,2 %	12,6 %
25-30							8,9 %
30-35							5,3 %
35-40							5,3 %
40-45							2,9 %
45-50							0,9 %
50-55							1,6 %
< 55							0,2 %

As shown in Table 1, there is a high frequency of difference in QNH observations larger than 5 hPa and also above 10 hPa, especially in the south-western and north-western parts of Norway FIR.

If Option 1 (ref. 3.3.1) is selected, there will clearly be a need for several ASRs of less geographical extent (~100-150 nm range) within Norway FIR. One solution could be to establish ASRs based on existing boundaries of ATCC AORs, or subdivisions thereof. This would give 5 to 10 ASRs, depending on the degree of subdivision of the AORs.

In Option 2 (ref. 3.3.2), regularly updated QNH observations not further apart than 100 nm will have to be available on the AFTN network at all times. Currently all regional airports in Norway are equipped with Automatic Weather Observation Systems (AWOS), capable of producing QNH observations every 30 minutes. For most of Norway FIR the AWOS stations are within 100 nm apart, but in some areas additional stations would probably be needed. Also, some technical and regulatory issues will have to be solved in order to ensure availability of the observations on AFTN.

SWEDEN

A rough estimate on the pressure variations from northern Sweden to the south:

Summer average 10-15 hPa (variation 5-30 hPa)
Winter average approximately 20 hPa (variation 10-40 hPa, in extreme cases 60 hPa)

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APPENDIX D

Common transition altitude

	Advantages		**Disadvantages**
1	ICAO recommended	1	Implementation of change for some ANS providers
2	IFALPA Recommended	2	Training and adjustment period
3	IFATCA Recommended	3	Temporary loss of ATCO comfort zone and familiarity
4	IAOPA Recommended	4	Possible resources implications for implementation
5	Flight deck study recommended	5	May require some State regulatory amendments
6	ATC perspective study recommended	6	Operations changes and publication amendments required to implement changes
7	Common procedures reduce potential for error		
8	Facilitates common approach design		
9	More compatible w/ RNAV/BARONAV procedures		
10	Simplifies ATCO adjustment and training to various airspace/sectors		
11	Facilitates national and international working arrangements		
12	Proven record of safe application in other regions of over 50 yrs		
13	Facilitates integration of VFR/IFR altimeter setting procedures		
14	Facilitates integration with future changes in airspace structure and classification		
15	Reduced safety risk over aerodrome based TAs		
16	Eliminates the need for ATC to provide TL information		
17	Overall improvement to flight safety		
18	Compatible with the EUROCONTROL Agency ANS Safety Policy		
19	Eliminates en-route altimeter conundrum		

Low transition altitude (5 000 ft)

	Advantages		Disadvantages
1	Already exists in some jurisdictions or locations	1	Only adequate for terrain clearance where obstacles are relatively low
2	No change in procedures for some providers	2	Not best compatibility w/ SID/STAR design
3	Familiarity for some providers and minor adjustment for others	3	Loss of valuable airspace in TMA
4	No terrain clearance safety issue for States w/ lower elevations.	4	Not ideal for flight operations procedures
		5	Not easily compatible w/ changes in airspace structure or classification
		6	Mix of altitude and flight level references in TMA airspace
		7	Current VFR/IFR integration problems
		8	Exceptions to regional agreements
		9	Requires application altimeter correction factors for determination of obstacle clearance at some locations
		10	Flight deck workload too high
		11	Potential en-route altimeter setting problem

Medium transition altitude (10 000 ft)

	Advantages		Disadvantages
1	Compatible with most SID/STAR and noise procedures	1	All contras involved w/ changes to TA
2	More preferable for flight operations	2	Not high enough for MFA for ECAC wide terrain clearance
3	Acceptable to IFALPA et al	3	Some TMA caps are above this altitude
4	Minimises terrain clearance issue in most States	4	Transfer of some workload for most ANS providers
5	Reduces altitude/FL reference mix	5	Exceptions needed to regional agreement
6	More compatible for VFR/IFR integration		
7	Facilitates airspace structure changes more easily than lower TA		
8	No loss of usable airspace in lower TMAs due to TL changes		
9	Constant radar vectoring parameters		
10	Above many TMA caps		
11	No application of altimeter corrections in most areas		
12	Existing SOPs at 10000 ft		
13	Elimination of the 10000/11000 ft misinterpretation		
14	Reduced en-route altimeter setting problem		

High transition altitude (18 000 ft)

	Advantages		Disadvantages
1	More adaptable to airspace structure changes	1	More aircraft need QNH
2	Eliminates terrain clearance correction issue in all but one State	2	Additional workload for ACCs
3	Facilitates future SID/STAR, RNAV/BARONAV profile design more readily	3	All change related issues
4	Adaptable as common TA for most of ECAC	4	Potential complexity with airspace divisions at FL195 and FL245
5	Acceptable for flight operations		
6	Acceptable to IFALPA et al		
7	Most facilitates regional agreement		
8	No mix of altitude/FL references		
9	No application of altimeter corrections for terrain clearance		
10	Acceptable flight deck workload		
11	Loss of altitude awareness reduced		
12	Eliminates en-route altimeter setting question		

APPENDIX E

TA CHANGE CHECKLIST

Airspace design

1 – Decide TA concept to be adopted
- Airspace
- TMA or
- other

2 – Division levels – approach/en-route
- Vertical limits of TMA/CTA/CTR change if/as applicable

3 – SID/STAR design changes
- SID upper limit and intermediate steps
- Minimum altitudes/FLs
- Noise abatement procedures

4 – En-route, terminal and approach holding areas
- Revise as required

5 – Sectorisation
- Adjust sector boundaries/altitudes if/as applicable

6 – Coordination points & levels
- Adjust coordination fixes as applicable w/ new sectorisation

7 – Transfer of control points & levels
- Adjust as required

8 – ICAO SARPs compliance
- Ensure all redesign is ICAO compliant
- Regional application as appropriate

Procedures

1 – Selection of QNH sources
- Determine appropriate QNH sources
- Confirm availability of data

2 – Access & display of QHN data
- How will data be presented where needed?
- Controller access to data

3 – Communications & Coordination
- Delivery communications and frequency
- Coordination of QNH data as determined
- Contingency procedures

4 – LOA – inter & intra unit
- Cross border and delegated airspace
- Military operations and segregated airspace
- Review and amend as required

5 – Design, development & validation of new procedures

6 – FIS
- Review flight information services requirements

7 – Equipment/software changes

8 – Check for ICAO compliance

9 – Publication of new or amended procedures

10 – Distribution

11 – Monitoring and review process

Safety assessment

1 – Determine requirement
- Determine which elements of change require safety assessment

2 – Process
- ESARR & ICAO
- Apply State/agency mandated process
- Assess results and mitigate as required

3 – Documentation
- Compile and retain safety assessment documentation

Equipment

1 – Met inputs for QNH
- Hardware/software changes as required to retrieve selected QNH sources

2 – QNH display system
- System changes for display of data as determined

3 – RDPS changes
- Modify hardware/software as required for new altitude/FL division

4 – FDPS changes
- Modify as/if required

5 – Display settings or modifications

- Adjust or modify surveillance situation displays as required

6 – Communications systems changes
- Adjust/modify as new procedures dictate
- ATIS

7 – Document changes

8 – Incorporate changes in the new ATC procedures

Regulatory

1 – Air regulations changes
- Consult w/ State regulator re changes

2 – AIP
- Coordinate content and timing of changes as required

Publications

1 – AIC
- Select AIRAC implementation date
- Issue AIC giving notice of change(s)

2 – NOTAM
- Issue NOTAM(s) as appropriate

3 – Charts
- Coordinate required changes with appropriate authorities/agencies

Training

1 – Training needs analysis

2 – Design & validation

3 – Scheduling

4 – Delivery

5 – Documentation

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APPENDIX F

Summary of response questions 1 and 2

State	Organisation	Question 1: A common transition altitude can be implemented in different ways such as: one common area wide transition altitude covering all airspace; one common transition altitude covering all controlled airspace; or one common transition altitude in all TMAs. Which would be your preference?
Estonia	ANSP	A common area wide transition altitude covering all airspace in participating countries
Finland	All organisations	A common area wide transition altitude covering all airspace in participating countries
Norway	Avinor, ENSO, SAS, WIF, Norwegian, LTR, NLF, NFF, NF	A common area wide transition altitude covering all airspace in participating countries
	MIL	A common transition altitude established in all TMAs of participating countries
Sweden	LFV, MIL	A common transition altitude established in all TMAs of participating countries
		Question 2: If a common transition altitude was agreed by participating countries, what would be your preferred altitude?
Estonia	ANSP	10 000 ft
Finland	Finavia, MIL	5 000 ft
	Finnair, Finncomm, FATCA	10 000 ft
	Finnish Aeronautical Association	18 000 ft
Norway	ENSO, Norwegian, NF	10 000 ft
	Avinor, SAS WIF, LTR, NLF, NFF, NF, MIL	18 000 ft
	MIL	10 000/18 000 ft
Sweden	LFV	10 000 ft
	MIL	No change

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DETAILED RESPONSES TO THE QUESTIONNAIRE – ESTONIA

Question 1

A common transition altitude can be implemented in different ways such as: one common area wide transition altitude covering all airspace; one common transition altitude covering all controlled airspace; or one common transition altitude in all TMAs. Which would be your preference?

a) **A common area wide transition altitude covering all airspace in participating countries**; or
b) A common transition altitude in all controlled airspace in participating countries; or
c) A common transition altitude established in all TMAs of participating countries.

Question 2

If a common transition altitude was agreed by participating countries, what would be your preferred altitude?

a) **10 000 ft;**
b) 18 000 ft;
c) 10 000 ft with selected TMAs at 18 000 ft.

Question 3 a)

If a common **area wide** transition altitude covering **all airspace** in participating countries was agreed, what would be the impact as regards:

a) equipment; **-minor**

b) procedures; **- some additional rules have to be implemented to the rules of the air as the lower limit of controlled airspace in Estonia is FL95. For example, aircraft flying on FL100 will be at the same altitude with an aircraft flying on 9500 feet, if QNH is 994 or lower.**

c) training of staff **– mostly pilot training, some training to ATS.**

Question 3 b)

If a common transition altitude covering **all controlled airspace** in participating countries was agreed, what would be the impact as regards:

a) equipment; **- <u>minor</u>**

b) procedures; - **<u>same as TMAs, as the lower limit of controlled airspace in Estonia is FL95.</u>**

c) training of staff **- <u>mostly ATS, some pilot training.</u>**

<u>Question 3 c)</u>

If a common transition altitude covering **all TMAs** in participating countries was agreed, what would be the impact as regards:

a) equipment; **- <u>minor</u>**

b) procedures; - **<u>some changes in procedures and other local instructions/ agreements</u>**

c) training of staff- **<u>mostly ATS, some pilot training</u>**.

<u>Question 4</u>

In terms of cost, please indicate the amount of work and preparations (including equipment, procedures and training) that would be required to implement a common transition altitude?

a) area wide transition altitude covering all airspace; **- <u>that would be the cheapest one and the expenses would not be huge. And this would be preferable for Estonia.</u>**
b) all controlled airspace; and
c) all TMAs.

<u>Question 5</u>

What would be the estimated timeframe required for you to implement a common, higher transition altitude? – **<u>In all cases 6 months till 1 year</u>**

a) 10 000 ft; **-**
b) 18 000 ft;
c) 10 000 ft with selected TMAs at 18 000 ft.

<u>Question 6 (for ANSPs only)</u>

Please indicate the number of flights that take place in your area of responsibility on an average day: **<u>in percentage way looking then about 90% of flights are flying over</u>**

10000 ft, about 5% are flying between those levels and rest are flying below the 10000 feet.

a) below 10 000 ft; and
b) below 18 000 ft.

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ATTACHMENT 2

DETAILED RESPONSES TO THE QUESTIONNAIRE – FINLAND

Note.– The comments below are unofficial translations of the responses received.

Blue 1

Preferred TA: 10 000 ft

Comment: It is our view that the transition altitude should be raised to 10000ft and it should harmonised in the whole Scandinavia, Area wide common TA.

Question 1: Common area wide transition altitude covering all airspace in participating countries

Question 2: 10 000 ft

Question 3: What we need to do to implement these changes is connected to some procedures, pilot training and FMS-databases.

Question 5: Approximately three months from AIRAC publishing.

FATCA

Preferred TA: 10 000 ft

Comment: If the harmonisation takes place the best alternative in our point of view is one common transition altitude (10 000ft) in the whole area.

FINAVIA

Preferred TA: 5 000 ft

Comment: Not enough grounds for change to 10000' or 18000' TA. No requests have been received from operators in Finland to change TA. Finavia refers to "The Common Transition Altitude Initial Real Time Simulation (Riga, Latvia. March 2003) where the results show 20% raise in work load and comment that this study supports their view on keeping the present TA (5000'). A higher TA brings the need to define area QNH and changing from area QNH to local QNH during the flight reduces the benefits of proposed higher TA in comparison to present TA (5000'). Finavia finds it important that practices regarding the change of transition altitude and decisions regarding it would be dealt with as a part of the on going NEFAB-project.

Question 1: A common area wide transition altitude covering all airspace in participating countries.

Question 2: Not enough grounds to change present TA but considering the given options a) "10 000 ft" has the most natural "reminders" and is in accordance with present cockpit procedures.

Question 3: In all cases (a-c): a) equipment -significant. b) procedures -significant. c) training –significant.

Question 4: No assessment has been conducted.

Question 5: Estimated timeframe required at least 3,5 years.

Question 6: 19.1.-23.1. 2009 a) RFL < FL 100: 38 flights (total 831) in a day, 4,57% b) RFL < FL 180: 107 flights (total 831) in a day, 12,84%.

FINNAIR

Preferred TA: 10 000 ft

Timeframe required for implementation: Nil

Comments: In Finnair one third of all level busts are caused by similar lapses as the one that happened in Norway (SL No 2007/11T). The lower the TA is the more likely a loss of separation is due to higher density of traffic. Due to this reason we are in favour of raising the TA to 10 000ft. We also ask you to take into consideration the following: As 10 000ft TA is significantly different from the present TA's in Europe, Eurocontrol or EASA should promote a higher TA more widely in Europe. All TMAs should have the same TA as the rest or the airspace, variations cause confusion. At 10000ft several operations are made in the cockpit so changing the altimeter setting would fit in well from CRM (Crew Resource Management) point of view without a significant raise in workload. It would also lower the work load at lower altitudes which is good from the safety point of view.

Question 1: A common area wide transition altitude covering all airspace in participating countries" Rationale: A variety of different transition altitudes and altimeter pressure settings today cause at least one third of all level bust according to our own statistics. We wish not to increase the number of level busts due de-harmonisation. Non-harmonised transition altitude within one state (controlled airspace, TMAs, AFIS etc) increase risk more than present status.

Question 2: 10000 ft" Rationale: At 10000 ft also other cockpit actions or activities take place in our fleet. Changing altimeter setting suits well, in CRM-(Crew Resource Management) aspect, the standard operating procedures (SOPs). The workload increase at higher levels relieves resources to be used at lower, more critical, altitudes. 18000ft has no relevant actions, therefore memory cannot be tied to any other activity.

Question 3: a) Equipment; FMS Databases need to be changed, but that is taken care of in normal updates.
b) Procedures; Some SOP-changes might be needed.
c) Training of staff; In addition to annual recurrent training a separate leaflet need to be distributed.

FINNCOMM AIRLINES

Preferred TA: 10 000 ft

Comments: It is our view that the transition altitude should be raised to 10000ft and it should be harmonised in the whole Scandinavia, Area wide common TA.

Finnish Aeronautical Association

Question 1: A common transition altitude in all controlled airspace in participating countries

Question 2: 18 000 ft

Question 3: a) No impact

b) Easier and more safe

c) Easier. 3b and c. These alternatives would be more complicated to train and understand.

Question 4: No costs

Question 5: No timeframe

Finnish Military Authority

Preferred TA: 5 000 ft

Comment: The Finnish military authority does not see the harmonisation of TA to 10000-18000 ft as an operation which would benefit flight safety in Finland with the current airspace structure.

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ATTACHMENT 3

DETAILED RESPONSES TO THE QUESTIONNAIRE – NORWAY

ENSO

Question 1: A common area wide transition altitude covering all airspace in participating countries.

Question 2: 10 000 ft.

Question 3: Procedures, training of staff

Question 4: No relevance to our ATC unit.

Question 5: 10 000 ft

Question 6: Below 10 000 ft = 10. Below 18 000 ft = 0

NORWEGIAN

Comment: For Norwegian 10 000 ft is already tied to a number of procedures for our B-737 operation, such that we see a common transition altitude of 10 000 ft as a simplification of the procedures of today. The administrative work would generally consist of a revision of the Operations Manual, which can take place reasonably quickly. For Route Manuals there is a certain delay in the system in that it some time will pass from the time the provider of the Route Manual receives notification about an amendment through the AIRAC system until the revision is completed..

Question 1: A common area wide transition altitude covering all airspace in participating countries.

Question 2: !0 000 ft

Question 3a): Will simplify procedures

Question 3b): May slightly complicate procedures compared to 3 a

Question 3c): May slightly complicate procedures compared to 3 a

Question 4: Revisions of Route Manuals and Operations Manual will be required.

Question 5: Approx three months from AIRAC publishing

WIDERØE

Comment: The Company has for many years requested a harmonisation and increasing of the transition altitude, i.a. in our letter 20/10-1995 and later. The company is familiar with activities in the EUROCONTROL Airspace and Navigation Team and the Stakeholder Consultation Group, and their preliminary conclusions. It is therefore positive that now a regional initiative is taken. However, it is important that this safety promoting initiative is not delayed as a result of coordination with neighbouring States if this would prove to be difficult. The responses by Widerøe are as follows:

Question 1: The only viable solution is a common area wide transition altitude covering all airspace in participating countries. A solution covering only controlled airspace or only the TMAs will not serve the purpose, but instead introduce a variety of new challenges.

Question 2: 18 000 ft - some minimum flight altitudes in Norway are above 10 000ft.

Question 3a): For Widerøe there will be no equipment costs, as no new equipment will be required Procedural changes and crew training will carry only negligible costs; airspace is already a theme in the Company's recurrent ground/refresher training and operator proficiency check training.

Question 4: Costs will already be carried as part of recurrent training programmes.

Question 5: Lead time six months.

NLF (Norges Luftsportforbund)

Question 1: A common area wide transition altitude covering all airspace in participating countries.

Question 2: 18 000 ft

Question 3: General comments: Mainly all GA and air sports activities are conducted below 10 000 ft, however for parachute jumping and glider flying the following will apply:

a) Necessary for the pilot to calculate actual flight level above 10 000 ft when the parachute jumpers have requested drop from above 10 000 ft. The glider pilot needs to adjust altimeter when passing 10 000 ft which is regarded as minor impact.

b) Minor impact since there are seldom activities above this altitude.

c) As for alternative a), but additionally the pilot must make altimeter adjustments when entering and leaving TMA, also necessary to have awareness concerning TMA-locations which will increase work load.

Question 4: Minor cost and work impact regardless of alternative.

Question 5: We estimate that we need. three months to be sure that GA-pilots and air sports performers are properly informed about which transition altitude solution is chosen.

AVINOR

Comment: With reference to your letter of November 25th 2008, below you will find Avinors answers to the questionnaire. All Norwegian ATC units have been invited to contribute, and their comments have been taken into consideration. There are some discrepancies in opinions between the different ATC units. Avinor has chosen, to some degree, to emphasise the ACCs' opinion, because a higher transition altitude will have a greater impact on ACC operations, compared to TMA operations.

Question 1: Avinor considers it to be a safety benefit if all aircraft uses the same procedure for altimeter settings, regardless of airspace classifications. Alternative A will make the procedures similar in all airspace. With a lower transition altitude in some parts of the airspace, you might have situations with aircrafts in close proximity to each other having very different altimeter settings, and potentially risky situations when these aircrafts are entering an airspace with a different transition altitude. See also comments to questions 3a, 3b and 3c.

Question 2: Avinor would prefer alternative B – a common transition altitude at 18 000 ft. Oslo ASAP (planned implementation April 7th 2011) is planning closely spaced sequencing to ENGM (vertically separated) at 10 000, 11 000 and 12 000 ft. For safety reasons it is imperative that all aircraft are on the same altimeter setting in this area. A transition altitude of 10 000 ft, combined with a QNH below 1014, will in addition lead to the "loss" of one or more usable altitudes/levels for sequencing.

Also, in order to facilitate continuous descent approaches, it is beneficial that aircraft are on the same altimeter setting to manage their vertical profile. If a continuous descent approach is started on an altimeter setting of 1013.2 hPa (FL), a transition to a local high QNH might lead to challenges to meet published and required altitude and/or speed restrictions.

Vertical separation between arriving and departing traffic to/from ENGM will take place in the 10 000 ft layer. Therefore a transition altitude of 10 000 ft is not a good solution from an operational perspective, and might lead to hazardous situations.

Another advantage with raising the transition altitude to 18 000 ft is that the lowest usable flight level above 18 000 ft will provide terrain separation throughout Norway.

Some tower/approach units have expressed a wish for alternative A – 10 000 ft. They have expressed concern with the issue of en-route QNH for flights cruising between 10 000 and 18 000 ft. However, Avinor expects this issue to be solved within the working group.

Also, a transition altitude at 18 000 ft will raise the transition layer above congested TMA airspace (and in many cases above the entire TMA) to altitudes where aircraft and ATC normally have more airspace available to them. Subsequently, alternative B will lessen rather than raise the workload of the approach controller. Alternative B is also preferred by the ACCs.

(A suggestion has also been made to raise the upper level of all TMAs to 18 000 ft, if this is chosen as the transition altitude.)

Question 3a): a) Equipment – As of today the altitude/flight level information on a flight is displayed with three characters on the radar data display.

Examples: 4 000 ft is displayed as A40
14 000 ft is displayed as *40
FL 140 is displayed as 140

If a transition altitude of 10 000 ft or more is to be implemented, an update of the equipment is needed, to display four characters in stead of three, to avoid possible confusion between “A” and “*” above.

Examples: 4 000 ft displayed as A040
14 000 ft displayed as A140
FL 140 displayed as F140

This change is also required for questions 3b part a and 3c part a.

b) Procedures – If this alternative is chosen, it would make procedures similar in all airspace, and aircrafts in the vicinity of each other will be on the same altimeter setting. Procedures will have to be established regarding “QNH-areas” as well as transition between “QNH-areas”. If 18 000 ft is chosen as transition altitude, it will often be the task of the ACC controller to issue the aerodrome QNH to the aircraft during descend. There will be a need to review existing procedures and equipment to establish that the adjacent ACC unit at any time has the local QNH for the aerodrome concerned.

Compared to today ACC controllers might “loose” some levels, where as approach controllers might “gain” some. Some of the workload (regarding issuing of QNH to descending and en-route flights) will be shifted from the approach controller to the ACC controller.

Procedures regarding the transition layer (climb/descend through transition altitude/layer/level) are already established and should be familiar. However, if 18 000 ft is chosen, one might need to review the phraseology regarding numbers. For example “Descend to 15 000 ft (one-five thousand feet)” could be mistaken to be “Descend to 5 000 ft (five thousand feet)”.

Comments above also apply to questions 3b part b and 3c part b.

c) Training of staff – Training will need to be done to cover items above (question 3a part b) regarding “QNH areas”, ACC issuing aerodrome QNH to aircraft descending inbound an aerodrome and possibly new phraseology.

An initial estimation of required training is up to one day of combined theoretical/classroom education and practical (simulator) training per air traffic controller. (More extensive training will be needed for ACC controllers compared to approach controllers for this alternative.) The preparation for the practical training will have to be done locally, where as the theoretical training can be based on an information package provided by Avinors main office.

If the information package is received more than one year prior to the implementation date, this training can be carried out as part of the annual PFO (periodical refresher training for air traffic controllers). This will be the most cost effective.

Comments above also apply to questions 3b part c and 3c part c.

Question 3b): a) Equipment – See question 3a part a.
The possibility to have different transition altitudes and QNH in different airspaces already exists.

b) Procedures – See question 3a part b.

In addition there will be different procedures depending on the type of airspace, and procedures will have to be established for transition flights between areas with different transition altitudes, as well as for handling traffic operating close to or frequently crossing the boarder between these areas. These procedures might vary depending on airspace layout, hampering the harmonisation.

c) Training of staff – See question 3a part c.

In addition training will have to be done to cover items above (question 3b part b) regarding different procedures depending on type of airspace and transition flights. This might require up to an extra half a day per air traffic controller, including approach controllers.

Question 3c): a) Equipment – See question 3a part a.

The possibility to have different transition altitudes and QNHs in different airspaces already exists.

b) Procedures – See question 3a part b.
In addition there will be different procedures depending on the type of airspace, and procedures will have to be established for transition between areas with different transition altitudes, as well as for handling traffic operating close to or frequently crossing the boarder between these areas. These procedures might vary depending on airspace layout, hampering the harmonisation.

The current upper levels of TMAs in Norway FIR vary between FL95 and FL195. Any of the suggested alternatives implies that in some cases the transition altitude will be placed in the ACC sector and not the TMA. Consequently, if this option (a common transition altitude covering all TMAs) is chosen, you will have several ACC sectors with two different transition altitudes within the same sector. (One in connection to the TMA and one for the rest of the sector.) One will experience situations where aircraft closer than the minimum longitudinal separation operate with significantly different QNH settings, while they are both in controlled airspace. This should by all means be avoided.

Alternatively, the transition altitude will have to be coherent with the upper TMA boundary, resulting in non-harmonised transition altitudes.

c) Training of staff – See question 3a part c.

In addition training will have to be done to cover items above (question 3c part b) regarding different procedures depending on type of airspace and transition flights. Also, extensive training will need to be done if ACC sectors end up with two different transition altitudes within one sector.

Question 4: a) Area wide transition altitude covering all airspace – a rough estimation of costs:

Equipment:	Approx. 250 000 NOK
AIP amendment:	Approx 200 000 NOK
ATM procedures:	Approx 100 000 NOK
Training: Approx.	1,75 mill NOK
Total:	Approx: 2,3 mill NOK

b) All controlled airspace – This alternative will require more complex procedures and extra training. The total cost will be increased to approx 3,2 mill NOK.

c) All TMAs – This alternative implies substantial risk, requires extensive training and significantly higher costs, and should be avoided.

Question 5: The estimated timeframe required for Avinor to implement a common, higher transition altitude will be the same regardless of the alternative chosen.

In order to provide a smooth and cost efficient transition into the new airspace structure, a common, higher transition altitude should be implemented through the annual PFO. Including time for the preparation of training material, Avinor would need approximately 14 months for implementation. This is provided all necessary risk assessments/safety cases etc have been made beforehand. An earlier implementation will be possible, but not as cost effective, and for publication in the AIP Norway etc we need at least 6-9 months prior notice.

An ideal date for implementation is April 7th 2011, the planned implementation date for Oslo ASAP. During 2010 Oslo ATCC is heavily involved in training activities in preparation for Oslo ASAP. It is a good solution to incorporate the training for a common transition altitude into this training. An implementation during 2010 will be difficult, and may cause delay in other ongoing activities and projects.

Question 6: The number of flights that take place in Norway FIR on an average day is:

a) Below 10 000 ft approximately 520 (325 IFR flights and 195 VFR flights)

b) Below 18 000 ft approximately 830 (635 IFR flights and 195 VFR flights).

The estimation for the IFR flights is based on calculations from Friday July 4th and Friday November 7th 2008, and includes all flights that took place in Norway FIR only below 10 000 ft and 18 000 ft respectively, but which might have climbed to a higher level once leaving Norway FIR.

The VFR flights estimation is based on the number of VFR flights on the same two dates, and on the assumption that practically all VFR flights are conducted below 10 000 ft.

Question 7: This question has been an issue at the North Sea Operations Meeting (Nordsjømøtet) as ISSUE-7/95, -18/96, -2/97, -12/98, -01/99 and -16/00. The last time this question was discussed at the meeting (Meeting 2/2000) the conclusion was according to the description below.

The low level traffic offshore are operating in international airspace. All nations with FIRs bordering the North Sea and the Norwegian Ocean (EHAA, EDWW, EKCH, ENSV, EGPX, EGPD, EGLL, BIRD, ENOB, ENBD) are operating according to ICAO DOC 007 ”Guidance material on helicopter operations over the high seas", and using the common Transition Altitude of 3000FT:

> **4. Altimeter settings**
>
> 4.1 To ensure the safe operation of helicopters over the high seas, it is essential that the altitude information used on board *all* aircraft be based on the same altimeter setting.
>
> 4.2 States should establish, by regional agreement, a common transition altitude for application throughout an area of operation. If this should prove to be impractical, States should require all aircraft flying IFR as well as VFR at/or below 900 m (3 000 ft) MSL, to use an altimeter setting based on applicable QNH.
>
> 4.3 Arrangements should be made to establish specific altimeter setting areas to ensure that pressure values related to the area of operation, e.g. regional QNH, can be made available to flights operating over the high seas. The applicable QNH must be communicated to pilots flying within the areas concerned and should be set on the aircraft altimeter at/and below the Transition Altitude.

Stavanger ATCC (Sector Offshore) has common FIR/AoR borders with a length of 500NM with EKCH and EGPD (EGPX) along the Median Line from 63°N til 56°N. Offshore helicopter traffic crossing the Median Line, or doing radar-approaches (ARAs) closer than 10NM to the common borders are coordinated to avoid conflicting Missed Approaches. Some military traffic, GA-traffic or turboprop airliners are crossing the North Sea en-route at lower levels, crossing common borders offshore. All traffic is operating according to the same altimeter setting procedures.

In 1995 the Transition Altitude was raised to 7000FT within the TMAs along the Norwegian coast. The converting of Flight Level to QNH-altitude of offshore traffic entering the TMAs at FL40 or above (below the TMA Transition Altitude) was raised as a safety issue, but has been handled by the ATCCs since then by converting the level/altitude before entering the TMAs. It is much safer to handle this converting procedure along short domestic TMA borders than along the international Median Line border.

Other traffic operating offshore (military, Coast Guard, pollution control) over vast areas has to have similar altimeter setting procedures all over the North Sea Basin. Offshore helicopters are operating within more limited areas which require fewer changes of altimeter setting, and are changing altimeter setting according to Altimeter Setting Areas described in the nations AIPs. The Norwegian continental shelf is divided into 8 Altimeter Setting Areas and 2 Altimeter Setting Regions.

Several areas of offshore airspace have delegated ATS. A big portion of airspace above the southern part of Norwegian continental shelf has ATS delegated from Scottish ACC (Aberdeen Offshore) to Stavanger ATCC, and below the western part of Stavanger AoR has ATS delegated from Stavanger ATCC to Scottish ACC (Aberdeen Offshore) from MSL to FL085. This will be a safety issue if these ATS-units have different altimeter setting procedures.

Avinor/Stavanger ATCC and NATS/Aberdeen Offshore have been planning for some years to rise the upper limit of offshore airspace from FL085 to FL105 due to the new generation of helicopters operating offshore are using higher levels. UK CAA and Norwegian CAA have given the acceptance to the process. Another safety issue: TL and the lower limit of Sector North will be the same if TA is 10000FT in the offshore airspace.

For the offshore helicopter operations the raising of Transition Altitude would be a benefit because all lower altitudes would be accessible at all time regardless of the QNH-setting. But this will be a safety issue if not all nations with FIRs bordering the North Sea and the Norwegian Ocean are changing the procedures at the same time. Today the majority of these nations may have the same problems with conversion of levels towards TMAs along the coasts for their offshore traffic, and may share the same interest to raise the Transition Altitude above the continental shelf, but this should be done all over the North Sea Basin at the same time.

NFF (Norsk Flygelederforening)

Comment: NATCA supports a common area wide transition altitude covering all the airspace (**Q1 – a)**) and a transition altitude of 18 000 feet (**Q2 – b)**). It is difficult for us to comment on the other questions (cost, timeframe, equipment, training of staff etc), however, we would like to mention the importance of a good process when it comes to implementation.

It is important that procedures are common throughout all the airspace. With different procedures in controlled/uncontrolled airspace or different TMAs it could result in misunderstandings which could have a negative impact on safety. With a transition altitude of 18 000 feet (among other things), the transition level will always be above the highest terrain, it will move cockpit workload to a less busy time during climb/descend, it will reduce APP-controller workload, it will not have a negative effect on the procedures planned in Oslo TMA and it is easier for aircraft without a pressurized cabin.

The current procedures states that helicopters over the high seas shall use a transition altitude of 3000 feet. In NATCA's opinion this airspace should have the same status as the airspace over land, and common procedures should be implemented throughout all the North Sea States. ICAO doc 007 "Guidance material on helicopter operations over the high seas" should also be changed. Though, if 18 000 feet is chosen it should be considered changing the lower level of Norway CTA outside the

Norwegian west coast (Flight level 195) to avoid problems with the transition layer.

Regarding the determination of the transition level there are different procedures today. In Norway the transition layer is at least 1 000 feet, while in Sweden the transition level is the first available flight level above the transition altitude. We have good experience with a transition layer of at least 1000 feet, which means that the transition altitude and –level always are separated. However, the primary goal must be to harmonize.

NF (Norsk Flygerforbund)

Norsk Flygerforbund (NF) and International Federation of Airline Pilots' Associations (IFALPA) have, for years, been working for a harmonized and raised Transition Altitude in Europe. We are therefore pleased to see the effort taken by the Norwegian CAA, and would like to express support for the initiative.

With reference to Your letter of November 25th 2008, NF answers as follows:

Question 1: NF supports a common area wide transition altitude covering all airspace in participating countries.

Question 2: NF prefers a common Transition Altitude of 10 000 ft.

Questions 3a), b), c), 4 and 5): Minimal, NF's members fly all over the world, using different systems of Transition Altitudes.

All relevant maps and charts will have to be changed, but this is done on a regular basis anyway, and should not cause any difficulties.

Amended comments from NF

NF is member of ECA (European Cockpit Association) and IFALPA (International Federation of Airline Pilots' Associations). These organizations prepare policies and directives which the member associations in the respective countries are committed to work for, unless they have reported reservation/derogations.
Higher, and the establishment of, a common Transition Altitude was discussed on IFALPA ATS Committee Meeting in 2009. The Committee both wanted higher, and if possible, a world-wide common TA. The principle is to set the TA as high so it provides safe altitude above all terrain. This can be difficult in some areas of the world, but a value of 18 000 ft will cover most areas. The discussions ended in a policy of 10 000 ft, and this will most probably be agreed on the annual conference in 2009, and replace the former policy stating "10 000 ft or 20 000 ft".
It should be emphasized that 10 000 ft was a compromise. The objective was to limit the options, together with the consideration of choosing 10 000 ft would contribute to acceptance from more states.

After observing the Oslo ASAP Real Time Simulation in EUROCONTROL Bretigny, and based on discussions regarding the problems with a 10 000 ft TA, there is need for an amended comment on the origin reply from NF in this matter, which stated 10 000 ft.

- It is obvious that a 10 000 ft TA will, clearly, create enormous challenges on the ASAP-concept.
Therefore it is need to emphasize that NF has no problem with a 18 000 ft TA. If the choice is between today's system and a 18 000 ft TA, the latter is clearly preferable.

SAS Norway

SAS Norway reply to the questionnaire:

This is a most welcome initiative to standardize into a common Transition Altitude (TA). Our comments below are directly attached to the questions relevant to our answers. It should be noted that since SAS is devoted to early introduction of Continuous Climb and Descent, a high TA is preferred.

Question 1: A common area wide transition altitude covering all airspace in participating countries.

Question 2: 18000ft

Question 3a) a) None

b and c)

- A common TA should be developed for the whole region based on experience in other areas, such as the US and Canada, with the potential to become a more globally used TA.
- Benefits:
  - Avoid misunderstanding as the whole area would be under one rule
  - Reduce risk associated with level bursts at low altitudes
  - Reduce risk associated with terrain separation as 18 000ft is above most terrain in the region
  - Provide unambiguous altitude resolution for CDA approaches at an early stage and at a higher altitude, avoiding that "all happens" at FL100

It should be noted that most European airlines perform "after takeoff checklist" at today's TA. A new routine has to be developed when the TA is set higher, but the advantage of a common TA by far outweighs this minor problem.

Question 4: a, b, c) minimal cost adjusting documentation and training as long as training is performed at normal training cycles.

Question 5: a, b and c) same time consumption. The company normally publish revised operational documentation twice a year. If within these limits, no extra time or cost involved.

<u>Norwegian Military</u> (Forsvarsstaben)

Common transition altitude – contribution from airspace user

Background

Forsvarsdepartementet (FD) has received a letter of 25 November 2008 with information about project "Common transition altitude". After reorganisation of the defence command from 1 January 2009 the Forsvarsstaben has taken over the responsibility to handle this issue. Forsvarsstaben (FST) will with this give a general response to the questions put by the project in the attachment to the above mentioned letter. The response is coordinated with the Luftforsvarsstaben.

Discussion

FST supports the proposal to implement a common transition altitude which covers all controlled airspace within the participating countries. Without having any substantial arguments in favour of the transition altitude to be 10 000 ft rather than 18 000 ft, FST recommends a transition altitude of 10 000 ft. This altitude correlates the best with established cockpit routines in parts of the air defence operational milieu and this altitude will be well adapted to the terrain around Norwegian airports. FST considers it to be useful to reach an international agreement on a common transition altitude, especially within the area of our NATO allies. Implementation of a common transition altitude may achieve a positive effect on flight safety in general.

FST has not calculated any costs for implementation of common transition altitudes. The change entails that publications and approach procedures must be amended. These changes will mainly be possible to implement within the established routines that are accomplished regularly to catch changes in flight operational regulations and routines. But since this is a relatively large change which will bring a revision of many publications simultaneously, one must count on some additional work – within a limited time – for the work with the revisions. Most publications concern procedures outside of the Defence and therefore, the workload for the Defence should be handled within already established budgets.

As regards the question as to how long time the Defence will require to implement a common transition altitude, the general response will be that we can implement this as quickly as the civil users/authority. The defence has, in other words, no particular needs or restrictions which would put the brakes on the implementation of a common transition altitude. A period of 6 – 12 months should give a good indication of the time needed for such an implementation in the Defence. Considering the costs and time required, the FST can not see that there would be any difference if the transition altitude was set at 10 000 ft or 18 000 ft.

Conclusion

FST supports the proposal to introduce a common transition altitude which covers all controlled airspace within the participating countries. FST recommends that the transition altitude is set at 10 000 ft but has no substantial arguments against selecting 18 000 ft. It is seen as important that an international consensus is reached on a common transition altitude, especially within the area of our NATO allies. The Defence has no special need or restrictions which would put the brakes on the implementation of a common transition altitude.

LTR (Lufttransport)

Question 1: A common area wide transition altitude covering all airspace in participating countries – **This is according to Lufttransport, the best solution.**

A common transition altitude in all controlled airspace in participating countries – **The risk will be greatly increased if using partial transition altitude for only part of the international air space.**

A common transition altitude established in all TMAs of participating countries – **Not recommended.**

Question 2: 18 000 ft **is according to Lufttransport, recommended new transition altitude.**

Question 3a):
- a) equipment – No new equipment is needed in our fleet
- b) procedures – Only minor change to our EU OPS 1 documentation.
- c) training of staff – All operational crew will receive the new documentation, both as a revision to the OM Part A and as general information to pilots, “Info to”.

Question 3b):
- a) equipment – No new equipment is needed in our fleet.
- b) procedures – Only minor change to our EU OPS 1 documentation.
- c) training of staff – All operational crew will receive the new documentation, both as a revision to the OM Part A and as general information to pilots, “Info to”.

Question 3c):
- a) equipment – No new equipment is needed in our fleet.
- b) procedures – Only minor change to our EU OPS 1 documentation.

c) training of staff – All operational crew will receive the new documentation, both as a revision to the OM Part A and as general information to pilots, “Info to”.

Question 4: None of the alternatives will create extra work beyond normal procedural changes of existing manuals.

Question 5: For all of the alternates estimated 2 months.

ATTACHMENT 4

DETAILED RESPONSES TO THE QUESTIONNAIRE – SWEDEN

LFV

Question 1: According to PANS-OPS, Part VI, Chapter 1, paragraph 1.1.2.1.3 TA shall be as low as possible, normally not less than 3000 ft.
If we need to change we prefer alternative c) – A common transition altitude established in all TMAs of participating countries.

Question 2: If we need to change we prefer alternative a) – 10 000 ft. The consequences for airspace design and operational procedures will increase with higher TA. A higher TA influences a greater volume of airspace.

Question 3a): a) equipment – Area QNH. Swedish system E2kE (COOPANS) is making all vertical data calculations based on ISA, standard setting. The radar data processing system requires modifications for information from a number of selected QNH sources. Flight data processing system will also require modifications accordingly. Radar sources are used cross border between Denmark, Norway, Sweden and Finland forming cross border mosaic systems.

Presentation of area QNH information on radar situation display: For every QNH area there needs to be a QNH presentation on the radar screen. This presentation should be highlighted when QNH is changing. Presentation in the label for area QNH reference has to be discussed.

The current Swedish E2kE system is able to manage 10 TA areas. The COOPANS system will be able to use up to 20 TA areas. Every selected QNH area is to be regarded as one TA area in the system. Today the E2kE system in Stockholm is using all 10 available TA areas, so if the number of TA areas will be enough has to be investigated. A request to increase number of TA areas in the COOPANS system may generate additional costs.

MTCD calculations
Problems with separation alerts/warnings for conflicting traffic with different QNH settings.

b) procedures – Transition problems. Sweden has 9 adjacent States to consider for transition. We are using OLDI for silent transfer. There will be problems where adjoining States select different TA concepts. Norway, Finland and Estonia is only 3/9 of our transition partners. Especially the transition procedure between Denmark and Sweden is of great importance because of the amount of traffic climbing and descending at this boundary and around the Kastrup and Sturup area. Separation problems close to the AoR boundary for traffic flying at different QNH settings shall be avoided.

Area QNH
There is a need to select QNH areas and sources and to organize this sector wise if possible. What is the accepted tolerance between the sources? Large sectors could generate more than one area QNH within the same sector. Special procedures for combined sectors are needed.

OAT issues
There will be increased request from OAT traffic for area QNH reading, where OAT today are flying STD setting inbound and outbound TMAs. An exercise in military training areas is normally done on STD setting. If ACC coordinates civil traffic through this area on QNH settings there will be separation problems for the Fighter controller. OAT flights are today using their references concerning "area QNH" given by the met office or fighter controller, maybe not the same reference as "area QNH" for ACC. This has to be coordinated and will create extra workload.

Introducing LAF again is not desirable. Today ATS routes starts at FL95 which means that all traffic is using STD settings for ATS routes. There is no need for LAF calculations and no risk for misunderstanding/miscalculations in the present system.

Transfer at FL95
Today we have a number of procedures (estimated at 20 locations) where we have the transfer between ACC and APP at FL95. Arriving traffic is descending to FL100, climbing traffic is climbing to FL90. These procedures have to be changed. There can be traffic situations with conflicting traffic having different QNH reference regarding local- and area QNH settings.

Holding areas
18 000 ft as TA will effect Feeder holdings into Stockholm and Copenhagen airports. Levels above and below 18 000 ft are used when holdings are needed. Changing from one vertical reference to another in a holding stack should be avoided.

Misunderstanding of QNH read backs
Every read back includes a potential risk for misunderstanding. With a high TA we will have more QNH read backs increasing the overall risk. Using STD level means the same altimeter setting, reducing the risk.

Benefits in TMAs
- Level bust at low levels, possible reduction of incidents
- One more level available in TMA

- Changing from one vertical reference to another when performing CDA is not necessary if TA is higher. Restrictions on CDA STARs will be easier to publish and follow
- Benefits with a higher TA when developing SIDs and STARs with regards to noise abatement.

Airspace:
TMA upper limit
For a TA at 10 000 ft or above the upper limit of TMA in Sweden has to be changed.

Controlled airspace at FL95+
For a TA at 10 000 ft or above the lower limit of controlled airspace in Sweden has to be changed.

As all ATS routes are published only in controlled airspace (FL95+). This system/design, easy to understand and with no day-to-day changes, will not work if choosing 10 000 ft or 18 000 ft as TA.

Division between TMA and ACC sectors needs to be redesigned

Rönne TMA, mostly within Danish territory, is situated inside Sweden FIR, but airspace classification and TA application is according to Danish regulations.

c) training of staff – Training involves both FDOs and ATCOs. Training should include procedures, QNH readings and system changes. Training also includes airspace design and procedure design staff.

Question 3b): In Sweden the division between controlled and uncontrolled airspace is FL95. So the answers from Question 3a) are also valid for 3b). All ATS routes is published only in controlled airspace (FL95+). This system/design, easy to understand and with no day-to-day changes, will not work if choosing 10 000 ft or 18 000 ft as TA.

Question 3c): a) equipment – no impact foreseen

b) procedures – Transition problems.
Sweden has 9 adjacent States to consider for transition. We are using OLDI for silent transfer. There will be problems where adjoining States select different TA concepts. Norway, Finland and Estonia is only 3/9 of our transition. Choosing the concept of changing TA only in TMAs will reduce the problem to mainly the transition between South Sweden and Copenhagen TMA but it may also affect the interface between Stockholm TMA/Finland FIR and Göteborg TMA/Copenhagen FIR.

Procedures for traffic passing the lateral border of TMAs have to be developed for the transition between QNH and STD settings.

Transfer at FL95
Today we have a number of procedures (estimated at 20 locations) where we have the transfer between ACC and APP at FL95. Arriving traffic is descending to FL100, climbing traffic is climbing to FL 90. These procedures have to be changed.

TMA upper limit
For a TA at 10 000 ft the upper limit of TMA in Sweden has to be changed.

Benefits in TMAs
- Level bust at low levels, possible reduction of incidents
- One more level available in TMA
- Changing from one vertical reference to another when performing CDA according to current procedures is not necessary if TA is higher. Restrictions on CDA STARs will be easier to publish and follow
- Benefits with a higher TA when developing SIDs and STARs with regards to noise abatement.

Airspace
Division between TMA and ACC sectors need to be redesigned.

Rönne TMA, mostly within Danish territory, is situated inside Sweden FIR, but airspace classification and TA application is according to Danish regulations.

Question 4: (estimated costs are calculated on 120 €/hour)

4a) and 4b) area wide transition

Equipment
Preparation and Activation = 76 800 Euro
Procedures
LoA ACC, LoA TMA, Operational handbooks, QNH proc, Sectorisation, Mil coordinations and AIP changes 547 200 Euro
Training
Planning, ATCO training and FDO training = 144 000 Euro

Total

Equipment	76 800 €
Procedures	547 200 €
Training	144 000 €
Total 4a) area wide	**768 000 €**

4c) all TMAs

Equipment
Activation = 19 200 Euro

Procedures,
LoA ACC, LoA TMA, Operational handbooks, QNH proc, Sectorisation, Mil coordinations and AIP changes = 316 800 Euro

Training
Planning and ATCO training = 82560 Euro

Total

Equipment	19 200 €
Procedures	316 800 €
Training	82 560 €
Total 4c) all TMAs	**418 560 €**

Question 5: 2 to 3 years after CAA decision, depending on:

- Timetable for system change from E2kE to COOPANS
- a possible TMA change is a shorter timeframe than the area wide proposal
- a higher TA influence more in the procedures, giving a longer preparation time

Question 6: Week from 20 to 26 April 2009 – total number of flights: 13 393

Actual level FL180 and below: 2 157 (16.1 per cent)
Requested FL 180 and below: 1 956 (14.6 per cent)

Actual level FL100 and below: 588 (4.4 per cent)
Requested FL100 and below: 508 (3.8 per cent)

SWEDISH DEFENCE FORCES (unofficial translation)

Harmonising transition altitude in Swedish airspace

Background

The CAA has in its letter LS 2008-3936 requested the point of view of the Defence Forces regarding advantages and risks with implementing a harmonised transition altitude in the northern European States. De main alternatives that are mentioned are a transition altitude of 10 000 ft, 18 000 ft or a combination of these altitudes. In the background material to the letter by the CAA are just a few occurrences mentioned as the basis for this request.

Considerations

A change from today's transition altitude would involve great costs for the Defence Forces disregarding which alternative is decided. Today's transition altitude is programmed into JAS39 and a change would involve costs for re-programming of the system. In addition, there would be costs for changes in publications, procedures and for training.

The Swedish Defence Forces is exercising and in action over great areas and with a change of transition altitude which covers all Swedish airspace one of the consequences would be that STRI would have to either increase the separation towards civil traffic or reserve a sector to a higher altitude than today; this in order to maintain separation to civil traffic without needing to instruct the pilots to change the pressure setting during ongoing air exercise. A harmonisation established within TMA only would not involve any operational problems for the Defence Forces.

The eventual air safety gains or risks have not been possible to analyse or identify with the material provided.

Statement

The Defence Forces can see no direct gains in a change of today's transition altitude. A change which involves TMA only is operationally manageable but also such a change would involve costs and therefore, the Defence Forces are of the opinion that this change should not be carried out.

– END –

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