GTE/5

INTERNATIONAL CIVIL AVIATION ORGANIZATION

FINAL REPORT

FIFTH MEETING/WORKSHOP OF THE SCRUTINY WORKING GROUP

(GTE/5)

Lima, Peru, 11 to 13 March 2008

INDEX

HISTORY OF THE MEETING

ii-1 PLACE AND DURATION OF THE MEETING

The Fifth Meeting/Workshop of the Scrutiny Working Group (GTE/5) was held at the ICAO Regional Office, in Lima, Peru, 11 to 13 March 2008.

ii-2 OPENING CEREMONY AND OTHER MATTERS

Mr. Carlos Stehli, Regional Deputy Director (ai) of the ICAO South American Office, greeted the participants, and highlighted the importance of the issues to be dealt with.

Mr. Roberto Rodríguez Galloso, General Director of Civil Aviation of Peru, welcomed the participants highlighting the importance of the matters to be dealt with have at a regional level, inaugurating the meeting. Mr. Jorge Ráez, Air Navigation Manager, CORPAC, S.A. was also present at the ceremony.

ii-3 SCHEDULE, ORGANIZATION, WORKING METHODS, OFFICERS AND SECRETARIAT

The Meeting agreed to hold its sessions from 0800 to 1500 hours, with appropriate breaks. The work was done with the Meeting as a Single Committee, Working Groups and Ad-hoc Groups.

Mr. Madison Walton, delegate from United States, served as Chairman of the Meeting and Rapporteur of the Scrutiny Working Group.

Mr. Jorge Fernández Demarco, RO/ATM/SAR Regional Office, Lima, acted as Secretary.

ii-4 WORKING LANGUAGES

The working languages of the Meeting were Spanish and English. and its relevant documentation was presented in both languages.

ii-5 **AGENDA**

The following agenda was adopted:

Agenda Item 1: History of RVSM, Regional Monitoring Agencies and Scrutiny Groups

a) Roles and responsibilities
b) Overview of Target Levels of Safety

Agenda Item 2: GTE Overview

a) Review of Terms of Reference
b) Background
c) Composition
d) Objectives
e) Methodology
f) Reporting

Agenda Item 3: Large Height Deviation (LHD) Analysis

a) Application of GTE methodology to LHD events
b) Summarize parameter values
c) Identify operational trends

Agenda Item 4: Other business

ii-6 **ATTENDANCE**

The meeting was attended by 22 participants from 1 State of the CAR Region and 7 States of the SAM Region. The list of participants is shown in pages iii-1 to iii-4.

LISTA DE PARTICIPANTES / LIST OF PARTICIPANTS

ARGENTINA

Humberto Héctor Fernández
Jefe Div. Aviónica de la
Dirección de Aviación de Transporte
Dirección Nacional de Aeronavegabilidad
Junín 1060
Ciudad Autónoma de Buenos Aires
Argentina

Tel: +00541 4508 2110
Fax: +00541 4576 2108
E-mail: avionica@dna.org.ar

Carlos Medina
Inspector de Aviónica
División de Ingeniería
Dirección General de Aviación General
Dirección Nacional de Aeronavegabilidad
Junín 1060
Ciudad Autónoma de Buenos Aires
Argentina

Tel: +00541 4508 2105
Fax: +00541 4576 6404
E-mail: av.general@fibertel.com.ar
wasser75@yahoo.com

BRASIL

Renato Pietroforte Carvalho
Jefe de la Agencia Regional de Monitoreo
del Caribe y Sudamérica (CARSAMMA)
Centro de Gerenciamiento de Navegación
Aérea – CGNA
Av. General Justo 160 – 4° Andar
Rio de Janeiro – RJ – Brasil 20021-130

Tel: +5521 2101 6372
Fax: +5521 2101 6358
E-mail: carsamma@cgna.gov.br
pietroforte@cgna.gov.br
Website: www.cgna.gov.br/carsamma

Artur Flávio Dias
Collision Risk Evaluator
Comando Geral de Tecnología Aeroespacial – CTA
Instituto de Estudios Avanzados - IEAV
División de Energía Nuclear- ENU
CARSAMMA
Av. Dr. Nelson D'Avila 1125, Bloco D Apto. 108
12 245 – 030 Sao José Dos Campos, SP
Brasil

Tel: +5512 3947 5477
Recados 3947-5482 Raquel
Cel +5512 9134 5538
Fax: +5512 3944 1177
E-mail: arturf@ieav.cta.br
aturf@directnet.com.br

CHILE

Héctor Ibarra Martínez
Controlador de Tránsito Aéreo
Miguel Claro 1314, Providencia
Santiago, Chile

Tel: +562 492 1604
E-mail: hibarra@dgac.cl

COLOMBIA

José Alexander Alvarez Estailes
Controlador de Transito Aereo
UAEAC
Aeropuerto Internacional El Dorado
C.N.A. Bogotá, Colombia

Tel: +571 2662213
Fax: +571 2663276
E-mail: jalvare@aerocivil.gov.co

ESTADOS UNIDOS/UNITED STATES

Madison Walton
Aviation Safety Inspector
FAA, Suite 4102, 420 L'Enfant Plaza EAST
Washington, D.C. 20024
United States

Tel: +1202 385 4596
Fax: +1202 385 4653
Email: madison.walton@faa.gov

Stephanie Beritsky
Separation Standards Program Manager, CSSI, Inc.
6712 Washington Ave. Suite 106
Egg Harbor Township, NJ 08234
United States

Tel: +1609 485 7851
Fax: +1609 485 5078
Email: stephanie.ctr.beritsky@faa.gov

Latonia Sewell
CSSI, Inc.
400 Virginia Ave, SW Ste. 210
Washington, DC 20024
USA

Tel: 001 202 484-3372
Fax:
E-mail: Lsewell@cssiinc.com

José Perez
FAA, William J. Hughes Technical Center
Atlantic City, NJ 08405
USA

Tel: +1609-485-5365
Fax: +1609-485-5117
Email: jose.perez@faa.gov

Lauren Martin
FAA, William J Hughes Technical Center
Atlantic City, NJ 08405, USA

Tel: +1609-485-7941
Email: lauren.martin@faa.gov

PANAMA

Manbir Singh
Jefe del Centro de Control
Autoridad Aeronáutica Civil
0816-0843 Balboa, Ancón
Panamá R.P.

Tel: +507 501 9805/9806
Fax: +507 501 9848
E-mail: msingh@aeronautica.gob.pa

PARAGUAY

Enrique Espinoza
Jefe Departamento Estadísticas y Control-GNA
Av. Mcal. López c/22 de septiembre
DINAC
Edificio MDN 2º. Piso
Asunción, Paraguay

Telefax: +595 021 205 365
E-mail: enrique.espinoza@gmail.com
estadisticas_gna@dinac.gov.py

Delia Giménez
Controladota de Tráfico Aéreo
DINAC
Av. Mcal. López c/22 de septiembre
Edificio MDN 2º. Piso
Asunción, Paraguay

Telefax: +595 205 365
E-mail deliagi@hotmail.com

PERÚ

Víctor Arturo Martínez Serna
ATC
CORPAC, S.A.
Av. E. Faucett s/n
Aeropuerto Internacional Jorge Chávez
Av. E. Faucett s/n, Callao, Perú

Tel: +511 544 0156
E-mail: amartinez@corpac.gob.pe
Website: www.corpac.gob.pe

Victor Luis Flores Silla
Jefe de Gestión de Calidad ATS
CORPAC S.A
Aeropuerto Internacional Jorge Chávez
Av. E. Faucett s/n, Callao, Perú

Tel: +511 708 1164 / 1165
Fax: +511 414 1440
E-mail: lflores@corpac.gob.pe

Marco Vidal Macchiavello
Controlador de Tránsito Aéreo
CORPAC S.A
Aeropuerto Internacional Jorge Chávez
Av. E. Faucett s/n, Callao, Perú

Tel: +511 9348 0188
E-mail: mv117@hotmail.com

Ricardo Díaz Bobadilla
Controlador de Tránsito Aéreo
CORPAC S.A
Aeropuerto Internacional Jorge Chávez
Av. E. Faucett s/n, Callao, Perú

Tel: +511 9946 8142
E-mail ctadelta@hotmail.com

José Fernando Escalante
Controlador de Tránsito Aéreo
CORPAC S.A
Aeropuerto Internacional Jorge Chávez
Av. E. Faucett s/n, Callao, Perú

Tel: +511 575 0886
E-mail: ferna6118@hotmail.com

Freddy Zacarías Acosta
Gerente de Operaciones CORPAC S.A
Aeropuerto Internacional Jorge Chávez
Av. E. Faucett s/n, Callao, Perú

Tel: +511 574 5549
Fax: +511 414 1434
E-mail: fzacarias@corpac.gob.pe
Website: www.corpac.gob.pe

José Moreno Mestanza
Jefe area de Normas y Procedimientos
CORPAC S.A.
Aeropuerto Internacional Jorge Chávez
Av. E. Faucett s/n, Callao, Perú

Tel: +511 708 1166
Fax: +511 708 1167
E-mail: jmoreno@corpac.gob.pe
Website: www.corpac.gob.pe

Fredy Núñez Munárriz
Inspector Navegación Aérea
Dirección General de Aeronáutica Civil
Ministerio de Transportes y Comunicaciones
Jirón Zorritos 1201, Lima, Perú

Tel: +511 315 7880 Ext. 1511
Fax: +511 315 7881
E-mail: fnunez@mtc.gob.pe
Website: www.mtc.gob.pe

OACI / ICAO

Jorge Fernández
RO/ATM/SAR
Oficina Regional Sudamericana
Av. Víctor Andrés Belaúnde No.147
Centro Empresarial Real, Vía Principal No.102
Edificio Real 4, Piso 4, San Isidro
Lima 27 – Perú

Tel: +511 6118686 Anexo 104
Fax: +511 6118689
E-mail: jf@lima.icao.int
Website: www.lima.icao.int

Alberto Orero
RO/ATM/SAR
Oficina Regional Sudamericana
Av. Víctor Andrés Belaúnde No.147
Centro Empresarial Real, Vía Principal No.102
Edificio Real 4, Piso 4, San Isidro
Lima 27 – Perú

Tel: +511 6118686 Anexo 108
Fax: +511 6118689
E-mail: ao@lima.icao.int
Website: www.lima.icao.int

Agenda Item 1: History of RVSM, Regional Monitoring Agencies and Scrutiny Groups

a) Roles and responsibilities
b) Overview of Target Levels of Safety

1.1 The meeting recalled background information related with RVSM implementation at a global level and particularly in the CAR/SAM Regions, which lead to the creation of the Regional Monitoring Agency, as well as to the creation of Scrutiny Groups.

1.2 The initial steps of the concept of an independent monitoring authority which would be in charge of the analysis of the issues related to safety, comes from those times of the North Atlantic Systems Planning Group (NAT/SPG) and also from the development of the minimum navigation performance specifications (MNPS).

1.3 It was recalled that each State authority requires that these minimum performance specifications be applied by regional agreements and that aircraft performance be certified or approved by its State of authority.

1.4 This leads to the arising of the need to maintain regional data and also the need to carry out an analysis was created to ensure that system providers and operators with similar performances were within the boundaries established by the Regions.

1.5 During 1981, the NAT/SPG commissioned one of the first organizations to conduct activities related with one Scrutiny Work Group known as Central Monitoring Agency (CMA).

1.6 The Meeting noted that the ICAO Standards and Recommended Practices (SARPs) provide the basis to carry out this function, detecting and correcting, where necessary, the events generating risk through the application of the ICAO collision risk methodology. Further, ICAO issued regulations oriented towards the implementation of safety management systems, which are undoubtedly addressed towards the identification of hazards which threaten air operations, applying a methodology for the elimination and/or reduction of these hazards.

1.7 When the decision was taken to implement RVSM in the CAR/SAM Regions airspace, which is made jointly with the application of this minimum separation in the North American Region, the CAR/SAM Regional Monitoring Agency (CARSAMMA) was created, which has among their main functions the system performance monitoring. This function is described in the RVSM Manual (Doc 9574), which establishes that it is necessary, in order to ensure the continuous and safe use of RVSM, and also to ensure that the target level of safety (TLS) established is complied. This activity is carried out with the support of the Scrutiny Group (SG).

1.8 Each monitoring agency is responsible to establish a method to identify large-height deviations (LHD) and also the agency has to establish a mechanism to collect and analyze the reports of such deviations. In this connection, CARSAMMA, together with the SG, created a form for LHD collection, which is mandatory for all CAR/SAM States.

1.9 When RVSM was implemented; that is to say a reduction of vertical separation applied in the CAR/SAM Regions airspace, GREPECAS, in addition to creating CARSAMMA as a Regional Monitoring Agency, deemed pertinent to create the CAR/SAM Scrutiny Group, which would provide support to CARSAMMA with regard to LHD assessment.

1.10 The Scrutiny Group requires the participation of experts from the CAR/SAM Regions in different matters, such as air traffic control, aircraft maintenance, regulations and certifications, data analysis and risk management.

1.11 The complete presentation made by United States FAA, is shown as **Appendix A** to this part of the report. The objectives of the SG are therein detailed, as well as the meaning of an LHD, and why is it necessary to evaluate and analyze each one of them, and how do they influence and have an impact in the technical and operational risk assessment with regard to RVSM. The meeting also noted the ICAO collision risk model and the parameters contained in the model.

1.12 On the other hand, the presentation recalled on the need to classify for risk assessment purposes, each one of the LHDs reported, using to this end the Error Type Codes Table, as approved by GREPECAS.

1.13 One of the main functions of the GTE is to identify the adverse trends that might endanger airspace safety under study. The SG evaluates the different categories of events and if a particular event occurs more often than others. In these cases, the Group has the assignment provide recommendations for the application of measures that favor the reduction of the effects of these trends and thus ensure that technical and/or operational errors are kept to the minimum, in order to satisfy applicable safety requirements and objectives. Experience has shown that the actions and measures proposed to reduce the risk are not exclusively related with RVSM airspace.

1.14 The delegate from CARSAMMA made a presentation on the monitoring agency and which actions have been taken from the beginning of their activities as well as those foreseen in a short term. In this connection, the meeting noted that CARSAMMA has been the focal point to obtain the necessary information in order to carry out safety assessments. During RVSM implementation, it had the assignment to supervise aircraft performance, as well as to evaluate large-height deviations occurrences.

1.15 The meeting also took note of the four different monitoring methods currently used to determine aircraft height-keeping performance errors.

1.16 With regard to the activities planned for 2008, the meeting noted, among other issues, that CARSAMMA developed a significant training activity to ATCOs from the Brazilian Control Centers and continued with air traffic movement data collection carried out in February 2008, which had been submitted to the Agency. Based on the experience obtained, it developed an executable CD-ROM which shall serve to train ATCOs in the CAR/SAM Regions, in filling the LHD report forms. A basic course of risk assessment between cruising levels aircraft is also being prepared, and shall be offered to CAR/SAM States and International Organizations.

1.17 On the other hand, CARSAMMA shall present a new CAR/SAM RVSM airspace safety assessment to the ATM/CNS/SG/6 to be held in July 2008, reason for which the activities to develop this task have been initiated. CARSAMMA will finally participate in the Special RMA meetings at a worldwide level, where among other matters, will analyze the lack of standardization of procedures established with States and how to monitor the operators requirements. It will have as additional objectives to harmonize the parameters used b the different RMAs to develop risk assessments and also to review RMA manual. For a better reference, the complete presentation is presented as **Appendix B** to this part of the report.

1.18 Among other matters, the meeting was informed by CARSAMMA of a MaxPlay programme, containing all related information to the Regional Monitoring Agency, its activities, documentation from the different Scrutiny Groups, and other matters of interest inherent to their functions.

APÉNDICE A AL INFORME SOBRE LA CUESTIÓN 1 DEL ORDEN DEL DÍA

APPENDIX A TO THE REPORT ON AGENDA ITEM 1

Techniques for Monitoring Aircraft Height Keeping Performance

RMA Training

Presented to: ATMB of CAAC

By: José L. Pérez

Date: March 31 – April 4, 2008

Federal Aviation Administration

Overview

- **Monitoring program**
- **Monitoring Height Keeping Performance Diagram**
- **Overview of Calculation Process**
- **Height Keeping Performance Calculation Process Data Flow**
- **Data requirements to estimate aircraft height keeping performance**
- **Data files: Variable and Formats**
- **TVE/ASE Processor**
  - ***Assigning Sequence Numbers***
  - ***Automation***
  - ***Determine straight and level flight segments***
  - ***Processing of the data***
- **Quality Control: Table Discussion**
- **ASE reporting**

Monitoring Program

- A program to monitor or verify aircraft height-keeping performance is considered a necessary element of RVSM implementation. RVSM monitoring programs have the primary objective of observing and evaluating aircraft height-keeping performance to gain confidence that airspace users are applying the airplane/operator approval process in an effective manner and that an equivalent level of safety will be maintained when RVSM is implemented.

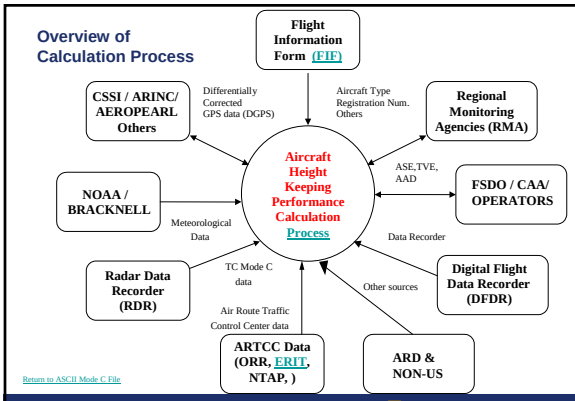
Monitoring Height-Keeping Performance

FL 350 = Constant Pressure Altitude

FL 350 Geometric Height

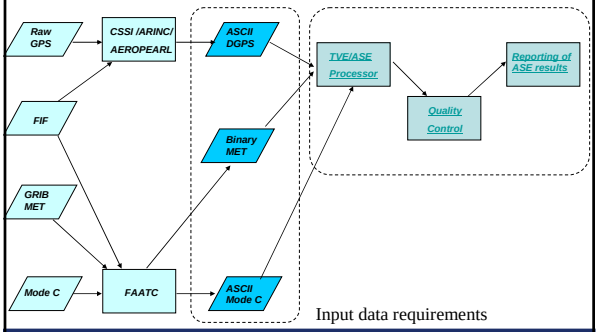
Total Vertical Error (TVE)
= Altimetry System Error +
Assigned Altitude Deviation
= ASE +AAD

Overview of Calculation Process



Return to ASCII Mode C File

Height Keeping Performance Calculation Process



Input data requirements

Flight Information Form (FIF)

FIF

- *Variables*
  - *assigned flight level*
- Some of the key information contained on the FIF are the following:
  - Operator point of contact
  - Aircraft type and series
  - Aircraft registration number and call sign
  - Airframe serial number
  - Origin airport, departure date and time
  - Planned destination, arrival date and time
  - Beacon code
  - GMU file name

ASCII DGPS File

ASCII DGPS

- *Differentially corrected GPS data*
- *Variables*
  - *time (seconds) from start of day*
  - *latitude (degrees)*
  - *longitude (degrees)*
  - *height (feet) referenced to WGS-84*
  - *pdop*
  - *hdop*
  - *figure of merit (feet)*

ASCII DGPS File Format

- ***Format :*** 500 read (10,30,end=520)gtime,glat,glong,hgt,pdop,hdop
  30 format (1x,f11.3,2f13.8,f12.2,103x,2f6.1)
- ***Variables needed :***
  TIME (var read = gtime, var name in file = TOW)
  LAT (var read = glat, var name in file = POS[1])
  LON (var read = glong, var name in file = POS[2])
  HGT (var read = hgt, var name in file = POS[3])
  PDOP (var read = pdop, var name in file = PDOP)
  HDOP (var read = hdop, var name in file = HDOP)
- ***File name:*** c:\yymmdd\04308n00.dfa

ASCII DGPS File Variables

C:\RAWGMU\48\A4802236.mez
8/24/02 Network Stations = ALGO, AOML, BOGT, BRMU, CASA, CRO1, FORT, JPLM, NLIB, PIE1,
antenna sep, ft = 7.000
8/26/ 2 15:23:29 RVSM PFP version 4.02
LLA

TOW	POS[1]	POS[2]	POS[3]	PDOP	HDOP	N	FOM
59706.729	34.73446321	-92.23267980	285.19	2.8	1.7	3	29.82
59707.729	34.73447796	-92.23265309	271.64	2.8	1.7	3	29.82
59708.729	34.73443156	-92.23266045	281.41	2.8	1.7	3	29.81
59709.729	34.73444771	-92.23257142	239.32	2.8	1.7	3	29.81
59710.729	34.73445705	-92.23257300	248.08	2.8	1.7	3	29.80
59711.729	34.73446471	-92.23249478	203.15	2.8	1.7	3	29.80
59712.729	34.73452422	-92.23244435	215.78	2.8	1.7	3	29.80
59713.729	34.73454704	-92.23238508	205.69	2.8	1.7	3	29.79
59714.729	34.73454343	-92.23240099	217.47	2.8	1.7	3	29.79
59715.729	34.73454956	-92.23240984	216.02	2.8	1.7	3	29.79
59716.729	34.73457438	-92.23240158	211.83	2.8	1.7	3	29.78

Return to Height-Keeping Performance Diagram

Binary Meteorological Data

Binary MET

- *Bracknell / NOAA Global Model Output*
- *Variables:*
  - *geopotential height (meters) at 10 mb levels referenced to MSL*
  - *virtual temperature (Kelvin) at 10 mb levels*
- *Data Coverage:*
  - *latitude = [-90,+90], longitude = [-180,+180] in 1.25 x 1.25 degree increments*
  - *time periods : 00Z (back cast) 06Z (forecast)*
    12Z (back cast) 18Z (forecast)
- *Degribbing software : Bracknell / NOAA Grib Conversions*
- *Filename: (c:\bracknl\yyyy\mmddyypp.atb)*

ASCII Mode C File

ASCII Mode C

- *FAATC merged and reduced Mode C*
- *Variables*
  - *beacon code*
  - *channel number*
  - *range (nm)*
  - *azimuth (degrees)*
  - *height (feet)*
  - *time (hh/mm/ss) from start of day*
  - *time (seconds) from start of day*

ASCII Mode C File Format

- ***Format :*** 500 read (10,30,end=520)ibc,ich,range,az,ihgt,ihr,imin,tsec
  30 format (i5, i2, 2f8.3, 2x, i5,2(1x,i2), 1x, f5.2)
  (Zero lines of header information)
- ***Variables needed :***
  HEIGHT (var read = ihgt, field 5)
  TIME (vars read = (ihr, imin, isec), field 6)
- ***File name:*** c:\yymmdd\04308000.mc

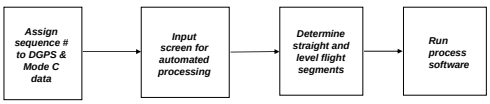
ASCII Mode C File Variables

5502 1 35.679 91.402W 28900 17/45/ 9.00 63909.00
5502 1 35.688 91.397W 29000 17/45/14.00 63914.00
5502 1 35.706 91.380W 29300 17/45/26.00 63926.00
5502 1 35.721 91.362W 29600 17/45/38.00 63938.00
5502 1 35.738 91.344W 29800 17/45/50.00 63950.00
5502 1 35.757 91.324W 30000 17/46/ 2.00 63962.00
5502 1 35.772 91.304W 30100 17/46/14.00 63974.00
5502 1 35.791 91.289W 30300 17/46/27.00 63987.00
5502 1 35.811 91.271W 30600 17/46/39.00 63999.00

Return to Height-Keeping Performance Diagram

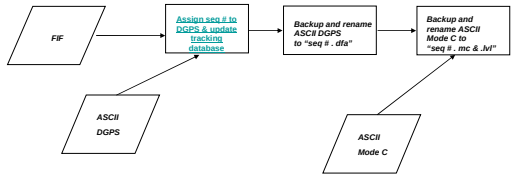
TVE/ASE Processor

TVE/ASE Processor



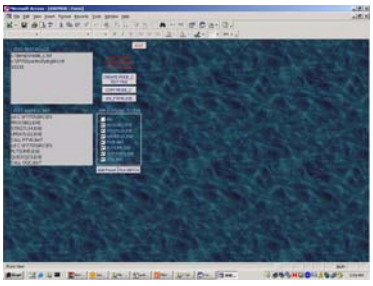
Assigning Sequence Numbers

Assign sequence #



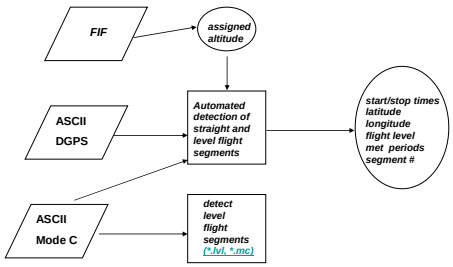
Input Screen for Automated Processor

Input screen for processor



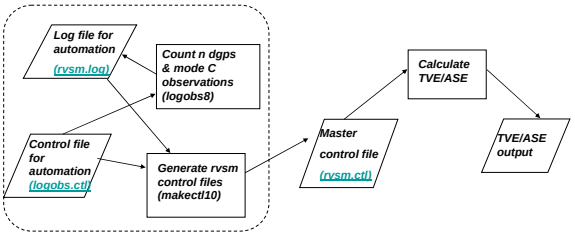
Determine Straight and Level Flight Segments

Determine straight and level flight segments



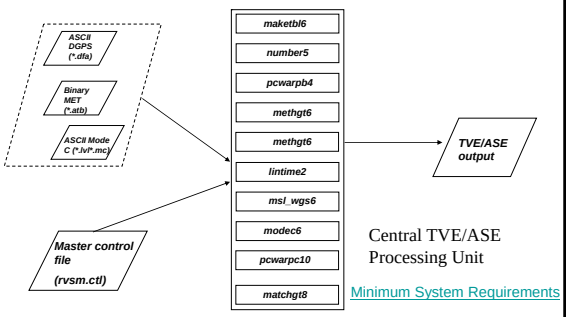
Run Process Software

Run process software



Calculate TVE/ASE

Calculate TVE/ASE



Central TVE/ASE Processing Unit

Minimum System Requirements

Central TVE/ASE Processing Unit

Central TVE/ASE processing unit

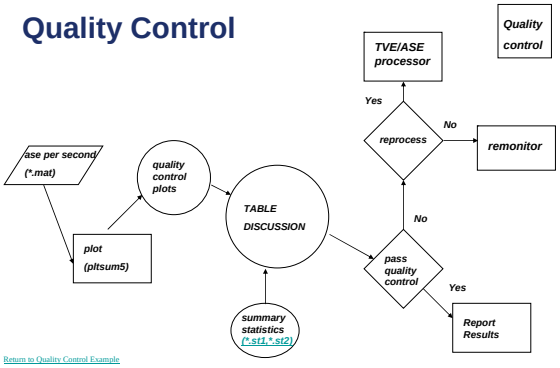
maketbl6	read met data and generate flight level heights
number5	read dgps data and extract straight and level portion
pcwarpb4	smooth straight and level dgps data
methgt6	interpolate spatially flight level height at time period 1 according to aircraft path
methgt6	interpolate spatially flight level height at time period 2 according to aircraft path
lintime2	interpolate linearly flight level height according to aircraft time
msl_wgs6	convert flight level height from geopotential height above MSL to geometric height above WGS-84 and compute TVE
modec6	read mode C data and extract straight and level portion
pcwarpc10	smooth mode C data and interpolate at a one second rate
matchgt8	match TVE data with AAD data and compute ASE

ASE Equation

Return to Height-Keeping Performance Diagram

- *TVE = ASE + AAD*
- *TVE = smooth dgps - met flight level height*
  - *-tve per second data in *.hgt, statistics in *.st1*
- *AAD = smooth mode C - assigned flight level*
  - *-aad per second data in *.mat, statistics in *.st2*
- *ASE = TVE - AAD*
  - *-ase per second data in *.mat, statistics in *.st2*

Quality Control



Return to Quality Control Example

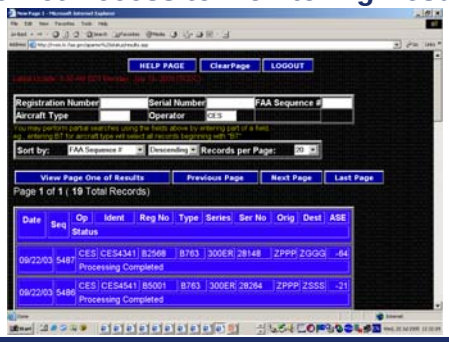
Reporting of ASE results

- **A letter is sent to the State CAA after the RMA determines that the operator has completed minimum monitoring requirements**
- **If any estimated ASE value is found to be non-compliant, RMA notifies the State authority of result and awaits modifications so that the aircraft can be re-monitored**

Internet Access to Monitoring Results

http://rvsm.tc.faa.gov

Internet Access to Monitoring Results

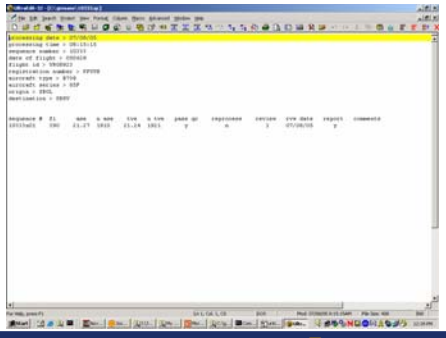


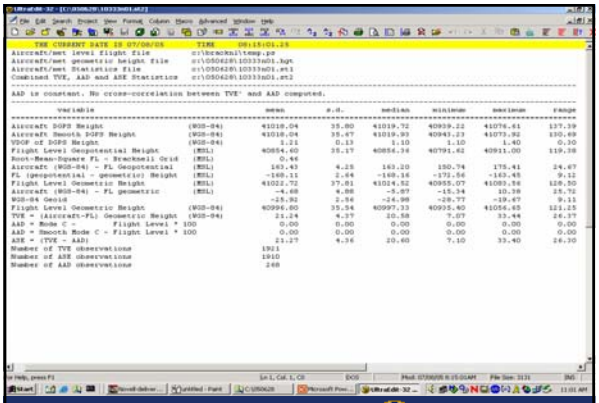
Quality Control Example

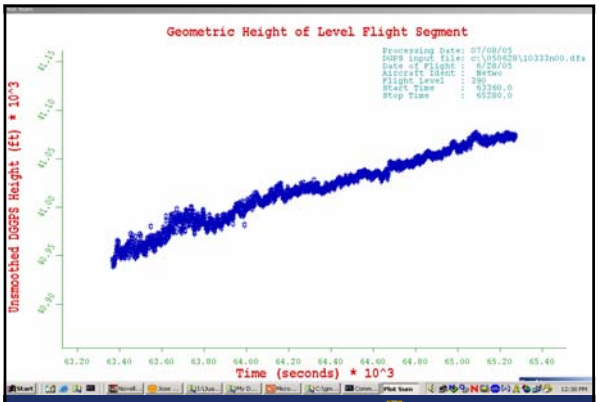
- Sequence Number: 10333
- Flight Identification: VRG8923
- Registration Number: PPVSB
- Aircraft Type: B738
- Series: 85F
- Operator: VRG

Return to Quality Control Diagram

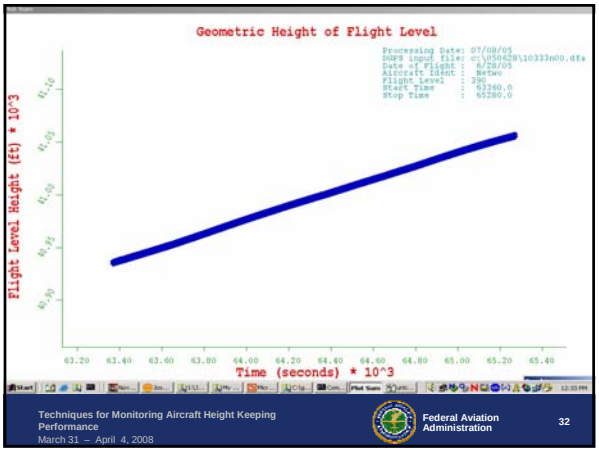
Quality Control

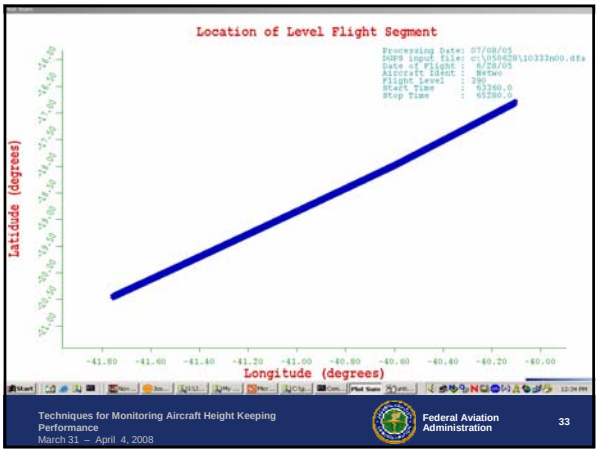




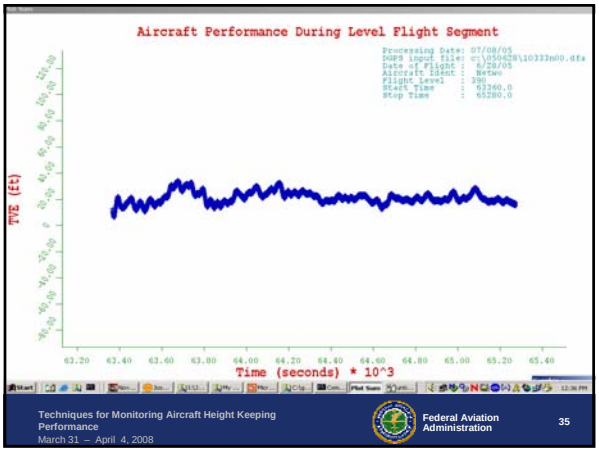



Geometric Height of Level Flight Segment
Smooth DGPS Height (Ft) * 10^3
Time (seconds) * 10^3
63.20 63.40 63.60 63.80 64.00 64.20 64.40 64.60 64.80 65.00 65.20 65.40

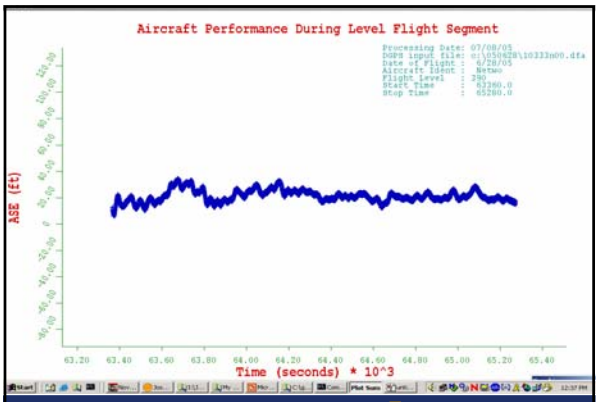

Geometric Height of Flight Level
Flight Level Height (Ft) * 10^3
Time (seconds) * 10^3
63.20 63.40 63.60 63.80 64.00 64.20 64.40 64.60 64.80 65.00 65.20 65.40

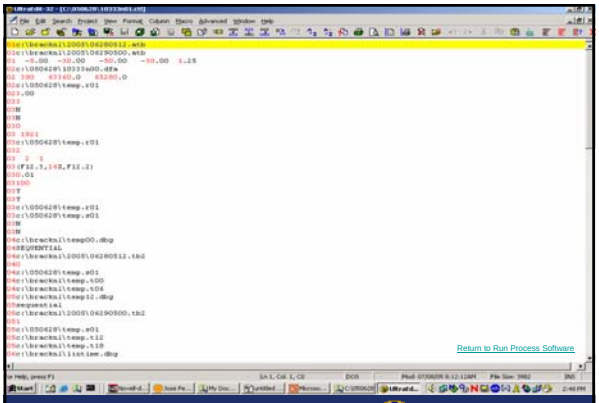

Location of Level Flight Segment
Latitude (degrees)
Longitude (degrees)
-41.80 -41.60 -41.40 -41.20 -41.00 -40.80 -40.60 -40.40 -40.20 -40.00


Mode C Altitude During Flight Segment
Processing Date: 07/08/05
DOPS input file: c:\050628\10333n00.dfa
Date of Flight : 6/28/05
Aircraft Ident : Netwo
Flight Level : 390
Start Time : 63360.0
Stop Time : 65280.0
Smooth Mode C Altitude * 10^3
63.20 63.40 63.60 63.80 64.00 64.20 64.40 64.60 64.80 65.00 65.20 65.40
Time (seconds) * 10^3
Techniques for Monitoring Aircraft Height Keeping Performance
March 31 – April 4, 2008
Federal Aviation Administration
34


Aircraft Performance During Level Flight Segment
Processing Date: 07/08/05
DOPS input file: c:\050628\10333n00.dfa
Date of Flight : 6/28/05
Aircraft Ident : Netwo
Flight Level : 390
Start Time : 63360.0
Stop Time : 65280.0
TVE (ft)
63.20 63.40 63.60 63.80 64.00 64.20 64.40 64.60 64.80 65.00 65.20 65.40
Time (seconds) * 10^3
Techniques for Monitoring Aircraft Height Keeping Performance
March 31 – April 4, 2008
Federal Aviation Administration
35


Aircraft Performance During Level Flight Segment
Processing Date: 07/08/05
DOPS input file: c:\050628\10333n00.dfa
Date of Flight : 6/28/05
Aircraft Ident : Netwo
Flight Level : 390
Start Time : 63360.0
Stop Time : 65280.0
Smooth AAD (ft) * 10^3
63.20 63.40 63.60 63.80 64.00 64.20 64.40 64.60 64.80 65.00 65.20 65.40
Time (seconds) * 10^3
Techniques for Monitoring Aircraft Height Keeping Performance
March 31 – April 4, 2008
Federal Aviation Administration
36


Aircraft Performance During Level Flight Segment
ASE (ft)
Time (seconds) * 10^3


Return to Run Process Software

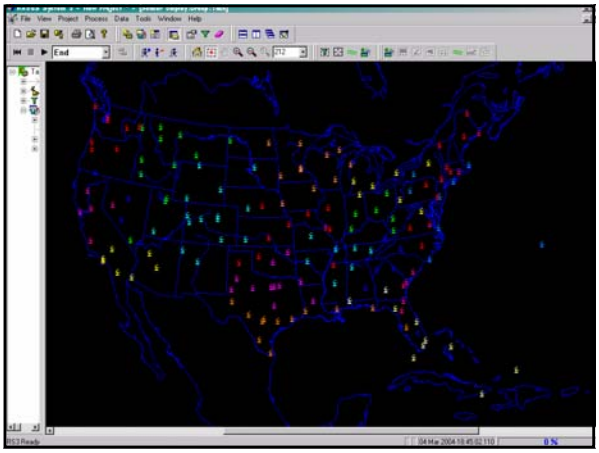
THE END

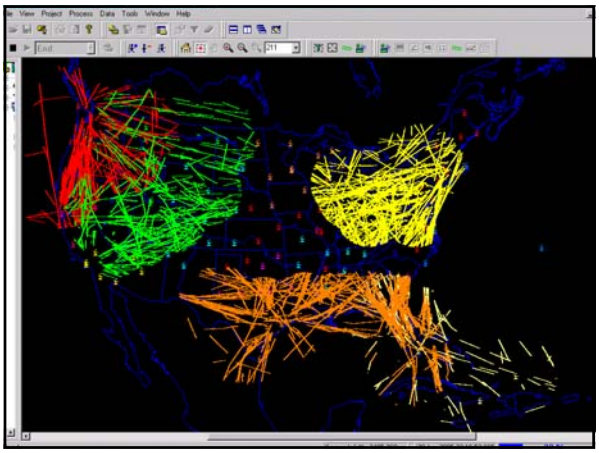
Minimum System Requirements

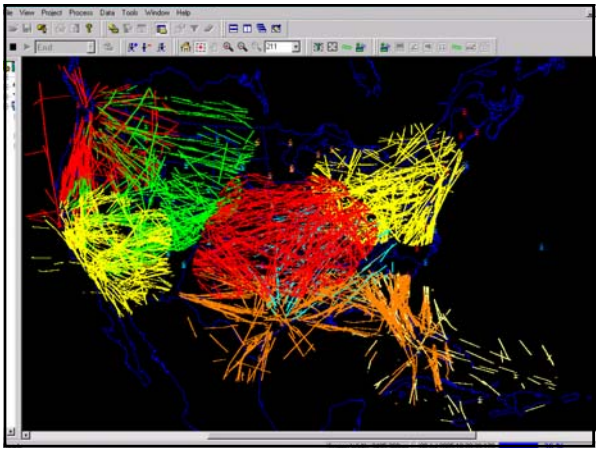
- Lahey Fortran 95 environment for executable modules
- Lahey Fortran 95 software or above to compile and run source code (Telephone 800-548-4778 : 775-831-8123 or www.lahey.com)
- 16 or 32 bit operating system for DOS application – Windows 95 or above
- 486 processor
- 32 mb memory
- 500 mb of disk space
- Microsoft ACCESS 2000

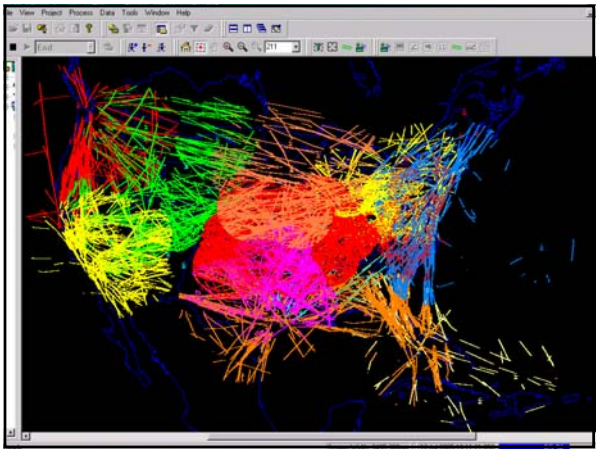
Regional Monitoring Agencies

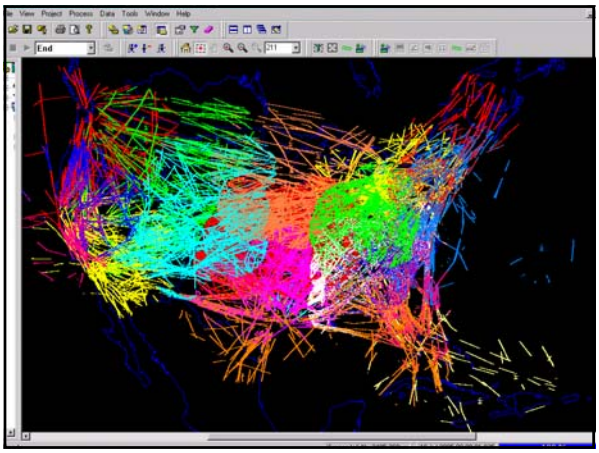
- North America Regional Monitoring Agency
- North Atlantic Central Monitoring Agency
- Euro control
- Monitoring Agency of Asia Region
- Caribbean and South America Monitoring Agency
- Others











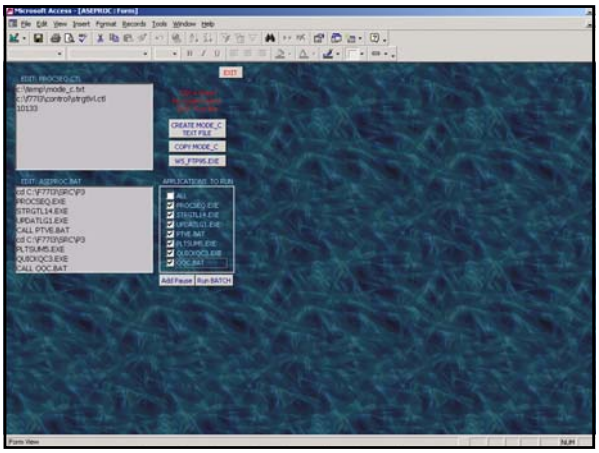
FIF

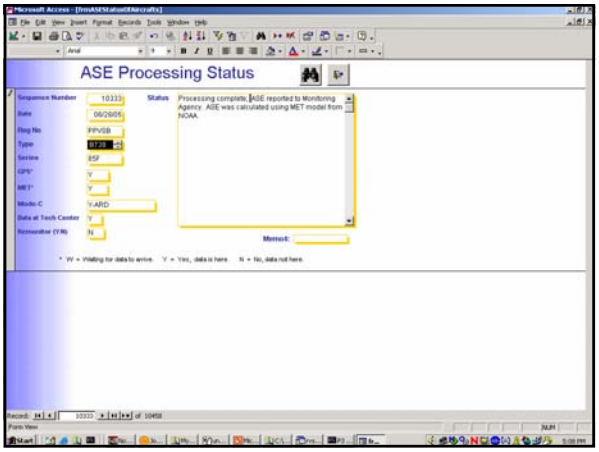
Return to Diagram

End Result of the Height-Keeping Performance Process

- Compliant
- Non Compliant

Return to Diagram



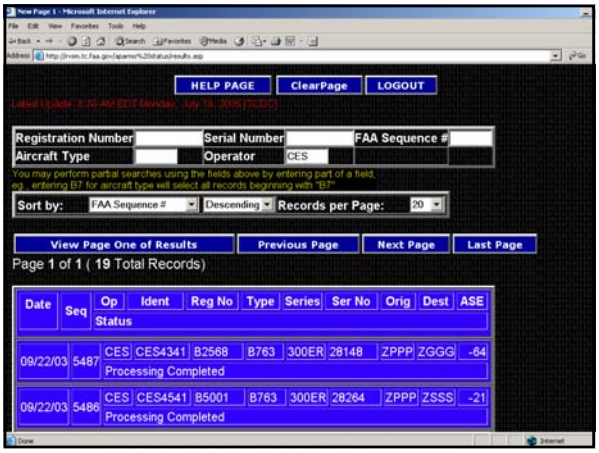


Input Control Files : rvsm.log

REC	DAY	JD	CODE	FCODE	START	STOP	FL	OBS	NN
29	960720	202	00046	00046n02	69621	70400	310	703	70.00
30	960720	202	00046	00046n03	70528	70846	310	280	70.00
31	960720	202	00046	00046n04	71900	78935	330	5927	70.00
32	960720	202	00046	00046n05	81231	83366	350	1440	65.00
33	960720	202	00046	00046n06	83967	84800	350	531	65.00
34	960724	206	00054	00054n01	34900	42452	310	5058	70.00
35	960724	206	00054	00054n02	44492	51285	310	4580	70.00
36	960724	206	00054	00054n03	51700	53698	350	1346	65.00
37	960724	206	00054	00054n04	54795	56337	350	1359	60.00
38	960724	206	00054	00054n05	57123	59088	350	364	55.00

Input Control Files: logobs.ctl

00046n02
00046n03
00046n04
00046n05
00046n06
00054n01
00054n02
00054n03
00054n04
00054n05



U.S. Department of Transportation

Federal Aviation Administration

Technical Center

APARMO

Atlantic City Int'l Airport
New Jersey 08405

Diane E. Ribota
OIC, Aviation Safety Division
Air Transportation Office, MIA Road
1300 Pasay City
Philippines

22 Nov 2002

Business: +63 2 8340145
Fax: +63 2 8916402
Email: atc-as@1wmpass.com.ph

Subject: RVSM Monitoring Results for PAL/B733/B734 Seeking Fleet Approval

On 24 February 2000 at 0700 UTC, the Reduced Vertical Separation Minimum (RVSM) was implemented in Pacific flight information regions in accordance with an amendment of applicable Regional Supplementary Procedures (Doc 7030/4 - MID/ASIA/PAC RAC/3), signed by the President of the ICAO Council on 13 Feb 2000 as APAC-S 99/5. That amendment authorizes the Asia/Pacific Approvals Registry and Monitoring Organization (APARMO), a service provided by the U.S. Federal Aviation Administration's FAA Technical Center, to monitor the height keeping performance of aircraft in conjunction with application of the State RVSM approval process. This monitoring results in an estimate of aircraft altimetry system error (ASE) using a GPS Monitoring System (GMS).

Please be advised that the APARMO has estimated ASE for the following PAL/B733/B734 aircraft seeking fleet approval and that these values are compliant with the requirement, stated in paragraph 6.5.1 2) b) of APAC-S 99/5, that the ASE of individual airframe members of an operator/aircraft-type group be less than 245 feet in magnitude:

Registration/Serial Number	Aircraft Type	Date Monitored	Flight Level	ASE (ft)	GMS Seq #
RPC60072/5996	B733-300	02/11/02	290	-01	3818
E8CVN/24684	B734-400	12/10/01	310	-109	3697

Please accept our assurances that these results satisfy completely the agreed Asia/Pacific height keeping performance monitoring requirements forming part of the State RVSM approval process for PAL/B733/B734 aircraft type.

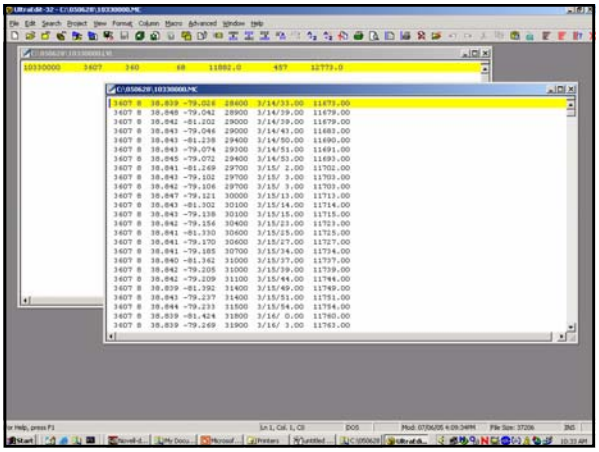
The maintenance of an accurate global database of RVSM approvals is essential to ensuring safe operations as RVSM is used worldwide. We, therefore, respectfully request that you inform this office if you grant RVSM approval to additional PAL aircraft or if you withdraw any approvals previously granted, using APARMO form F2 and F3, respectively.

Yours truly,

Richard W. Soper
Asia /Pacific Approvals Registry and Monitoring Organization
FAA Technical Center
Atlantic City International Airport
Atlantic City, NJ USA 08405

Copy: [illegible]

Return to Reporting of ASE results



APÉNDICE B AL INFORME SOBRE LA CUESTIÓN 1 DEL ORDEN DEL DÍA

APPENDIX B TO THE REPORT ON AGENDA ITEM 1

Caribbean and South American RVSM Grupo de Trabajo de Escrutinio (CAR/SAM RVSM GTE)

Workshop on ATS Safety Evaluation and Fifth Meeting of the Scrutiny Working Group (GTE)

Lima, Peru, 11-13 March, 2008

CARSAMMA

History of the Reduced Vertical Separation Minimum (RVSM) and Establishment of Regional Monitoring Agencies (RMAs) and Scrutiny Groups

2

Independent Monitoring Authority

- The concept of an independent monitoring authority that would act as a clearing house for safety related materials in a given ICAO region dates back to the North Atlantic (NAT) System Planning Group and the development of the Minimum Navigation Performance Specification (MNPS).
- MNPS is required by each State authority in accordance with regional agreements.
- MNPS requires that the navigation performance of the aircraft be certified or approved by a State authority.

3

NAT CMA

- A need was recognized to maintain regional records and quality control information for the region and conduct analysis to assure the system providers and operators alike that the performance was within established limits.
- In 1981 the North Atlantic Systems Planning Group (NAT SPG) commissioned one of the first organizations to conduct Scrutiny Group-type activities, the Central Monitoring Agency (CMA).

4

Lateral Separation Monitoring

- The responsibility of collecting reports of gross navigational errors (GNEs) was assigned to the CMA.
- The NAT SPG assembled operational experts to comment on unusual GNEs, to interpret the circumstances around them and to recommend changes to policies, practices and procedures to minimize the occurrence of infrequent but risk generating events.

5

Connection To ICAO SARPs

- ICAO Standards and Recommended Practices (SARPs) provides the basis for this work.
  - A feedback mechanism wherein one detects and then corrects risk generating events is part of ICAO endorsed collision risk methodology.
  - Hazard monitoring is also a fundamental component of the ICAO Safety Management System (SMS).

6

Vertical Separation - RVSM

- Prior to the establishment of the CMA in the North Atlantic, the NAT SPG decided to implement RVSM in its airspace.
- The RVSM implementation process was defined in the ICAO RVSM Manual, Doc 9574.
- Doc 9574 was developed by the ICAO Review of the General Concept of Separation Panel (RGCSP) which later became the Separation and Airspace Safety Panel (SASP).

7

System Performance Monitoring

- System performance monitoring, as outlined in ICAO Doc 9574, is necessary to ensure the continued safe use of reduced vertical separation minimum (RVSM) and that established safety goals are met.
- This activity includes monitoring the minimum risk of collision associated with operational errors and in-flight contingencies. The monitoring process is divided into two main categories:
  - Risk associated with the aircraft technical height-keeping performance (technical risk)
  - The overall risk, i.e. risk due to all causes

8

RVSM Manual - RMA

- The ICAO RVSM Manual, Doc 9574, established the roles and responsibilities of the Regional Monitoring Agency (RMA).
- The RVSM Manual was also developed using collision risk modeling (CRM) methodology, therefore, a similar set of processes for recording, analyzing and acting on information gathered in the system was established.

9

RVSM Initial Implementation

- In 1997, when RVSM was implemented in the NAT, the CMA's role was expanded to include vertical events.
- The process of evaluating vertical events and developing remedial action is ongoing in the NAT.
- In 1999 RVSM was implemented in Pacific airspace in accordance with Doc 9574.
- A Pacific RMA, the Pacific Approvals Registry and Monitoring Agency (PARMO), was established and operated by the Federal Aviation Administration.

10

RVSM Expansion

- The ICAO RVSM implementation process and RMA establishment was repeated as RVSM was implemented in other regions for example:
  - Europe
  - Asia
  - Caribbean and South America
  - North America
    - Canada
    - Mexico
    - United States

11

Regional Monitoring Agency (RMA) Roles and Responsibilities

12

Establishment of a Regional Monitoring Agency (RMA)

- ICAO Doc 9574 describes a five-step implementation process for introduction of the RVSM. Among other actions required, the implementation process calls for establishment of a regional monitoring agency (RMA) to act as the safety oversight body.
- RMAs are established by regional planning groups.
- The draft ICAO RMA Handbook lists all flight information regions (FIRs) where RVSM has been implemented and the cognizant RMA for each FIR.

13

RMA Roles and Responsibilities

- It is the responsibility of the cognizant RMA to establish a program for identifying large height deviations and a mechanism for collecting and analyzing reports of such deviations.
- The Caribbean-South American Monitoring Agency (CARSAMMA) is the regional monitoring agency (RMA) established by GREPECAS to conduct this work for the Caribbean and South American regions.

14

Data Collection

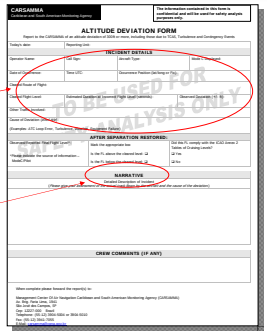
- It is the responsibility of the relevant RMA, CARSAMMA, to establish procedures for the collection of reports of LHDs
- CARSAMMA, with the advisement of the GTE, created a LHD reporting form designed to capture the information necessary to accurately assess large height deviations.

15

LHD Reporting Form

Incident Details

The GTE relies on the narrative


CARSAMMA

The information contained in this form is confidential and will be used for safety analysis purposes only.

ALTITUDE DEVIATION FORM

Report to the CARSAMMA all an altitude deviation of 300ft or more, including those due to TCAS, Turbulence and Contingency Events

INCIDENT DETAILS

AFTER SEPARATION RESTORED:

NARRATIVE

CREW COMMENTS (IF ANY)

Accessibility plays a key role in reporting

The LHD reporting form is available on CARSAMMA's website and is available in three different languages

GTE Overview

Need for a Scrutiny Group

- Why have a Scrutiny Group?
  - When you establish a change in separation it is impossible to predict all conditions
  - The airspace is dynamic, requires continuous monitoring
- One good example:
  - Review panels have noted that the expanded use of highly accurate global navigation satellite systems, while decreasing lateral risk, has contributed to an increase in vertical risk.

Establishment of the GTE

- To assist the RMA in analyzing LHDs, a body of experts has been established by GREPECAS. This group of operational, ATC, flight crew and safety experts is called a Scrutiny Group, Grupo de Trabajo de Escrutinio (GTE).
- The GTE Terms of Reference as follows:

19

GTE Terms of Reference

- To assemble subject matter experts, as needed, in air traffic control, aircraft operations and maintenance, regulation and certification, data analysis and risk modeling;
- To analyze and evaluate large height deviations of 300 ft or greater as defined by ICAO Doc 9574;
- To coordinate the assembly and review of large height deviation data with the Regional Monitoring Agency;
- To produce an estimate of flight time away from the cleared flying level to be used a primary input in the preparation of an estimate of risk by the Regional Monitoring Agency;
- To identify large height deviation trends and to recommend remedial actions in order to improve safety;
- To report results to GREPECAS through the ATM/CNS subgroup;
- To accomplish other tasks as directed by GREPECAS.

20

GTE Composition

- The Scrutiny Group requires a diverse set of subject-matter experts. The Group is composed of subject matter experts in air traffic control, aircraft operations and maintenance, regulation and certification, data analysis, and risk modeling from the involved regions.
- In the CAR/SAM regions, the following organizations are represented in the Scrutiny Group:
  - CARSAMMA
  - FAA
  - DGAC
  - IFALPA
  - COCESNA
  - CORPAC (S.A.)

21

Objectives

- Provide on-going assessment of factors which affect the estimate of collision risk in RVSM airspaces
- Prepare periodic estimates of the risk of collision due to the loss of planned vertical separation in RVSM airspaces
- Analyze available data and, under expert guidance, make recommendations to procedures and practices that will maintain the operation of the airspace below agreed thresholds or to improve the operational safety in the airspaces

22

What is a Large Height Deviation?

- A deviation in the vertical dimension from the cleared flight level of 90 m (300 ft) or greater in magnitude
- The causes of large height deviations have been found to be, but are not limited to:
  - Altimetry error
  - Turbulence
  - Emergency descent
  - Response to airborne collision avoidance system
  - Not correctly following an ATC clearance
  - An error in issuing an ATC clearance
  - Coordination errors between adjacent ATC units

23

Why Evaluate and Analyze LHDs?

- Experience has shown that large height deviations have a significant impact on operational and technical risk in RVSM airspace.
- The additional risk associated with operational errors and in-flight contingencies influence the outcome of RVSM safety assessments.

24

Parameter Values Assessed by GTE

- One of the main objectives of the GTE is to identify the following parameter values for each reported LHD:
  - Cleared flight level
  - Event flight level
  - Duration at unplanned flight level
  - Total vertical deviation
  - Levels crossed
  - Levels final
  - Rate of climb or descent
  - Event category

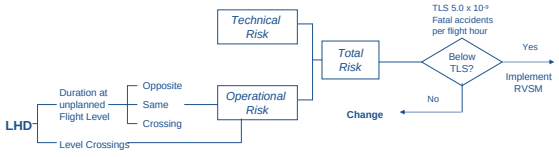
25

Methodology and Parameter Values

26

Collision Risk Model Overview

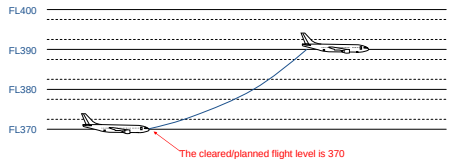
- The CRM established key parameters
  - Rate of LHD occurrences
  - Growth in traffic and congestion (reflected in passing frequency and occupancy
  - Lateral navigation performance



27

Cleared Flight Level

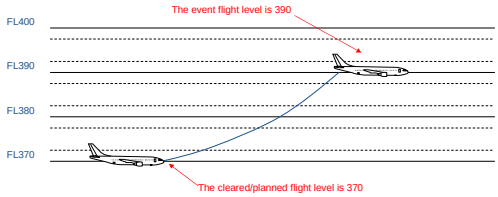
- The flight level at which the pilot was cleared or currently operating.
- For example, aircrew accepts a clearance intended for another aircraft and ATC fails to capture the read back error.



28

Event Flight Level

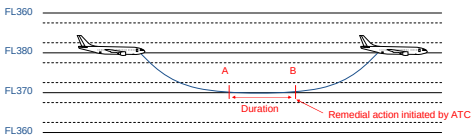
- The flight level of error or the incorrect altitude of operation for an identifiable period of time without having received an ATC clearance



29

Duration at Unplanned Flight Level

- The length of time that an aircraft was level at an altitude (flight level) that was not cleared, or planned, by air traffic control.
- Duration is recorded in one second increments.



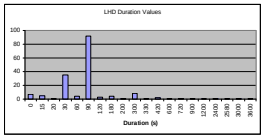
* The calculation of duration begins once the aircraft is level at a flight level other than the cleared level or planned level by ATC, and terminates once ATC initiates remedial action.

30

Default Value for Duration

- The GTE identified the need to establish a default duration value to assign to those events where there is not enough information included in the report to determine the time spent at incorrect flight level.
- Two default values were established, one for a radar environment and one for a non-radar environment

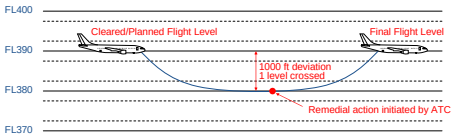
Radar Environment	Non-Radar Environment
90 seconds	90 seconds



31

Total Vertical Deviation

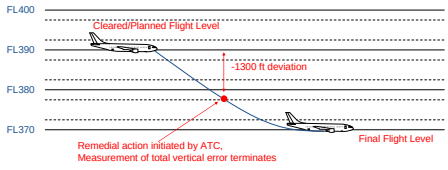
- The distance in feet between the altitude of current operation prior to the deviation and the point at which the aircraft is once again under ATC supervision.



32

Total Vertical Deviation

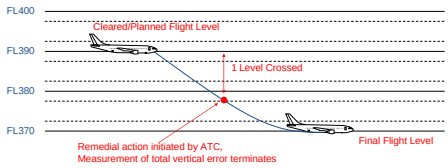
- Resumption of ATC supervision may occur at a point other than a flight level



33

Levels Crossed

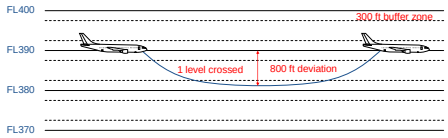
- The total number of flight levels between the point that the aircraft exits the cleared flight level and is once again under ATC supervision.



34

Levels Crossed

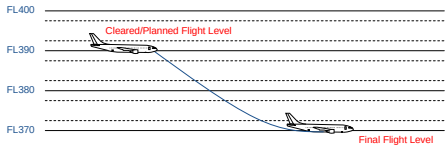
- The Scrutiny Group must consider the hazard zone when calculating the number of levels crossed.
- The value of the hazard zone is ± 90 m (300ft)
- This criterion shall be used to determine that a specific level is occupied by an aircraft



35

Levels Final

- The cleared flight level after the error/deviation
- Some reports of LHDs do not contain the final flight level. When this information is not available, the Scrutiny Group relies on operational expert judgment to determine the final flight level



36

Rate of Climb or Descent

- The rate of climb or descent of an aircraft crossing through an uncleared level also contributes to the estimate of operational risk.
- In most cases, this parameter value is not included in reports of large height deviations.
- The GTE established climb and descent rate default values.

37

Event Category

- Classification of each LHD event is necessary for risk assessment purposes and for the identification of adverse trends
- Each LHD event is assigned an error type code that identifies the type of event that caused the deviation

38

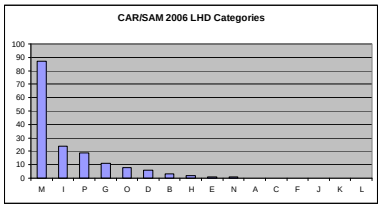
Error Classification Scheme

A	Failure to climb/descend as cleared
B	Climb/descend without ATC clearance
C	Entry into airspace at an incorrect flight level
D	Deviation due to turbulence or other weather related cause
E	Deviation due to equipment failure
F	Deviation due to collision avoidance system (TCAS) advisory
G	Deviation due to contingency event
H	Aircraft not approved for operation in RVSM restricted airspace
I	ATC system loop error; (e.g. pilot misunderstands clearance message or ATC issues incorrect clearance)
J	Equipment control error encompassing incorrect operation of fully
K	Incorrect transcription of ATC clearance or re-clearance into the FMS
L	Wrong information faithfully transcribed into the FMS (e.g. flight plan followed rather than ATC clearance or original clearance followed instead of re-clearance)
M	Error in ATC-unit-to-ATC-unit transition message
N	Negative transfer received from transitioning ATC-unit
O	Other
P	Unknown

39

Analysis

- It is the responsibility of the GTE to summarize their findings and analyze the data with the goal of identifying adverse trends and assess the overall risk



40

Analyzing LHD Data Over Time

- Maintaining a cumulative summary of analyzed LHD events will allow the GTE to determine the following:
  - The frequency of occurrence
  - Whether errors appear to occur systematically or randomly in time
  - Time between each event
  - Effect of airspace changes, if any, since RVSM implementation

41

Identify trends

- One important function of the GTE is to identify adverse trends
- The GTE will evaluate grouped event categories and determine whether one particular event type occurs more often than another.
- The GTE will also identify operational trends that may be revealed in the data. If any exist, the Group may make recommendations for reducing the effect of those trends

42

Remedial Recommendations

- If adverse trends are identified, the GTE will submit recommendations for remedial actions to ensure that operational errors are kept to a minimum and that the airspace being examined continues to satisfy the requirements of the target level of safety
- The actions and measures proposed to reduce risk should not be exclusive to RVSM airspace

43

Reporting

- The GTE reports annually to the RMA the results of its operational analysis including the identification of performance trends, summary of categories and estimation of duration at incorrect flight level, and recommended measures to reduce the risk in RVSM airspace.
- The RMA will incorporate the analysis of the Scrutiny Group in its report to the ICAO Regional Planning Group (GREPECAS) for the CAR/SAM regions.

44

Meeting Frequency

- The Scrutiny Group should meet regularly so that adverse trends due to operational errors that cause large height deviations can be identified quickly and remedial actions can be taken.

45

Agenda Item 2: GTE Overview

a) **Review of Terms of Reference**
b) **Background**
c) **Composition**
d) **Objectives**
e) **Methodology**
f) **Reporting**

2.1 Under this agenda item, the meeting reviewed the work programme and terms of reference of the Scrutiny Group (SG) (See **Appendix A** to this part of the report).

2.2 Also, the meeting recalled that GREPECAS took note that RVSM post-implementation safety assessment carried considering the technical risk plus the risk for all the other causes, shows that the total risk for the CAR/SAM Regions is greater than the TLS agreed and that this total risk is influenced by large-height deviations (LHD).

2.3 Taking into consideration that the Scrutiny Group (SG) in analyzing the LHD, verified that errors are not caused by RVSM operation but for common procedures in aircraft transference from an ATC unit to another one. For this reason, new corrective actions at short and mid term were proposed, therefore, GREPECAS/13 considered that these measures are additional to those contained in Conclusion 13/61.

2.4 In addition to the short-term actions, to find a solution to the identified LHD cause, GREPECAS encouraged States and International Organizations to implement a safety management system and as far as possible, as a technological defense, to gradually implement data communications between ATS (AIDC).

2.5 On the other hand, GREPECAS/14 considered that in order to significantly reduce the occurrence of this type of errors, CAR/SAM States and International Organizations should, as an urgent matter, commit to adopt the measures referred in Conclusion GREPECAS 13/61 “Measures to reduce operational errors in the ATC coordination loop between adjacent ACCs”, and particularly the error prevention programme in ATC coordination cycle between adjacent ATS units, associated to the referred conclusion and additional measures previously described (See **Appendix B** to this part of the report).

Reference Guide

2.6 The delegation from United States presented a reference guide to the meeting, describing the conformation, purposes, and SG methodology so that it serves as consultation material by interested parties in the activities being carried out by this Working Group. The Reference Guide is shown in **Appendix C** to this part of the report.

2.7 In general terms, the guide presents the role and responsibilities of a Regional Monitoring Agency, the establishment of the Scrutiny Work Group (SG), its composition, objectives, data collection, revision and data evaluation, methodology to carry out LHD reports analysis, error codes table, etc.

APPENDIX A

TERMS OF REFERENCE OF THE CAR/SAM RVSM SCRUTINY GROUP (RVSM/GTE)

a) To assemble subject matter experts, as needed, in air traffic control, aircraft operations and maintenance, regulation and certification, data analysis and risk modeling;

b) To analyze and evaluate large height deviations of 300 ft or greater as defined by ICAO Doc 9574;

c) To coordinate the assembly and review of large height deviation data with the Regional Monitoring Agency;

d) To produce an estimate of flight time away from the cleared flying level to be used a primary input in the preparation of an estimate of risk by the Regional Monitoring Agency;

e) To identify large height deviation trends and to recommend remedial actions in order to improve safety;

f) To report results to GREPECAS through the ATM/CNS subgroup;

g) To accomplish other tasks as directed by GREPECAS.

Composition: 1 State/Organization from the CAR Region, 1 State/from the SAM Region, United States, CARSAMMA, COCESNA, IATA, IFALPA, IFATCA.

APPENDIX B

ERROR PREVENTION PROGRAMME IN THE COMMUNICATIONS BETWEEN ADJACENT ACCs

CONCLUSION 13/61 MEASURES TO REDUCE OPERATIONAL ERRORS IN THE ATC COORDINATION LOOP BETWEEN ADJACENT ACCs

That, taking into account the impact that operational errors in the ATC coordination loop between adjacent ACCs have on safety, the CAR/SAM States/Territories/International Organizations agree:

a) to adopt, as a matter of urgency, the appropriate measures described in **Appendix AI** to this part of the Report, in order to reduce LHDs caused by errors in ATC-unit-to-ATC-unit traffic coordination messages by at least 50% by **December 2005**, with a view to reaching the optimum operational efficiency;

b) to continue with the efforts and programmes in order to reach 100% operational efficiency of their ATC coordination; and

c) that ICAO coordinate, assist in, a follow-up the implementation of such remedial action and report the results of the effort to reduce this error to the 6th Meeting of the ATM Committee.

ERROR PREVENTION PROGRAMME IN THE COMMUNICATIONS BETWEEN ADJACENT ACCs

There are many initiatives that can be pursued to prevent operational errors from occurring. However, there are five primary areas, which can directly contribute to its prevention: **communications, phraseology, supervision, teamwork, and ATC proficiency**. In an effort to accomplish the goal of reducing communication errors between adjacent Area Control Centres and thus reduce or minimize the occurrence of large-height deviations, the following objectives should be included in the prevention programme:

The ATS authority shall:

a) identify individual, procedural, and/or equipment deficiencies used in air traffic services;

b) promptly correct individual, procedural, and/or equipment deficiencies which affect coordinations with adjacent and ATS units. This can be achieved through:

- guidance on procedures to be followed;
- implementation of read-back/hear-back programmes;
- training in the filling of LHD forms;
- increase and/or closer monitoring of ATCOs performance;

-
- immediate coordination programme after a re-authorization or change in flight level;
- changes in procedures and/or corrections/amendments of equipment.

c) communicate performance expectations to ATS supervisors and controllers;

d) ensure the ATS unit maintains a summary of and have information letters on operational errors, causal factors and trends, and incorporate them into training;

e) monitor and evaluate voice recordings (all ATS operational personnel);

f) take initiatives to improve communications among all ATS personnel to create an atmosphere conducive to sharing information;

g) exercise strict monitoring in ATC units;

h) ATS supervisors should:

- communicate performance expectations to controllers, stressing the importance of operational control position discipline, awareness, teamwork, the use of proper phraseology, proper coordination procedures, control position relief briefings and utilization of a position relief checklist;
- take prompt follow-up actions when controller performance does not meet with expectations;
- inform on individual and team accountability, and the consequences for not meeting expectations;
- provide efficient and consistent oversight of the ATS unit operation, and use effective resource management to ensure proper and timely assignment of personnel to promote the safe, orderly, and expeditious handling of air traffic;
- ensure that distractions and noise levels in the ATS unit are kept at a minimum;
- require all personnel to maintain a high degree of professionalism, teamwork, control position discipline, and awareness at all times in the ATS unit environment; and require that each controller knows, applies, and adheres to the appropriate requirements in the performance of his/her operational duties and responsibilities;
- promote an open flow of communications with all ATS personnel, allowing them to provide input to programme;
- place emphasis on hear-back/read-back errors during team meetings.

i) ATC personnel should:

- apply read-back/hear-back procedures when carrying out ATC coordinations;
- keep ATS supervisors advised of traffic problems and equipment limitations;
- make suggestions for ATS unit improvements and/or prevention of operational errors;
- maintain situational awareness;
- extend the extra effort to assist busier control position(s);
- continuously review their own operating techniques and ATS unit procedures to effect the highest quality of performance;
- promptly report all ATS incidents to the operational supervisor or other appropriate ATS

- authority for proper follow-up investigation;
- utilize memory aids.

VOICE RECORDING EVALUATIONS

Voice recording reviews should be conducted to ensure proper phraseology, good operating practices, and adherence to the standards set forth in ICAO provisions, and national/local directives and practices. Voice recording reviews should be conducted as follows:

a) the ATS unit should ensure that voice recording reviews are conducted at least semi-annually on all ATS operational personnel;

b) the ATS supervisor should review the voice recording, document comments and develop an action plan for documenting performance deficiencies; and

c) the ATS supervisor and the controller should review and discuss the voice recording.

ADDITIONAL SHORT AND MEDIUM TERM MEASURES APPROVED BY GREPECAS/14

Actions suggested as short term solution:

a) That States, authorities and International Organizations continue their excellent compliance with the LHD requirements to report CARSAMMA on a monthly basis, and

b) That States, authorities and International Organizations distribute a copy of category "M", Error messages in ATC unit to ATC unit in transference messages and category "N", messages ("No ATC unit transference message was received"), received from transitioning ATC-unit LHD reports only to the adjacent ACC involved in addition to CARSAMMA.

c) When a trend is identified from shared reports, the States, Territories, and International Organizations shall share information and shall meet on a bilateral basis to develop a solution to the cause of the identified LHD.

d) Because some ACCs adjoin international oceanic airspace, ICAO NACC and SAM Regional Offices are requested to advise the corresponding adjacent ICAO regional Offices (EUR/NAT, WACAF) that said LHD report will be forthcoming from the adjacent ACC and urge positive interaction with reporting CAR/SAM unit.

Actions suggested as a medium term solution:

a) In an effort to eliminate the largest contributing LHD error category "M", the solution is to implement a quality management programme based upon safety management concepts outlined in Annex 11 amendment 44.

b) The "*Progressive implementation of ATS interfacility data communications (AIDC)*" will enhance the safety of the airspace and would reduce category "M" error. However, it is a medium term project incurring a large expense and hereby encourages that the CAR/SAM Regions States begin arrangements to submit to the World Bank an application for sufficient monies to enhance such implementation systems. The Meeting recalled that the AIDC is seen within the Automation Task Force Program and therefore is not required another action at this point

International Civil Aviation Organization

CARIBBEAN AND SOUTH AMERICAN RVSM GRUPO DE TRABAJO DE ESCRUTINIO (CAR/SAM RVSM GTE)

REFERENCE GUIDE

1. Introduction

1.1. This reference guide is a consolidation of materials describing the construction, purpose and methodology of the CAR/SAM RVSM Grupo de Trabajo de Escrutinio (GTE). It is intended to be used as a basic reference for anyone interested in Scrutiny Group activity.

1.2. It is essential that regional authorities take into account all possible means of ascertaining and reducing the level of risk of collision resulting from operational errors that cause large height deviations (LHD). The CAR/SAM RVSM GTE is the primary group to evaluate and assess the operational aspects of large height deviations.

2. Background

2.1. System Performance Monitoring

2.1.1. Experience has shown that large height deviations, a deviation in the vertical dimension from the cleared flight level whereby established margins of separation may be eroded, of 90 m (300 ft) or greater in magnitude have a significant impact on operational and technical risk in RVSM airspace. The causes of such deviations have been found to be, but are not limited to:

a) an error in the altimetry or automatic altitude control system of an aircraft;

b) turbulence and other weather-related phenomena;

c) an emergency descent by an aircraft without the crew following established contingency procedures;

d) response to airborne collision avoidance system (ACAS) resolution advisories;

e) not following an ATC clearance, resulting in flight at an incorrect flight level;

f) an error in issuing an ATC clearance, resulting in flight at an incorrect flight level; and

g) errors in coordination of the transfer of control responsibility for an aircraft between adjacent ATC units, resulting in flight at an incorrect flight level.

The additional risk associated with operational errors and in-flight contingencies influence the outcome of RVSM safety assessments. A diagram illustrating the LHD contribution to the overall risk assessment is included in Appendix A.

2.1.2. System performance monitoring, as outlined in ICAO doc 9574, is necessary to ensure the continued safe use of reduced vertical separation minimum (RVSM) and that

established safety goals are met. This activity includes monitoring the minimum risk of collision associated with operational errors and in-flight contingencies. The monitoring process is divided into two main categories:

a) Risk associated with the aircraft technical height-keeping performance (technical risk), and

b) The overall risk, i.e. risk due to all causes.

2.1.3. The monitoring process involves the collection and evaluation of operational data. Appropriate methodologies will need to be in place to process this data in order to enable comparison with regionally agreed overall safety objectives.

2.2. Regional Monitoring Agency (RMA) Roles and Responsibilities

2.2.1. ICAO Doc 9574 describes a five-step implementation process for introduction of the RVSM. Among other actions required, the implementation process calls for establishment of a regional monitoring agency (RMA) to act as the safety oversight body. The RMA is required to conduct regular comprehensive safety assessments in order to ensure that the Target Level of Safety (TLS) is met. That is, that the risk associated with the RVSM as estimated by ICAO risk modeling is less than the TLS value. In other words, the RMA determines if the estimated risk of collision, calculated in accordance with ICAO collision risk methodology, is less than the agreed TLS.

2.2.2. A critical component of RVSM safety assessment, as well as a system performance monitoring requirement, is the analysis of large height deviations.

2.2.3. It is the responsibility of the cognizant RMA to establish a program for identifying large height deviations and a mechanism for collecting and analyzing reports of such deviations. It is also the responsibility of the RMA to provide periodic reports of observed height deviations to the appropriate PIRG and/or its subsidiary bodies, in accordance with procedures prescribed by the PIRG.

2.2.4. The Caribbean-South American Monitoring Agency (CARSAMMA) is the regional monitoring agency (RMA) established by GREPECAS to conduct this work for the Caribbean and South American regions.

2.2.5. While the RMA will be the recipient and archivist for reports of large height deviations, it is important to note that the RMA alone cannot be expected to conduct all activities associated with a comprehensive program to detect and assess large height deviations.

2.3. Establishment of a Reduced Vertical Separation Minimum Scrutiny Group

2.3.1. To assist the RMA in analyzing LHDs, a body of experts has been established by GREPECAS. This group of operational, ATC, flight crew and safety experts is called a Scrutiny Group, Grupo de Trabajo de Escrutinio (GTE). The GTE Terms of Reference is included in Appendix B.

3. Composition

3.1. The Scrutiny Group requires a diverse set of subject-matter experts. The Group is composed of subject matter experts in air traffic control, aircraft operations and maintenance, regulation and certification, data analysis, and risk modeling from the involved regions.

3.2. In the CAR/SAM regions, the following organizations are represented in the Scrutiny Group:

a) The Caribbean and South American Monitoring Agency (CARSAMMA)

b) The Federal Aviation Administration (FAA)

c) Dirección Générale de l'Aviation Civile (DGAC)

d) International Federation of Air Line Pilots' Associations (IFALPA)

e) Corporación Centroamericana de Servicios de Navegación Aérea (COCESNA)

f) Corporación Peruana de Aeropuertos y Aviación Comercial S.A. (CORPAC S.A.)

3.3. Scrutiny Groups in other regions have recommended the formation of a Scrutiny Sub-Group. Participation in the Sub-Group is by subject matter experts and specialists. The Sub-Group is responsible for executing the preparatory work for the Scrutiny Group including the analysis and categorization of selected large height events. The Scrutiny Group shall govern the decisions proposed by the Sub-Group. Sub-Group members are drawn from the Scrutiny Group.

4. Objectives

4.1.1. The Scrutiny Group’s work contributes directly to the requirement to provide on-going assessment of factors which affect the estimate of collision risk in RVSM airspaces.

4.1.2. The initial result of the Group’s effort is to examine the “event” reports and produce an estimate of time spent at a flight level other than cleared. This estimate is used as a primary input used in the preparation of an estimate of the operational risk for the implementation of Reduced Vertical Separation Minimum (Appendix A). The Group examines both technical risk (affected by reliability and accuracy of the avionics within the aircraft) and operational risk (affected by the human element) in the development of the safety assessment.

4.1.3. Once the Group has made its initial determination, the data are reviewed to look for performance trends. If any adverse trends exist, the Group may make recommendations for reducing or mitigating the effect of those trends as a part of the RVSM

implementation. Subsequently, the Group will meet to examine the post-implementation record of performance and to assure that operational errors are kept to a minimum. This information is used to assure that the airspace being examined continues to satisfy the requirements of the target level of safety, which is necessary to support continued RVSM operations. New procedures or other mitigation strategies to reduce occurrences of large height deviations may evolve out of this process.

5. Data Collection

5.1.1. It is the responsibility of the relevant RMA, CARSAMMA, to establish procedures for the collection of information concerning large height deviations of 90m (300ft) or greater in magnitude

5.1.2. The primary source for reports of LHDs is the ATC units. Surveillance data collected by ATC units provides the basis for identifying large height deviations. ATC units should be required to submit monthly reports of large height deviations to the cognizant RMA.

5.1.3. CARSAMMA, with the advisement of the GTE, created a LHD reporting form designed to capture the information necessary to accurately assess large height deviations. The form is available in three different languages, Portuguese, Spanish, and English and is accessible on CARSAMMA's web site at the following location: http://www.cgna.gov.br/CARSAMMA/siteUSA/inicial.htm . A sample of this form is included in Appendix C.

5.1.4. Accessibility of LHD reporting materials is essential to encourage the reporting of events by all parties involved in the provision of air traffic services.

5.1.5. The GTE will explore all sources for reports of large height deviations such as State databases of air safety incident reports and voluntary reporting safety databases.

5.1.6. When analyzing reports of large height deviations, the primary concern of the GTE is the impact of such events on the collision risk and on the overall safety of the system. Data collected by the GTE is used for analysis purposes only and all LHD events reviewed by the GTE are de-identified. Confidentiality will be maintained.

6. Data Review and Evaluation

6.1.1. The methodology employed by the GTE is to examine existing databases as well as other sources and analyze events resulting in a large height deviation of 300ft or greater within FL290-FL410. These events are usually the result of Air Traffic Control (ATC) loop errors (the undiscovered misunderstanding of a clearance), instances wherein a controller fails to capture an inaccurate read-back, an altitude over or undershoot, turbulence situations, emergencies, errors in coordination, weather complications or response to an ACAS resolution advisory. The largest source of reports useful for these purposes comes from the established regional safety reporting systems. However, in many instances these reports are designed for other purposes so they may lack the clarity on information that would be desirable to the GTE. Thus, the experience of the members

of the Scrutiny Group is essential in order to infer the effect, if any, the events have on risk in the airspace. All data sources undergo an initial review using key RVSM parameters and all reports of interest are extracted for further evaluation.

7. Methodology

7.1.1. The GTE is tasked with the responsibility of analyzing all reports of interest and assigning parameter values, as defined in the GTE LHD White Paper (Appendix D), that consist of cleared flight level, event flight level, levels crossed, final flight level, duration at unplanned flight level and total vertical deviation. Since the reports are not tailored for the needs of the Scrutiny Group, these values are not typically clearly defined. The GTE must rely on the expert judgment and operational experience of its members to assign these values.

7.2. Parameter Values

7.2.1. Cleared Flight Level

7.2.1.1. The flight level at which the pilot was cleared or currently operating. For example, aircrew accepts a clearance intended for another aircraft and ATC fails to capture the read back error or aircrew conforms to a flawed clearance delivered by ATC.

7.2.1.2. This parameter, in some cases, will require expert judgment and operational experience to assign a value. The Scrutiny Group must take into consideration the controller's plan versus the cleared flight level.

7.2.2. Event Flight Level

7.2.2.1. The event flight level is the flight level of error or the incorrect altitude of operation for an identifiable period of time without having received an ATC clearance

7.2.3. Duration at Unplanned Flight Level

7.2.3.1. The greatest exposure to risk is the time spent level at a flight level other than the cleared level. This parameter value contributes significantly to the calculation of operational risk.

7.2.3.2. The duration at unplanned flight level is the length of time that an aircraft was level at an altitude (flight level) that was not cleared, or planned, by air traffic control. Duration is recorded in one second increments.

7.2.3.3. The calculation of duration begins once the aircraft is level at a flight level other than the cleared level or planned level by ATC, and terminates once ATC initiates remedial action.

Figure 1 illustrates a large height deviation that has a duration value larger than zero. The duration calculation begins and point A and terminates and point B.

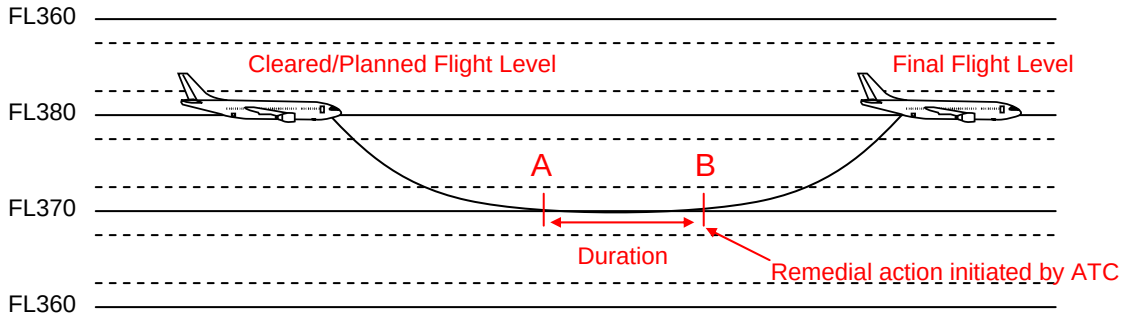


Figure 1.

7.2.3.4. It is important to note that not all large height deviations result in the aircraft being level at a flight level other than that cleared or planned by ATC; therefore, some events are assigned a duration value of zero.

7.2.3.5. It is also important to note the duration value determined or assigned by the GTE of LHDs that occur in a radar environment will vary significantly from that of a non-radar environment.

7.2.3.6. In most cases, LHD reports reviewed by the GTE lack the information necessary to calculate the time spent at incorrect flight level. Thus, the experience of the members of the Scrutiny Group is essential to provide in-depth analysis of each event

7.2.3.7. If the Scrutiny Group is unable to determine the time spent at incorrect flight level, a default value is assigned.

7.2.3.8. The GTE identified the need to establish a default duration value to assign to those events where there is not enough information included in the report to determine the time spent at incorrect flight level. Two default values were established, one for a radar environment and one for a non-radar environment. The default values are included in the GTE LHD White Paper, Appendix D.

7.2.4. Total Vertical Deviation

7.2.4.1. Total vertical deviation is the distance in feet between the altitude of current operation prior to the deviation and the point at which the aircraft is once again under ATC supervision. A deviation that resulted in an increase of altitude will be recorded as a positive number and a deviation that resulted in a decrease of altitude will be recorded as a negative number.

7.2.4.2. Figures 2 and 3 illustrate two large height deviations of different magnitudes. The first example, Figure 2, illustrates a large height deviation with a magnitude of 1000ft. The second example, Figure 3, illustrates a large height deviation with a magnitude of 1300 ft.

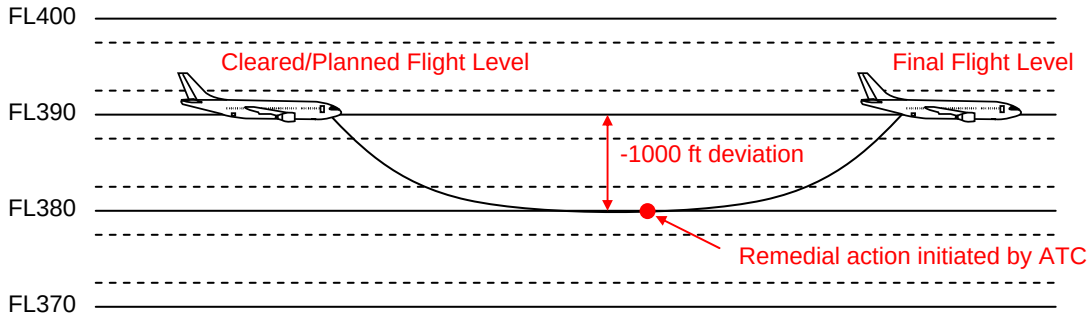


Figure 2.

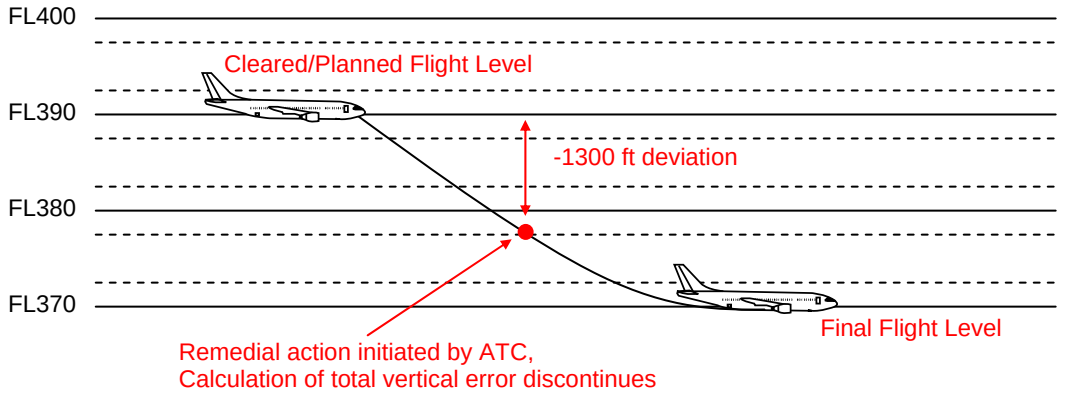


Figure 3.

7.2.5. Levels Crossed

7.2.5.1. The total number of flight levels between the point that the aircraft exits the cleared flight level and is once again under ATC supervision is calculated to determine the number of levels crossed. For example, in the examples provided in figures 2 and 3 in section 7.2.4.2, one level was crossed.

7.2.5.2. The Scrutiny Group must consider the hazard zone when calculating the number levels crossed. The hazard zone is also referred to as the buffer zone.

7.2.5.3. The hazard zone is the minimum physical distance of defined dimensions to accommodate:

a) Variations in an aircraft's flight path due to air movements, etc.;

b) The size of the aircraft;

c) An additional "miss" distance

7.2.5.4. The value of the hazard zone was determined to be ± 90 m (300ft). A brief explanation of the considerations underlying this value is included in paragraph 2.3.6.7 in the *Air Traffic Services Planning Manual (Doc 9426).* The explanation is also included in Appendix E

7.2.5.5. This buffer zone criterion shall be used to determine that a specific level is occupied by an aircraft. In the LHD illustrated in figure 4, the aircraft penetrates the buffer zone but does not reach the next flight level. Applying the criterion described in paragraph 7.2.5.4, the total number of levels crossed in this example is 1.

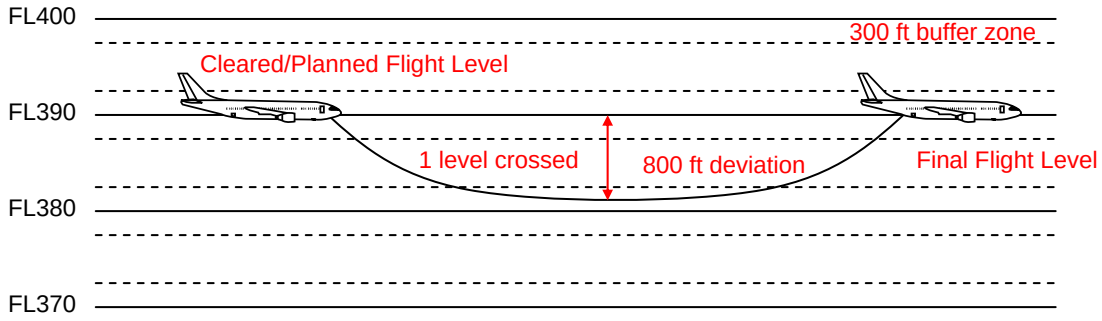


Figure 4

7.2.6. Levels Final

7.2.6.1. The final flight level is the cleared flight level after the error/deviation.

7.2.6.2. Some reports of large height deviations do not contain the final flight level. When this information is not available in the LHD report, the Scrutiny Group relies on operational expert judgment to determine the final flight level. The final flight level of the large height deviation illustrated in figure 5 is 370

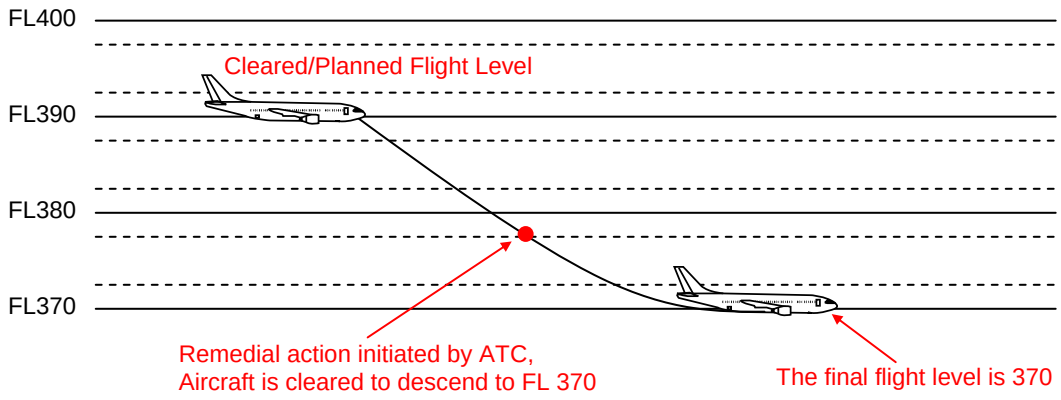


Figure 5.

7.2.7. Rate of Climb or Descent

7.2.7.1. The rate of climb or descent of an aircraft crossing through an uncleared level also contributes to the estimate of operational risk. In most cases, this parameter value is not included in reports of large height deviations. The GTE must rely on operational expert judgment to determine the rate of climb or descent.

7.2.7.2. The GTE established climb and descent rate default values. The default values are included in the GTE LHD White Paper (Appendix D)

7.2.8. Event Category

7.2.8.1. Classification of each LHD event is necessary for risk assessment purposes and for the identification of adverse trends. Each LHD event is assigned an error type code that identifies the type of event that caused the deviation. The error codes are categorized as operational or technical for consideration in the Collision Risk Model (CRM). A complete list of the error codes is included in table 1.

Table 1. Error Codes

A	Failure to climb/descend as cleared
B	Climb/descend without ATC clearance
C	Entry into airspace at an incorrect flight level
D	Deviation due to turbulence or other weather related cause
E	Deviation due to equipment failure
F	Deviation due to collision avoidance system (TCAS) advisory
G	Deviation due to contingency event
H	Aircraft not approved for operation in RVSM restricted airspace
I	ATC system loop error; (e.g. pilot misunderstands clearance message or ATC issues incorrect clearance)
J	Equipment control error encompassing incorrect operation of fully
K	Incorrect transcription of ATC clearance or re-clearance into the FMS
L	Wrong information faithfully transcribed into the FMS (e.g. flight plan followed rather than ATC clearance or original clearance followed instead of re-clearance)
M	Error in ATC-unit-to-ATC-unit transition message
N	Negative transfer received from transitioning ATC-unit
O	Other
P	Unknown

7.3. Analysis

7.3.1. It is the responsibility of the GTE to summarize their findings and analyze the data with the goal of identifying adverse trends and assess the overall risk.

7.3.2. The benefits of analyzing LHD data over time

7.3.2.1. Maintaining a cumulative summary of analyzed LHD events will allow the GTE to determine the following:

a) The frequency of occurrence

b) Whether errors appear to occur systematically or randomly in time

c) Time between each event

d) Effect of airspace changes, if any, since RVSM implementation

7.3.3. Identify trends

7.3.3.1. The cumulative LHD summary is also used to identify adverse trends. The Scrutiny Group will evaluate grouped event categories and determine whether one particular event type occurs more often than another. This particular analysis can also be applied to geographic regions.

7.3.3.2. The Scrutiny Group will also identify operational trends that may be revealed in the data. If any exist, the Group may make recommendations for reducing the effect of those trends.

7.4. Remedial Recommendations

7.4.1. If adverse trends are identified, the Scrutiny Group will submit recommendations for remedial actions to ensure that operational errors are kept to a minimum and that the airspace being examined continues to satisfy the requirements of the target level of safety, which is necessary to support continued RVSM operations.

7.4.2. It is important to bear in mind that height deviations, as a consequence of operational errors and in-flight contingencies, occur in all airspace irrespective of the separation minimum. The purpose of this monitoring activity is to ensure that operations in RVSM airspace do not induce an increase in the risk of collision from these events and that the total vertical risk does not exceed the agreed overall safety objectives. The actions and measures proposed to reduce risk should not be exclusive to RVSM airspace.

7.5. Reporting

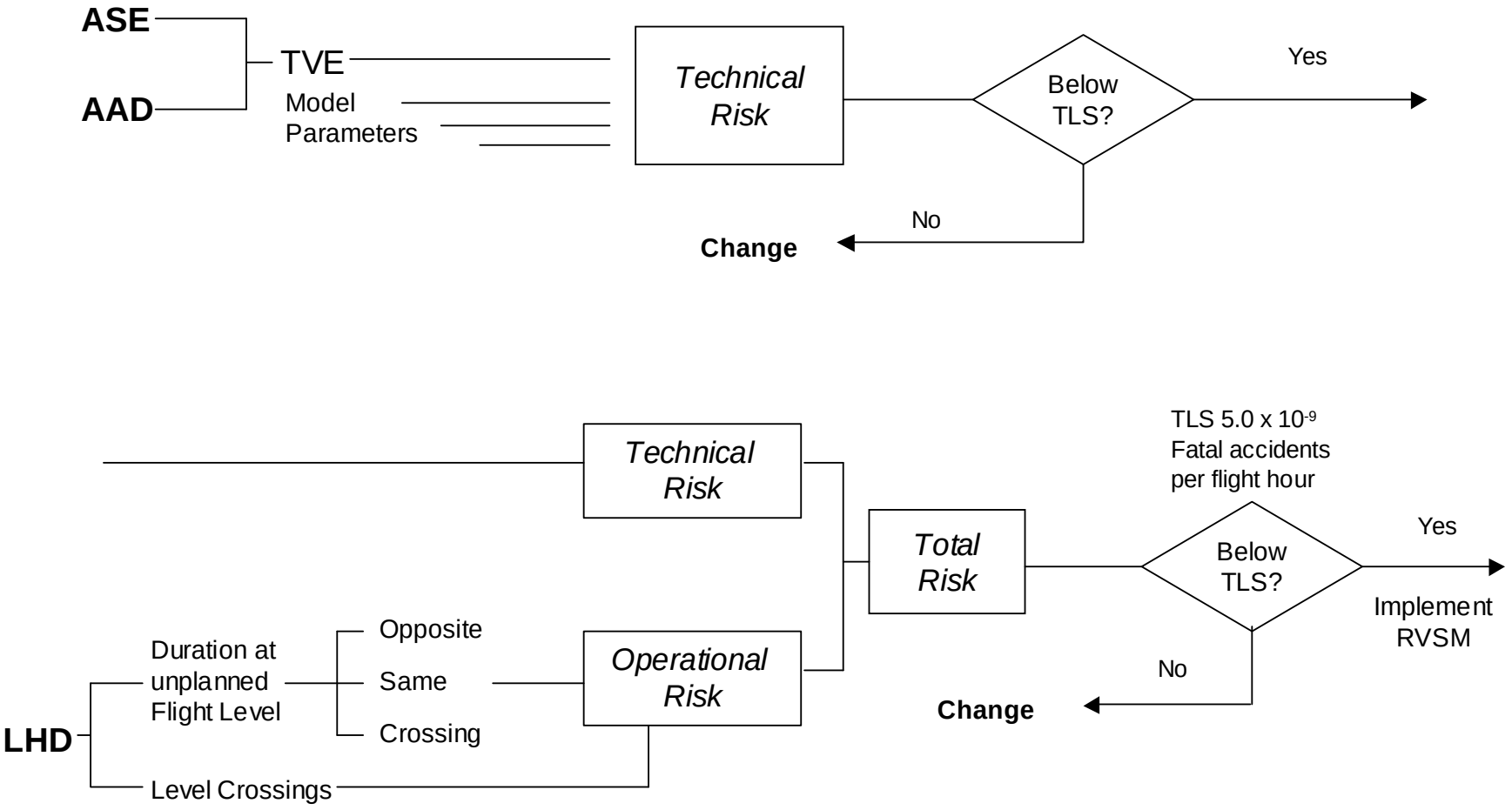
7.5.1. The Scrutiny Group reports annually to the RMA the results of its operational analysis including the identification of performance trends, summary of categories and estimation of duration at incorrect flight level, and recommended measures to reduce the risk in RVSM airspace. The RMA will incorporate the analysis of the Scrutiny Group in its report to the ICAO Regional Planning Group (GREPECAS) for the CAR/SAM regions.

7.6. Meeting Frequency

The Scrutiny Group should meet regularly so that adverse trends due to operational errors that cause large height deviations can be identified quickly and remedial actions can be taken.

Appendix A

RVSM Dataflow and Decision-Making Process Highlighting Scrutiny Activities



Appendix B

Terms of Reference of the CAR/SAM RVSM Grupo de Trabajo de Escrutinio (RVSM/GTE)

a. To assemble subject matter experts, as needed, in air traffic control, aircraft operations and maintenance, regulation and certification, data analysis and risk modeling;

b. To analyze and evaluate large height deviations of 300 ft or greater as defined by ICAO Doc 9574;

c. To coordinate the assembly and review of large height deviation data with the Regional Monitoring Agency;

d. To produce an estimate of flight time away from the cleared flying level to be used a primary input in the preparation of an estimate of risk by the Regional Monitoring Agency;

e. To identify large height deviation trends and to recommend remedial actions in order to improve safety;

f. To report results to GREPECAS through the ATM/CNS subgroup;

g. To accomplish other tasks as directed by GREPECAS.

Composition: 1 State/Organization from the CAR Region, 1 State/Organization from the SAM Region, United States, CARSAMMA, COCESNA, IATA, IFALPA, IFATCA.

Appendix C

CARSAMMA
Caribbean and South American Monitoring Agency

The information contained in this form is confidential and will be used for safety analysis purposes only.

ALTITUDE DEVIATION FORM

Report to the CARSAMMA of an altitude deviation of 300ft or more, including those due to TCAS, Turbulence and Contingency Events

Today's date:	Reporting Unit:		
INCIDENT DETAILS			
Operator Name:	Call Sign:	Aircraft Type:	Mode C Displayed:
Date of Occurrence:	Time UTC:	Occurrence Position (lat/long or Fix):	
Cleared Route of Flight:			
Cleared Flight Level:	Estimated Duration at Incorrect Flight Level (seconds):		Observed Deviation (+/- ft):
Other Traffic Involved:			
Cause of Deviation (*brief title*): (Examples: ATC Loop Error, Turbulence, Weather, Equipment Failure)			

AFTER SEPARATION RESTORED:		
Observed/Reported Final Flight Level*: *Please indicate the source of information – ModeC/Pilot	Mark the appropriate box Is the FL above the cleared level: ❑ Is the FL below the cleared level: ❑	Did this FL comply with the ICAO Annex 2 Tables of Cruising Levels? ❑ Yes ❑ No

NARRATIVE
Detailed Description of Incident (*Please give your assessment of the actual track flown by the aircraft and the cause of the deviation.*)

CREW COMMENTS (IF ANY)

When complete please forward the report(s) to:

Management Center Of Air Navigation Caribbean and South American Monitoring Agency (CARSAMMA)
Av. Brig. Faria Lima, 1941
São José dos Campos, SP
Cep: 12227-000 Brazil
Telephone: (55-12) 3904-5004 or 3904-5010
Fax: (55-12) 3941-7055
E-Mail: carsamma@cgna.gov.br

Appendix D

Grupo de Trabajo de Escrutinio (GTE) Large Height Deviation (LHD) White Paper

Description of Criteria

Note: *The following terms, expressions and definitions are not approved by the ICAO's Council and should be used for analysis of Large Height Deviation purpose only.*

Cleared Flight Level – the flight level at which the pilot was cleared or currently operating (eg, Aircrew accepts a clearance intended for another aircraft and ATC fails to capture the read back error or aircrew conforms to a flawed clearance delivered by ATC)

Reference Flight Level – The altitude that would have provided at least the minimum separation (vertical or horizontal) required

That flight level from which the Height Deviation is calculated; this level may be different from the Cleared Flight Level and must often be determined by the Scrutiny Group operational experts from the data in the Large Height Deviation report

Event Flight Level – the flight level of error, the incorrect altitude of operation for an identifiable period of time without having received an ATC clearance

Height Deviation – any altitude variation of 300ft or greater from the assigned altitude, these variations can be the result of turbulence, equipment malfunction, ATC loop errors, etc.

ATC Loop Errors – any incident where there is a misunderstanding between the pilot and the controller, failure to properly coordinate altitude information or unable to maintain situational awareness

Total Deviation – the total amount of feet between the altitudes of current operation prior to the deviation and the point at which the aircraft is once again under ATC supervision, a deviation that resulted in an increase of altitude will be recorded as a positive number, a deviation that resulted in a decrease of altitude will be recorded as a negative number

Hazard Zone – 300ft buffer zone above and below each flight level (Diagram 1-A)

Duration - length of time that an aircraft was level at an altitude that was not cleared by air traffic control, duration will be recorded in one second increments (Diagram 1-A), if the Scrutiny Group is unable to determine the time spent at incorrect flight level, a default value is assigned. The default values are included in Table 1.

Table 1. Duration Default Values

Radar	**Non-Radar**
90 s	90 s

Levels Crossed – the total number of flight levels between the point that the aircraft exits the cleared flight level and is once again under ATC supervision (Diagram 1-A)

Levels Final – the cleared flight level after the error/deviation

Code – a category and a subcategory assigned to each event (Diagram 1-B)

Rate of Climb or Descent – the climb and descent values are included in Table 2.

Table 2 Climb and Descent Values

Rate of Descent		**Rate of Climb**	
Drift	1000 ft per minute	Minimum	500
Normal	1500+ ft per minute	Normal	750
Rapid	2500+ ft per minute	Expedite	1250

Diagram 1-A

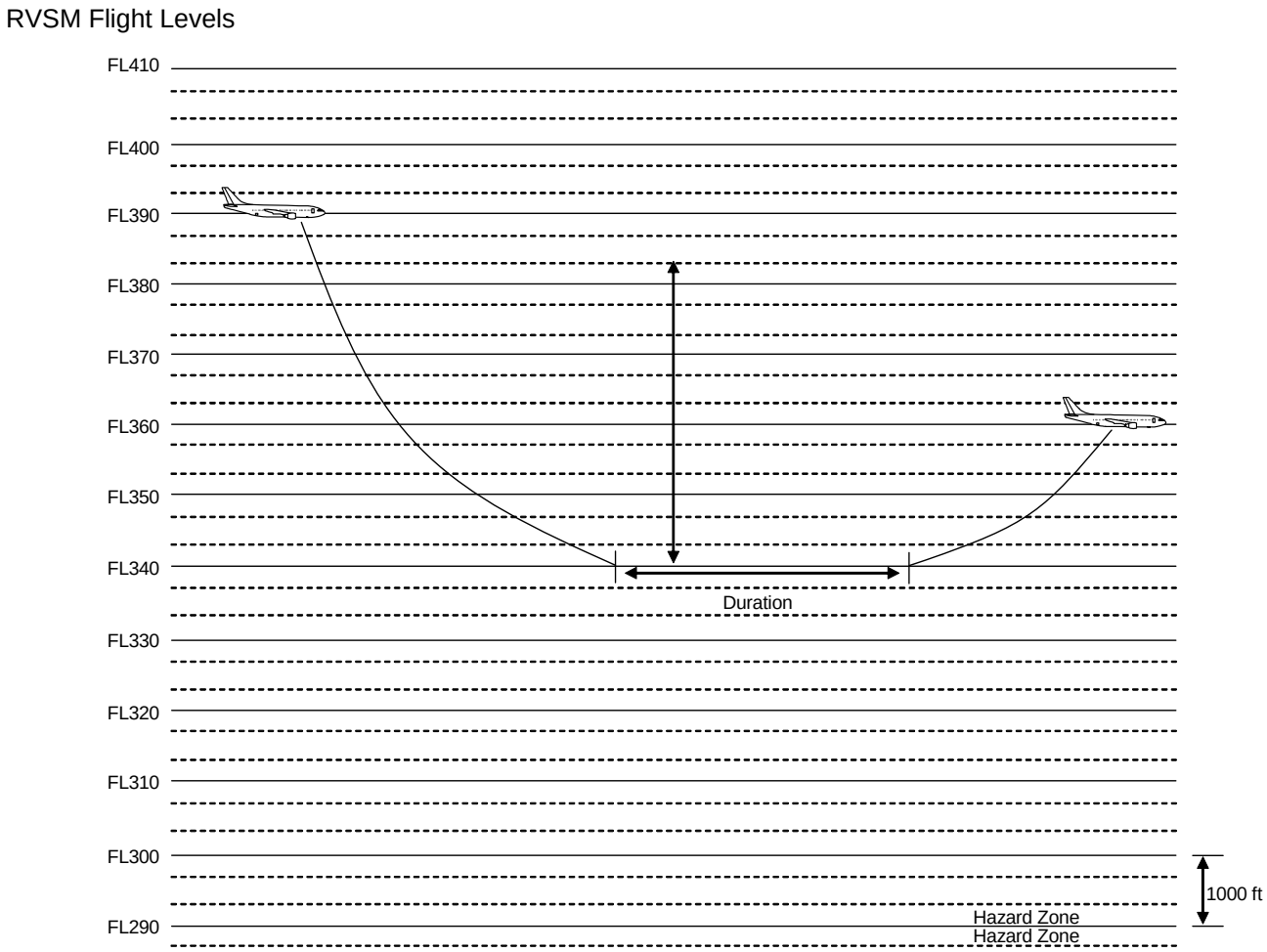

RVSM Flight Levels
FL410
FL400
FL390
FL380
FL370
FL360
FL350
FL340
FL330
FL320
FL310
FL300
FL290
Duration
1000 ft
Hazard Zone
Hazard Zone

Diagram 1-B

Error Codes

Code	Cause of Large Height Deviation
A	Failure to climb/descend as cleared
B	Climb/descend without ATC clearance
C	Entry into airspace at an incorrect flight level
D	Deviation due to turbulence or other weather related cause
E	Deviation due to equipment failure
F	Deviation due to collision avoidance system (TCAS) advisory
G	Deviation due to contingency event
H	Aircraft not approved for operation in RVSM restricted airspace
I	ATC system loop error ; (e.g. pilot misunderstands clearance message or ATC issues incorrect clearance)
J	Equipment control error encompassing incorrect operations of fully functional FMS or navigation system (e.g. by mistake the pilot incorrectly operates INS equipment)
K	Incorrect transcription of ATC clearance or re-clearance into the FMS
L	Wrong information faithfully transcribed into the FMS (e.g. flight plan followed rather than ATC clearance or original clearance followed instead of re-clearance)
M	Error in ATC-unit-to-ATC-unit transition message
N	Negative transfer received from transitioning ATC-unit
O	Other
P	Unknown

Appendix E

2.3.6.7 *Accuracy of SSR Mode C data*

2.3.6.7.1 The use of SSR Mode C data must take account of the following errors affecting accuracy:

a. Correspondence error, reflecting discrepancies between level information used and the level information encoded for automatic transmission. The maximum value of this error has been accepted to be f ± 38 m (125 ft) (95 per cent probability) (cf. ICAO Annex 10, Volume I, Part I, 3.8.7.12.2.5);
b. Flight technical error, reflecting inevitable deviations by aircraft from intended levels as a reaction to flight control operations, turbulence, etc. This error, when related to manually flown aircraft, tends to be larger than that for aircraft controlled by automatic pilots. The maximum value of this error used so far, based on a 95 per cent probability, is ± 60 m (200 ft) (cf. *Report of COM/OPS Divisional Meeting (1966)*, Item 9, page 9-35, 4.2). However, it should be noted that a number of factors contributing to this value have been improved since.

2.3.6.7.2 The mathematical combination of the non-related errors in a) and b) above results in a value of ± 72 m (235 ft) (based on a 95 per cent probability) and it is therefore believed that a value of f ± 90 m (300 ft) constitutes a valid decision criterion to be applied in practice when:

a. Verifying the accuracy of SSR Mode C data;
b. Determining the occupancy of levels.

Agenda Item 3: Large Height Deviation (LHD) Analysis

a) **Application of GTE methodology to LHD events**
b) **Summarize parameter values**
c) **Identify operational trends**

3.1 Under this agenda item, the meeting reviewed all 90 m (300 ft) large-height deviations (LHD) occurrences provided by CARSAMMA and informed by CAR/SAM States in the period January 2007 to December 20007. The evolution of such reports is shown at **Appendix A** to this part of the report.

3.2 Under this task, the meeting reviewed, among other data, the flight estimated times in incorrect flight levels, large height deviations (LHD) in each one of the reports, flight levels crossed in these deviations, and reviewed the causes of each one of them. These values shall be used to estimate the operational risk of operations carried out in the RVSM airspace under the responsibility of CARSAMMA.

3.3 In a first analysis, note was taken that LHD reports provided by Paraguay, corresponding to the Asuncion FIR informed on events that did not correspond to LHD occurrences, and for this reason it was agreed not to keep them into consideration and to recommend to the administration to take the necessary actions, so that personnel in charge of collecting such information, could receive training to facilitate the identification and filling of LHD occurrences form.

3.4 Also, that reports received by Ecuador are used to report other incidents different to those related with LHD, and for this reason the meeting requested CARSAMMA to consult with the Ecuadorian administration all LHD reports informed during the period January-December 2007 and to review if times shown in the same are accurate.

3.5 Note was also taken that a significant number of LHD events classified as “M” and “N” were reported by Rochambeau and Atlántico ACC, which were related with the lack of coordination of Dakar FIR. To this respect, the Secretariat informed that this matter would be evaluated during the Fourteenth Meeting on the Improvement of Air Traffic Services over the South Atlantic (SAT/14) Meeting to be held in Montevideo, Uruguay, 7 to 9 May 2008.

3.6 Note was also taken of other FIRs that have also presented a greater incidence of events classified as “M” and “N”:

Guayaquil and Bogotá;

Guayaquil and Lima;

Bogotá and Panamá Oceanic;

Barranquilla and Panamá Oceanic;

Maiquetía and Curaçao;

In fewer cases:

Lima and Antofagasta

Panamá Oceanic and Kingston.

3.7 As a result of the revision carried out, the meeting discussed on the different aspects, highlighting the following:

Time of permanence in an incorrect level

3.8 Moment/hour that should be taken as initial count in seconds in which an aircraft remains in the incorrect flight level (FL) until it reaches the authorized FL. This type of events are mostly related with operational errors between ACCs, provided that normally the exact moment in which the aircraft is in a different level cleared by the accepting ACC is not known. To this respect, the meeting agreed that the time will be considered according to those defined in each LHD, and if this information were not available, a permanence of 90 seconds will be used by default.

3.9 The meeting recalled that many letters of operational agreement (LOAs) between ACCs had a procedure for the transference of ground/air communications, which establishes that such transference of communications of an aircraft shall be transferred FIVE (5) minutes before the estimated hour in which the aircraft shall reach the transference point for each ATS route.

3.10 In view of the above, and as a prevention method to minimize the impact that the lack of an effective coordination of aircraft transference might have in safety, the meeting agreed that States should take the corresponding actions, so that ACCs apply the communications procedure aforementioned. In cases where current LOAs do not contemplate these 5 minutes for the communications transference, the meeting deemed pertinent that ACCs involved, if applicable, review and incorporate such procedure.

TCAS resolution events

3.11 So far in reports received by CARSAMMA, no LHD reports produced by TCAS resolution events are registered. Regarding this matter, the meeting agreed that States should take pertinent actions to report such events, so that they may be taken into consideration by CARSAMMA.

Differences in the foreseen and real passing hour

3.12 The events produced by the difference of coordinated arrival hour to the reporting point with the real passing hour, could be reported, but always taking into account that they are not LHD events, but somehow could affect safety assessment. In these cases, States should take note of this type of operational errors and list and report them to CARSAMMA, separately from LHDs.

LHDs observed with radar assistance

3.13 The meeting thoroughly examined the cases in which an aircraft changes its level before reaching the common point between two adjacent FIRs and the ACC in charge of the control authorizes a change of FL different to that coordinated with the accepting ACC and does not accept such information, but the accepting ACC through the radar assistance observes such change.

3.14 The analysis was focused in the fact that an aircraft entering an airspace not expected (not coordinated previously) should be or not considered as an LHD, or as an operational incident, with the purpose to decide if these cases must be considered as vertical deviations and consequently be part of the collision risk estimation by CARSAMMA.

Lateral deviations

3.15 When analyzing the reports involving lateral deviations produced in the FIRs boundaries proximities, or entrance o the same, without prior coordination between adjacent ACCs, the meeting agreed that it should be clear as to which events are really "large height deviations" (LHD) and which must be considered as navigation errors or large lateral deviations (LLD).

3.16 It is for this reason that the meeting was of the opinion that the vertical deviation codes table and LHDs are addressed only to the identification of vertical deviations and do not include lateral deviations. It was also recognized that a simple process should be developed controllers and pilots so that they may perform a more real narrative when reporting LHD events.

3.17 On the other hand, CARSAMMA indicated that in vertical collision risk assessments carried out to date, typical lateral errors have been taken into account in order to obtain the lateral overlapping probability ($P_y(0)$) applying a conservative vision, following Doc 9574 – Manual of RVSM implementation. Notwithstanding, as of this year, it is foreseen to apply an automated programme to collect lateral error data. To this respect, the meeting considered that such deviations collected in a data base as announced by CARSAMMA, could be of application in the future CAR/SAM Regions PBN implementation.

3.18 The meeting also examined the possibility to establish a definition in order to facilitate the Scrutiny Group work. In this connection, and in order that participants analyze it, the delegate from Chile proposed to examine the following:

a) It is considered that an LHD has occurred when an aircraft enters the airspace in a flight level differing in more than 90 mt (300 ft) to that coordinated with the transferring ATC unit, or enters without prior coordination.

b) In deviation codes "M" and "N" the deviation time is considered since the estimated or passing hour in the transference point, up to the moment in which the accepting controller acknowledges the traffic situation and initiates corrective actions.

c) In view of the above, its is not considered an LHD when the accepting controller acknowledges that the aircraft is at a flight level differing in more than 90 mts (300 ft), to that coordinated before it enters its airspace in view that a radar coverage exists or communication with the aircraft has been established and corrective actions have been taken.

Detection, registration and submission of an LHD form to CARSAMMA

3.19 CARSAMMA indicated the meeting that the greater difficulty to analyze LHD reports is that most of the data collected do not contain the indicated information; therefore it is necessary to point out to aeronautical authorities that the narrative of circumstances directly related with information on an LHD must be improved. This shall enable that collision risk assessment may show more real results.

3.20 It was also indicated that for an airspace safety assessment, all operational errors should be taken into account, taking into consideration that if they are not done in this manner, no safety assessment would be made. However, it was also recognized that in order to carry out a collision risk assessment in the RVSM airspace, which should be considered as first priority, are large height deviations, since otherwise, RVSM would be penalized with other aspects that should be examined in a different manner.

3.21 In conclusion, CARSAMMA informed that in following occasions shall carry out an airspace safety assessment, taking into account all aspects to be reported and at the same time a collision risk evaluation, considering only the parameters shown in ICAO RVSM Manual (Doc 9574), and, additionally, an assessment where only operational errors affecting RVSM application, will be taken into account.

3.22 Other aspects were also evaluated, related to the need that States take actions to train personnel as well as some actions that might be taken to prevent recurrence of operational errors. The complete text of Flimsy N° 1 presented by CARSAMMA is shown in **Appendix B** to this part of the report.

Large Height Deviations (LHD) Analysis

3.23 In order to define some criteria that facilitates the work of the Scrutiny Group, the delegate from Colombia, through Flimsy N° 2 presented different scenarios that were analyzed by the meeting, in order to identify if the situation proposed in each one of them represented or not an LHD. Following are the results of the analysis carried out by the meeting and the conclusions adopted for each scenario presented:

Scenario N1 – With radar coverage in the adjacent area

3.24 The meeting “agreed” that in this scenario it is not an LHD.

Scenario N2 - Without radar coverage in the adjacent area

3.25 Taking into consideration objections expressed by most of the participants, no agreement was reached in this scenario. For this reason, it was considered that further analysis is required by the Working Group.

Scenario N3 – Lateral deviation

3.26 Taking into consideration objections expressed by most of the participants, no agreement was reached in this scenario. For this reason, it was considered that further analysis is required by the Working Group.

Scenario N4 - Error in transference hour

3.27 The meeting “agreed” that in this scenario it is not an LHD.

Scenario N5 - Lateral deviation with radar coverage of the adjacent area

3.28 The meeting “agreed” that in this scenario it is not an LHD.

Scenario N6 – Without radar coverage

3.29 The meeting “agreed” that in this scenario it is not an LHD.

Scenario N7 – With radar coverage before FIR boundary

3.30 The meeting “agreed” that in this scenario it is not an LHD.

Scenario N8 - Lateral deviation without radar coverage of adjacent area

3.31 Taking into consideration the objections expressed by some participants, no agreement was reached in this scenario.

3.32 For this reason, it was considered that further analysis by the Working Group is required.

3.33 After the analysis carried out, the meeting considered that the scenarios on which no agreements were reached, should be evaluated in further meetings, in this connection, it was deemed pertinent to include the complete text of Flimsy N° 2 as **Appendix C** to this part of the report.

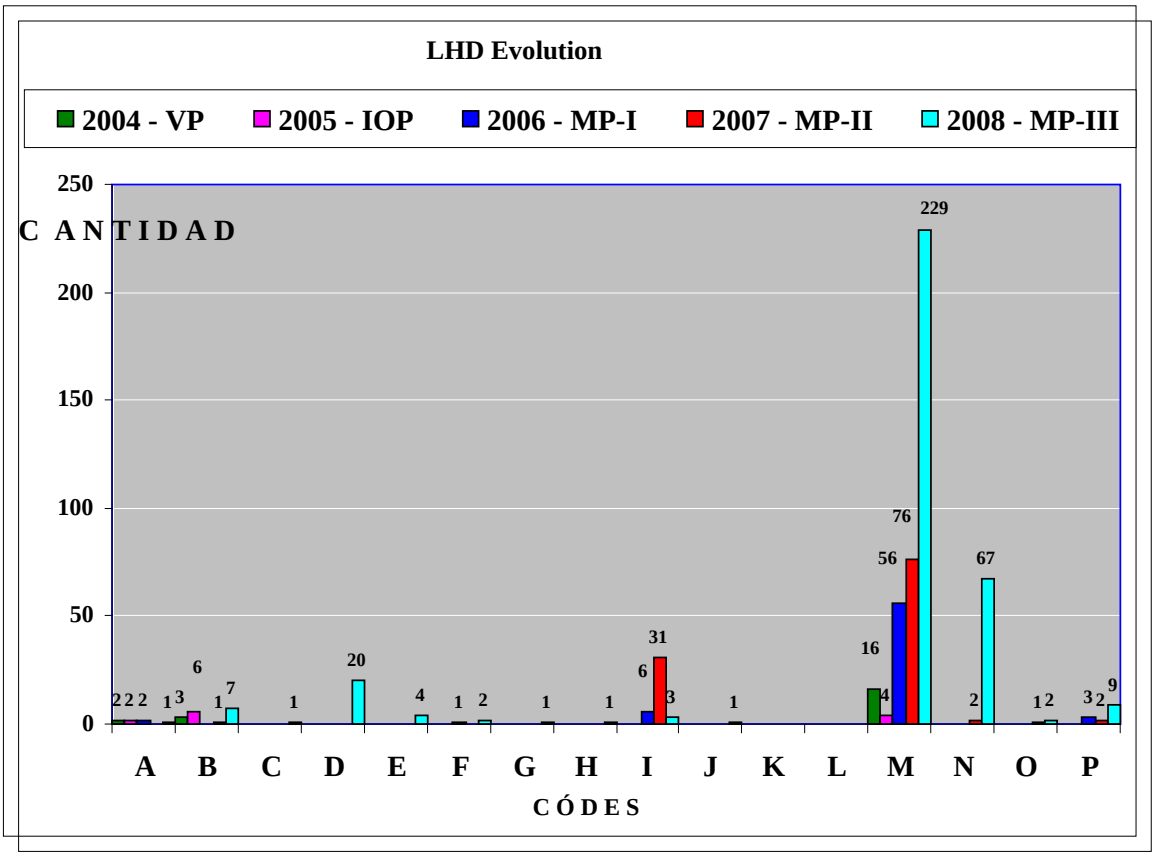
APPENDIX A

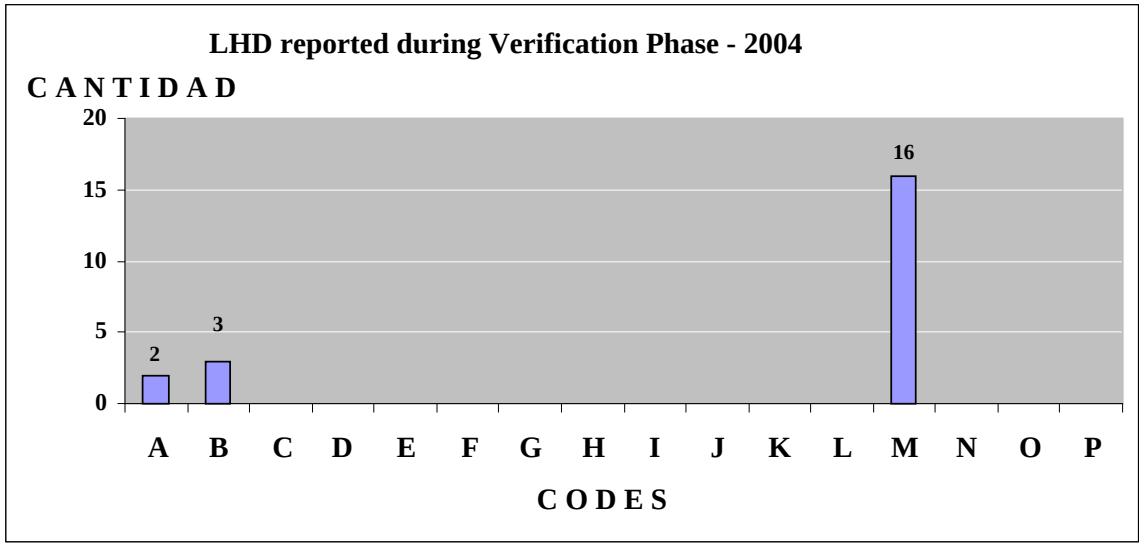
Tipo de LHD	VP 2004	IOP 2005	MP-I 2006	MP-II 2007	MP-III **2008**
A	2	2	2	-	1
B	3	6	-	1	4
C	-	-	-	-	1
D	-	-	-	-	14
E	-	-	-	-	-
F	-	-	1	-	2
G	-	-	-	-	1
H	-	-	-	-	1
I	-	-	6	31	3
J	-	-	-	-	-
K	-	-	-	-	-
L	-	-	-	-	-
M	16	4	56	76	99
N	-	-	-	2	32
O	-	-	-	1	2
P	-	-	3	2	9
TOTAL	21	12	68	113	169

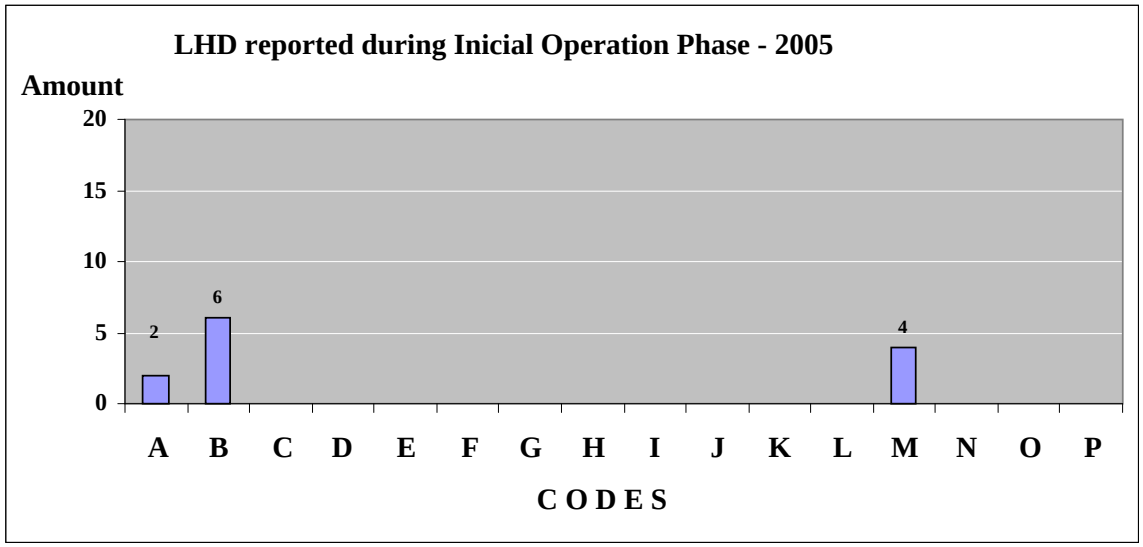
VP – Fase de verificación (2004);
Verification Phase
IOP – Fase inicial de operación (2005);
Inicial Operation Phase
MP-I – Fase de monitoreo-I (2006);
Monitoring Phase I
MP-II – Fase de monitoreo-II (2007)
Monitoring Phase II
MP-III – Fase de monitoreo-III (2008)
Monitoring Phase III

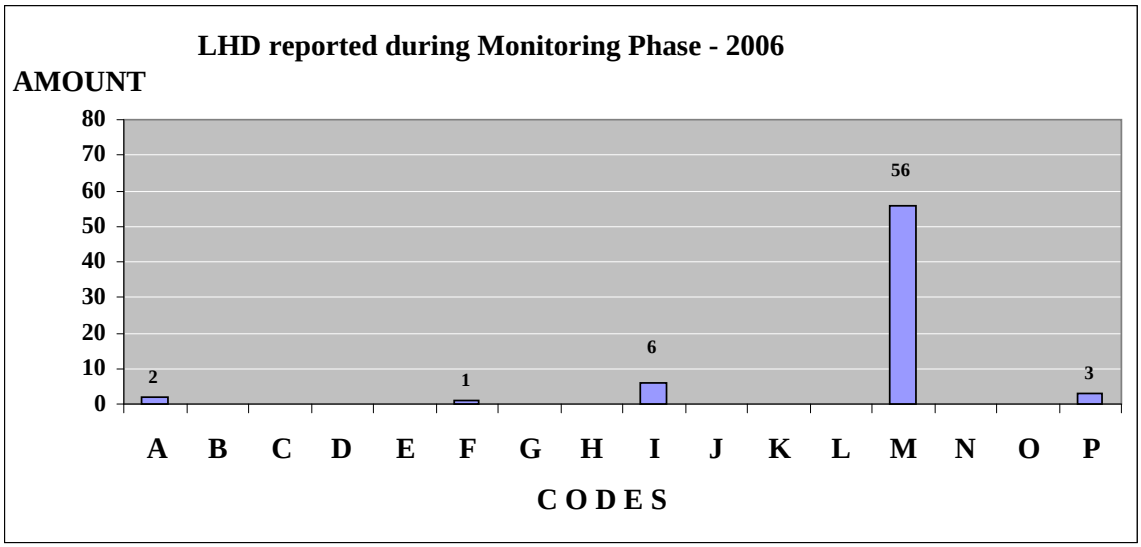
Table 20 . LHD Evolution

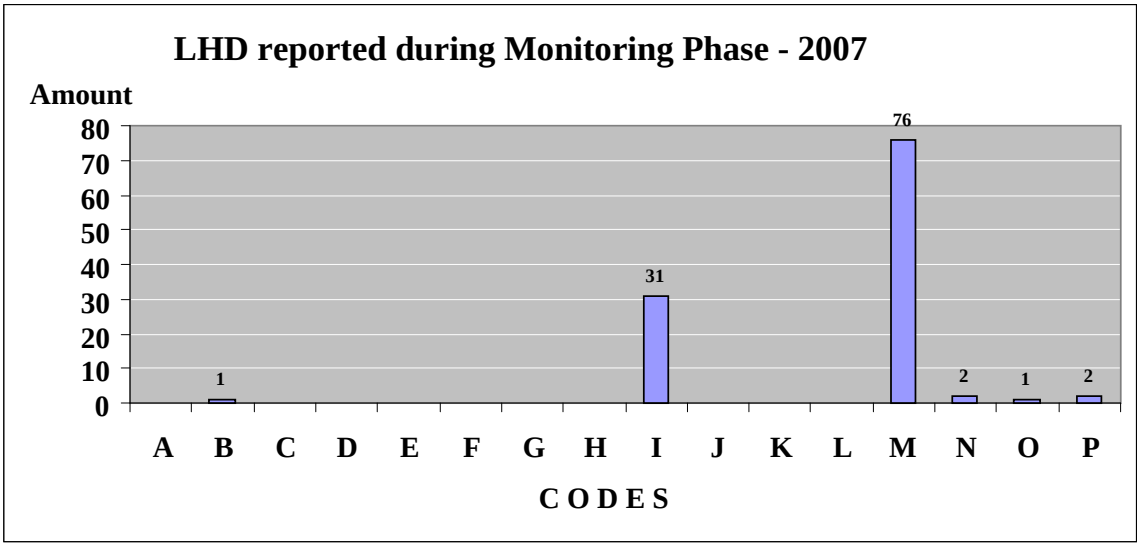
YEAR	PHASES	LHD CODES															TOTAL
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	
2004	VP	2	3											16				21
2005	IOP	2	6											4				12
2006	MP-I	2					1			6				56			3	68
2007	MP-II		1							31				76	2	1	2	113
2008	MP-III	1	7	1	20	4	2	1	1	3	1			229	67	2	9	348

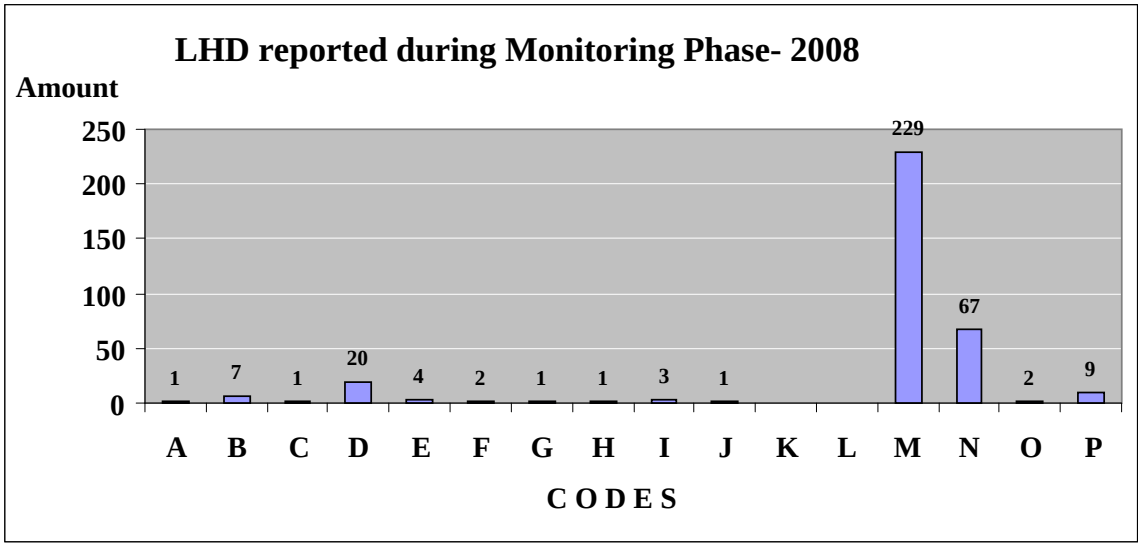



LHD reported during Verification Phase - 2004
C A N T I D A D
20
15
10
5
0
2
3
16
A B C D E F G H I J K L M N O P
C O D E S


LHD reported during Inicial Operation Phase - 2005
Amount
20
15
10
5
0
2
6
4
A B C D E F G H I J K L M N O P
C O D E S


LHD reported during Monitoring Phase - 2006
AMOUNT
80
70
60
50
40
30
20
10
0
2
1
6
56
3
A B C D E F G H I J K L M N O P
C O D E S


LHD reported during Monitoring Phase - 2007
Amount
80
70
60
50
40
30
20
10
0
1
31
76
2
1
2
A B C D E F G H I J K L M N O P
C O D E S


LHD reported during Monitoring Phase- 2008
Amount
250
200
150
100
50
0
1
7
1
20
4
2
1
1
3
1
229
67
2
9
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
C O D E S

APPENDIX B

Agenda Item 3: Large Deviation Analysis

(presented by CARSAMMA)

AWARENESS OF THE LHD PROBLEMS:

DETECTION, RECORDING, AND DELIVERY TO CARSAMMA

The GTE Scrutiny Working Group must trust the summaries in the incidents report, however this summary is not always reliable; this is the problem. In addition, not all States submit their reports. We must create mechanisms to solve this problem. How?

By creating simple procedures, such as:

1. **Create awareness:** to make Heads of State aware emphatically and from time to time of the importance of training air traffic controllers, pilots, and other professionals working in the ACCs so that the information that is provided in the reports actually describes the real situation as best as possible;
2. **revisit:** from time to time, the processes and criteria in place to allow pilots and controllers to report on incidents caused by navigation errors;
3. every State shall place emphasis on the need to schedule a suitable training program for all ACC staff. This program shall specifically address "**how to determine the real causes of LHDs";**
4. What actions could possibly be implemented in order to prevent this from happening again?
5. when the controller or pilot writes out or classifies an error in the incidents report, he can suggest what corrective measures can be implemented. (This is a way to make the professionals involved more aware of this situations);
6. ACC staff must be held accountable for the incidents reports and mainly for providing suggestions to remedy errors and to prevent these events from happening again.
7. seminars should be scheduled on a regular basis for all staff directly or indirectly involved in this issue.
8. Pilots and controllers must be careful in identifying the nature of a cause. If the default stems from a problem in the navigation equipment or in a specific piece of that equipment, and if this error is repeated, a solution must be sought until the root cause is eliminated. (We must find a way to determine whether or not a corrective action has already been put in place for that type of error. If it has already been corrected, the authorities and the ACC staff must be complimented by ICAO).
9. ACC staff must be encouraged, as part of their training, to find all possible types of errors, to identify their root causes, and to determine ways to solve those problems. This must be included in the training program. The best project should be awarded a prize and should be commended by its originating Regional Monitoring Agency or by ICAO.
10. Eliminate or minimize the high frequency of repeated errors by modifying the operators' training program, the maintenance schedules, or equipment certifications. In the event the information shows that the multiple errors are

attributed to a crew for a given flight, it might be necessary to give the crew corrective training or to review the crew's licence.

11. NB: In a near future, the new air surveillance equipment will detect and notify any large height deviation or aircraft position error. Therefore, any professional who fears putting his reputation at stake can avoid making mistakes by following the procedures described above.

APPENDIX C

Agenda Item 3: Analysis of the Large Height Deviations (LHD)

(presented by Colombia)

No LHD

1.- RADAR COVERAGE IN THE ADJACENT AREA

When the receiving FIR has a radar coverage in the airspace of the transferring FIR and observes that the aircraft has a flight level different to the one previously coordinated, which was not reviewed, we do not consider there is a LHD, because the FIR was only made aware of it before it entered its airspace. We must take into consideration that there is a risk in safety, but we must investigate it as a coordination incident and not as an LHD.

2.- WITHOUT A RADAR COVERAGE IN THE ADJACENT AREA

When the receiving FIR has contact with the aircraft before it enters its airspace, and it is made aware of the aircraft´s change of flight level with respect to a level previously coordinated, we do not consider there is a LHD , because the FIR is made aware of this before it enters its airspace. We do have to bear in mind that there is a risk in safety, but an investigation must be conducted as a coordination incident and not as a LHD.

3.- LATERAL DEVIATION

When an aircraft reports a laterally deviated position of the original point of transfer, either through another route or because of a deviation requested by the crew for operational convenience, we do not consider there is a LHD given that the initial philosophy of the reports of large height deviations exclusively corresponds to vertical deviations and not to lateral ones. In this case, we must investigate this situation as a coordination incident between adjacent ACC.

4.- TRANSFER TIME ERROR

When an aircraft reports a longitudinal deviated position in time due to coordination error or to lack of review of the transfer time, this is not considered an LHD. In light of the initial philosophy of large height deviations reports, this would only cover vertical deviations and not to horizontal ones. In this case, we must investigate this situation as a coordination incident between adjacent ACC.

5.- LATERAL DEVIATION WITH RADAR COVERAGE IN THE ADJACENT AREA

When an aircraft flies into an airspace that was not included in its route due to an operational deviation, this is not considered an LHD. Since this is an operation error

made by the ACC that is aware of the deviation and that failed to report it to the affected ACC, this event should be considered a coordination incident between adjacent FIRs.

LHD

6. WITHOUT RADAR COVERAGE

When an aircraft flies into a receiving FIR and reports a flight level different from the one previously coordinated, this is considered an LHD. We must take into account the time when the aircraft passes the FIR border and the corresponding ACC becomes aware of the traffic and takes an action regarding the deviation whether this action means leaving the aircraft at the level it is reporting or move the aircraft to a level at which it does not conflict with the FIR's traffic plan.

7. WITH RADAR COVERAGE BEFORE THE FIR BORDER

If communications failed, an aircraft is transferred to a certain flight level and then it goes into the accepting ACC's radar coverage at a different flight level, this is considered an LHD. We must take into account the time when the aircraft passes the transfer point border and the corresponding ACC becomes aware of the traffic and takes an action regarding the deviation and its traffic plan.

8. LATERAL DEVIATION WITHOUT RADAR COVERAGE IN THE ADJACENT LEVEL

When an aircraft flies into an airspace that was not included in its route due to an operational deviation, and there is no news of the deviation until the aircraft is already in the affected airspace, this is considered an LHD. Besides being an operational error made by the ACC that is aware of the deviation and that failed to coordinate with the affected ACC, this event directly impacts on the corresponding FIR as a traffic in an airspace putting at risk the RVSM airspace. This event should be considered a coordination incident between adjacent FIRs.

Agenda Item 4: Other business

4.1 The Meeting agreed that the forthcoming meeting GTE, be foreseen for March 2009 in a site to be agreed upon. A further meeting would be foreseen for September, in a site of the CAR Region, to be agreed upon.

****