International Civil Aviation Organization
CAR/SAM Regional Planning and Implementation Group (GREPECAS)
First Meeting of the Communications, Navigation and Surveillance / Air Traffic Management Subgroup (CNS/ATM/SG/1)
(Lima, Peru, 15-19 March 2010)

Agenda Item 6: Other matters

ICAO Training Guides for Developing the Competencies of Aeronautical Professionals

(Presented by the Secretariat)

SUMMARY

This working paper contains Appendix H of Resolution A36/13: Updated consolidated statement of continuing ICAO policies and practices related to a global ATM system and the communications, navigation and surveillance/air traffic management (CNS/ATM) systems, which makes clear reference to aeronautical training. It also contains information on the Seminar-Encounter on Human Resource Planning and Management and Training on Airports and Air Navigation Services, the symposium geared to Next Generation Aeronautical Professionals and information on training activities carried out in the CAR/SAM Regions.

References:

- Assembly Report - 36th Session (Montreal, September 2007);
- Seminar-Encounter on Human Resource Planning and Management and Training on Airports and Air Navigation Services, Cartagena de Indias, Colombia, October 2009;
- Symposium geared to Next Generation Aeronautical Professionals (Montreal, March 2010); and
- Report of the ninth meeting of Civil Aviation Training Centres (CIAC/9) (Lima, November 2009).

***ICAO Strategic Objective*:**	D: Efficiency

1. Introduction

1.1 ICAO and the aeronautical industry have focused on attaining and implementing a performance-based air navigation system, derived from industry good practices that have evolved throughout the years outside of the aviation field. Since the aviation industry has evolved to become a less regulated and more corporate environment that entails greater responsibilities, the advantages of implementing a performance-based air navigation system have become more and more apparent.

1.2 Taking into account the general objective of establishing and measuring the achievement of goals, a more cost-effective system will be achieved thanks to the efforts of all those involved, with less waste of resources, more equitable charging practices and a more efficient provision of services. But it will also be necessary to share knowledge, provide training and develop specialised knowledge.

1.3 The effort involved in this task is a challenge that requires substantial coordination at all levels. Consequently, the States, through their Civil Aviation Training Centres (CATCs), should also adopt a common approach to the development and implementation of a performance-based ATM system.

1.4 In this regard, Appendix H of Resolution A36/13: Consolidated statement of continuing ICAO policies and associated practices related specifically to air navigation, makes clear reference to aeronautical training and stipulates that contracting States will be encouraged and provided with assistance to maintain a high level of training for their aeronautical personnel, especially those engaged in the provision and operation of facilities and services geared to international civil aviation. To this end, and as part of its regular work programme, the Organization will carry out a permanent training programme that has been entitled the ICAO Aeronautical Training Programme. It also establishes some principles that will serve as a basis for the ICAO aeronautical training programme (see **Appendix A** to this working paper).

1.5 To continue with its support to training, ICAO and the Spanish Agency for International Cooperation for Development (*Agencia Española de Cooperación Internacional para el Desarrollo* - AECID) held the Seminar-Encounter on Human Resource Planning and Management and Training on Airports and Air Navigation Services, held in Cartagena de Indias, Colombia, in October 2009, aimed at providing the professionals of the sector with techniques for human resource management at airports and air navigation services, strategies for the definition of training programmes for aeronautical personnel and facilitating the exchange of experiences and results in these areas in the various countries.

1.6 The eleventh Symposium and Global TRAINAIR Conference (GTC/11), held in Punta Cana, Dominican Republic, on 7-11 December 2009, discussed experiences and relevant aspects of performance-based aeronautical training aimed at a new generation of aeronautical professionals.

1.7 In 2008 and 2009, two meetings of Directors of Civil Aviation Training Centres (CATCs) were also held in the region. The main objective of these meetings is to provide a forum for analysing personnel demand and the need for generating training capacity, analysing and assessing various alternatives to the development of harmonised courses that contemplate current and future requirements within the framework of air navigation services. The next CATC meeting is foreseen for November 2010.

1.8 ICAO has scheduled a symposium on Next Generation Aeronautical Professionals for 1-4 March 2010. The topic of the symposium is *"Seeing beyond the economic crisis: Mobilisation of the aeronautical community for contracting, educating, training, and preserving the next generation of aviation professionals"*.

Discussion

2.1 The training issue clearly revolves around the huge possibilities available for those who contemplate pursuing a career in the aviation field. According to the latest ICAO forecast, starting in 2010, a rapid and sustained growth of air traffic is expected in the next few years, which implies the incorporation of thousands of new aircraft into the air fleet. This, together with the new emerging technologies, will transform the nature of aeronautical jobs. Consequently, a larger number of pilots, air traffic controllers, maintenance personnel and managers capable of effectively meeting the demands of a changing labour environment will be required.

2.2 ICAO recognises that professional competency is fundamental for attaining optimum safety levels, and develops training strategies to ensure that the future global air transport system is supported by duly competent and qualified professionals.

2.3 These strategies include a four-step action plan to help member States maintain high training standards. This plan includes: the identification of the number of pilots, maintenance personnel and controllers needed, and of the associated training requirements; the harmonisation of ICAO standards with modern training methodologies; the identification of activities that must be implemented with industry partners; and the pooling of all parties around a common strategy.

2.4 The GTC/11 meeting agreed to promote TRAINAIR aspects as quality assurance guides for the States to ensure on-the-job training programmes for the new generation of aeronautical professionals. Amongst the main aspects that were discussed were the training of safety personnel, the impact of emerging technologies on the aviation industry, simulator-based training, and the evolution of integrated training strategies to meet the future performance of aeronautical personnel. The meeting also noted that ICAO was working on the updating of the guidance material on aeronautical training.

2.5 The purpose of the symposium on the Next Generation Aeronautical Professionals is to propose specific actions in two areas; to update and modify regulations in order to enhance the effectiveness and efficiency of training and education; and to mobilise the community in order to revitalise the image of aviation professionals. These actions are geared to the aeronautical community in general.

2.6 The CIAC/9 meeting (Lima, November 2009) examined this matter and agreed that it would be very convenient for the CATCs to prepare and submit to the aforementioned symposium a common position regarding medium- and long-term training requirements.

2.7 Another aspect examined by the meeting was the possibility of reaching an agreement regarding the establishment of specialised and higher training courses as necessary to develop the competencies required to install, operate and maintain facilities and services, as mentioned in Appendix H to Assembly Resolution A36/13.

2.8 Until further guidelines are generated by the symposium and other fora, CAR/SAM States/Territories and International Organisations are urged to continue their efforts, through their training centres, to improve training for aeronautical professionals, and to develop medium-term plans for the infrastructure and programmes that will enable them face the new challenges. This will allow administrations to have a robust aeronautical system, based not only on a well implemented system, with the necessary laws and regulations, the appropriate guidelines, and a duly organised aeronautical authority, but also with excellent training, experience, competence and dedication of its managerial, administrative and technical personnel. To this end, the CATCs could use as a source, *inter alia*, the list of training requirements shown in **Appendix B** to this working paper.

3 Suggested action

3.1 The Meeting is invited to:

a) take note of the information provided in this working paper; and

b) take into account the list of short- and medium-term training needs shown in Appendix B to this working paper, so that the CATCs, in coordination with the civil aviation authorities of CAR/SAM States/Territories and International Organisations, may develop aeronautical training programmes that contemplate regional air navigation and safety requirements.

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APPENDIX A

Resolution A36-13: Consolidated statement of continuing ICAO policies and associated practices related specifically to air navigation

Whereas in Resolution A15-9 the Assembly resolved to adopt in each session for which a Technical Commission is established a consolidated statement of continuing policies related specifically to air navigation up to date as at the end of that session;

Whereas a statement of continuing policies and associated practices related specifically to air navigation as they existed at the end of the 35th Session of the Assembly was adopted by the Assembly in Resolution A35-14, Appendices A to X inclusive;

Whereas the Assembly has reviewed proposals by the Council for the amendment of the statement of continuing policies and associated practices in Resolution A35-14, Appendices A to X inclusive, and has amended the statement to reflect the decisions taken during the 36th Session; and Whereas the statement of continuing policies in Resolution A35-14 is hereby superseded;

The Assembly:

1. Resolves that:

   a) the Appendices attached to this resolution constitute the consolidated statement of continuing air navigation policies and associated practices of the Organization as they exist at the close of the 36th Session of the Assembly; and

   b) the practices associated with the individual policies in the appendices constitute guidance intended to facilitate and ensure implementation of the respective policies; and

2. Declares that this resolution supersedes ResolutionA35-14 with its Appendices A to X inclusive.

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APPENDIX H

Aviation training

Whereas satisfactory provision and operation of ground facilities and services and implementation of SARPs and PANS are dependent upon a high standard of personnel training;

Whereas difficulties are being experienced by Contracting States in these matters owing to a lack of adequately trained personnel;

Whereas special effort is required to foster a high standard of personnel training and to assist Contracting States in meeting their training needs; and

Whereas training seminars conducted by the Organization are an effective means of promoting common understanding and uniform application of SARPs and PANS;

The Assembly resolves that:

1. Contracting States shall be encouraged and assisted in the maintenance of high standards of training of aviation personnel and particularly those employed in the provision and operation of services and facilities for international air navigation. To this end, as a part of its regular work programme, the Organization shall carry out a continuing training programme which is referred to as the ICAO aviation training programme*; and

2. the ICAO aviation training programme shall be governed by the following principles:

   a) aviation training is the responsibility of Contracting States;

   b) the Organization should place the highest priority on the establishment of safety-and security-related programmes;

   c) mutual assistance among Contracting States in the training of aviation personnel should be encouraged and facilitated, particularly in those matters where the lack of adequate training may adversely affect the safety, security or regularity of international air navigation;

   d) the Organization should advise Contracting States on the operational oversight of training facilities; and

   e) the Organization should not participate in the operation of training facilities but should encourage and advise operators of such facilities.

Associated practices

1. Through the development of specifications and guidance material, the conduct of training seminars, and by direct advice and consultation, the Council should assist Contracting States to:

   a) standardize, as far as practicable, the curricula, methods and content of training courses and establish adequate examination and licensing provisions;

   b) bring levels of accomplishment into line with international Standards; and

c) employ the criteria referred to in a) and b) above so as to bring about greater uniformity in operating practices and procedures.

2. Continuing attention should be given to the establishment of specialized and advanced training courses when needed to provide the skills required to install, operate and maintain facilities and services.

3. The Council should encourage the Contracting States to establish requirements for:

a) on-the-job training, including familiarization with relevant operating conditions, for personnel who, after completion of their basic training, require practical experience under actual operating conditions before being assigned to positions of responsibility in operational posts; in this regard States' attention should be invited to the possibility of drawing fully upon the resources of the various technical cooperation and assistance programmes; and

b) periodic refresher training particularly when new equipment, procedures or techniques are introduced.

4. The Council should request the Contracting States to provide, for dissemination to other States, information on the types of aeronautical courses they sponsor or are otherwise available in their States to which students are accepted from other States, including the address to which enquiries may be sent for additional details. Similarly, the Council should make available to Contracting States all pertinent information concerning training establishments assisted through ICAO that admit students from other countries.

5. The Council should urge Contracting States to make the maximum practicable use of training centres in their area for training their aviation personnel in fields where there are no corresponding national schools. To this end, the Council should encourage States to establish favourable conditions for attendance by nationals of other States in the area.

- END -

APPENDIX B

Training in the communications area

- Course on aeronautical applications over IP

Suggested curriculum:

Introduction
- Basic networking concepts
- ISO reference model
- Communications protocol architecture
- TCP/IP model and architecture

Physical layer protocols
- Types of transmission media
- Cable specification
- Types of cables and connectors
- TIA/EIA protocol
- Direct cable – crossover cable – rollover
- Fiber optics, radio link, VSAT
- LAN and WAN protocols

Link layer protocols
- General description of WAN protocols: HDLC, X.25, Frame Relay, etc.
- General description of LAN protocols: CSMA/CD, LAPB, LAPD, LLC, etc.
- IEEE 802.XX family
- MAC address
- Network layer protocols (IP)
- Classes of IP addresses
- Network subdivision
- IP addresses – masking exercises
- IPV4 *vs* IPV6
- Basic routing concepts

Transport layer protocols
- Flow control
- Establishing the connection
- Three-way exchange of signals
- Basic and sliding window
- Structure of the TCP protocol
- Structure of the UDP protocol
- Design of client–server programmes

Upper layer protocols
- DNS,FTP, http, SMTP, SNMP, Telnet
- Basic telephony concepts (FXS, FXO, E&M)
- Basic VoIP concepts

- Definition and structure of the ASTERIX protocol
- Basic AMHS concepts and ITU-400 and ITU-500 protocols
- ATN functionality
- ATN components
- End systems (ATN router, subnetworks)
- ATN physical and administrative structure
- AMHS system
- AIDC system
- CPDLC application
- General functionality
- Service functionality
- CPDLC SARPs
- HFDL, VDL
- ADS application (ADS-C, ADS-B)
- General functionality
- Service functionality
- ADS SARPs
- Mode S ES, VDL 4. UAT, AMSS

Training in the navigation area

- Course on the Global Navigation Satellite System (GNSS)
  Suggested curriculum

  Description of GNSS systems
  - Satellite-based navigation systems
  - Augmentation systems
  - GNSS avionics

  Services supported by GNSS
  - Performance characteristics
  - Potential operations with GNSS augmentation systems

  GNSS implementation
  - Organisation and planning
  - Development procedure
  - Airspace considerations
  - ATC considerations
  - Aeronautical information services
  - Certification and approval of operations
  - GNSS vulnerability
  - Transition plan

  GNSS evolution
  - GNSS requirements to support other applications
  - Security aspects
  - GNSS evolution
  - Protection dates

Training in the surveillance area

- Course on secondary surveillance radar systems
  Suggested curriculum

  - System description and functional objectives
  - Operating characteristics
  - Mode S compatibility with Modes A/C
  - Secondary surveillance system (SSR) technique
  - SSR by monopulse
  - Considerations concerning Mode S protocol
  - Implementation of Mode S
  - Interference considerations
  - ATN Mode S subnetwork
  - Extended squitter, system concept and application

- Course on multilateration
  Suggested curriculum

  - Multilateration applications
    - Airport surface
    - Terminal area
    - Wide area
    - Precision runway monitoring (PRM)
    - Unit altitude monitoring

  - Technical operating principle of the multilateration system
  - ADS-B and multilateration

- Course on ADS-B
  Suggested curriculum

  - Definition of ADS-B
  - ADS-B standard
    - 1090MHZ ES 1090MHZ ES
    - UAT (Universal Access Transceiver)
    - VDL Mode 4
  - ADS-B messages
  - ADS-B system integrity
  - ADS-B trials
  - Implementation of ADS-B systems

SUGGESTED ICAO BIBLIOGRAPHY

COMMUNICATIONS
Annex 10 Volume III
DOC 9739 (Comprehensive ATN manual)
DOC 9880 (ATN OSI manual)
DOC 9896 (ATN IPS manual)
DOC 9741(Manual on HF data link)
DOC 9776 (Manual on VHF data link Mode 2)
DOC 9805 (VHF data link Mode 3)
DOC 9816 (VHF data link Mode 4)
DOC 9694 (Manual on ATS data link applications)

NAVIGATION
Annex 10 Volume I
DOC 9849 (Manual on the global navigation satellite system)

SURVEILLANCE
Annex 10 Volume IV
DOC 9684 (Manual on the secondary surveillance radar (SSR) systems)
Doc. 9688 (Manual on Mode S specific services)
Circular 311 (Assessment of ADS-B to support ATS services, and Implementation Guide)

Training on automated systems at the ACCs

The purpose of this course is to describe the main automated systems at the ACCs**.**

General curriculum

- Function of the ACC and equipment necessary for its operation**.**
- Interface between sensors and processing systems at the ACCs
  - Surveillance system interface (radar, ADS-C, ADS-B , others)
  - Messaging system interface (AFTN, AMHS, etc.)
  - Databank interface (AIS, MET, others)
  - Interface between processing systems
  - Various interfaces
- Voice circuit selection and switching (VCS) systems
- Surveillance data processing systems (operational requirements, operational alerts, etc.)
- Flight plan processing systems
- Display systems (surveillance data, flight plans, etc.)
- Audio and video recording and playback systems

Training in the aeronautical information area

- Course AIS/024 (Second Generation of CAR/SAM Course AIS/021)
  - Considers training of AIS/MAP personnel for AIS-to-AIM transition, and its role within the framework of ATM requirements
- Training on the traditional AIS-MAP service

- Course on digital aeronautical mapping, with emphasis on the use of geographic information systems (GIS) and spatial databases;

- Course on the AIS-MAP quality management system;

- Basic course on introduction and transition from AIS-MAP to AIM

Training in the aeronautical meteorology area

- Equivalence course for aeronautical meteorologists trained under the old WMO Class II

Reference:
– Guidelines for the education and training of personnel in meteorology and operational hydrology, Vol. I – Meteorology. WMO-N° 258; and
– Training and qualification requirements for aeronautical meteorological personnel. Supplement N° 1 to WMO-N° 258

- Course on ATS/AIS/MET coordination

- Course on quality management system in MET services

Training in the air traffic management area (ATM)

Airspace planning

- Course on introduction to airspace planning and design

- Course on airspace safety assessment – Collision risk model

PBN for en-route, TMA and approach

- PBN airspace concept
  - CAR/SAM PBN roadmap
  - Continuous descent operations

- Introduction to performance-based navigation (PBN)
  - For technical personnel from all air navigation services

- Aircraft approval – operations

- Aircraft approval – airworthiness

- Aircraft dispatchers

- Maintenance personnel

- Pilots

- Activities geared to operators in relation to operational and economic benefits expected from PBN implementation

Training in the PANS/OPS area

- Basic procedure design
- Basic RNAV/RNP procedure design

  a) RNAV NPA procedures based on VOR-DME; DME-DME; GNSS sensors

  b) SID/STAR/approach procedures

  c) APV/Baro-VNAV

  d) RNP AR (authorisation required)

Training in the air traffic flow management (ATFM) area

- Introduction to ATFM – CDM concept
- Calculation of airport capacity and airport acceptance rate
- Calculation of ATS capacity (work sectors)

Training in the safety management area

- Introduction to the State Safety Programme (SSP)
- Introduction to the safety management system (SMS)
- Implementation of SSP and SMS
- Development of ATS safety programmes
- ATC Threat and Error Management (TEM)

Training in the search and rescue area

- Basic SAR course: Students will be capable of identifying the parts of a SAR system, its organisation, management, operation of all its components, and the documentation affecting it directly and indirectly;
- SAR unit coordinator course: Students will be capable of coordinating the missions of the SAR unit (on the mountain, at sea, etc.);
- SAR coordinator course: Students will be capable of managing a SAR unit, and plan, manage and coordinate SAR missions;
- SAR assistant course: Students will be capable of performing the administrative functions of a SAR unit and the required operational support tasks;

- SAR management course: Students will be able to take on the responsibility of establishing and managing the provision of SAR services, and managing and coordinating the planning of said services.

Training in the aerodrome area (AGA)
Suggested items that require training:

- Specific training for high executives
- Airports /Air navigation plan
- National airport development plans
- Airport master plans
- Airport certification
- Airport safety management systems (SMS)
- Performance and performance indicators
- Electrical systems/lights/air side lighting
- Electrical power on the land side
- Markings and signs
- Apron management
- Communications /movement of vehicles on the air side
- Cargo management
- Airport infrastructure maintenance
- Emergency plans/COE
- Adjustment of airport infrastructure
- Environment and fauna management
- Airport demand/capacity
- Aircraft/pavement interaction (roughness and friction)

Training in the area of language proficiency
Courses/seminars/workshops dealing with matters related to this area must be aimed at ensuring that air traffic control personnel, aeronautial station operators and flight crews engaged in flight operations in airspace requiring the use of the English language have the proficiency required to carry out and understand radiotelephone communications in said language.

- END -