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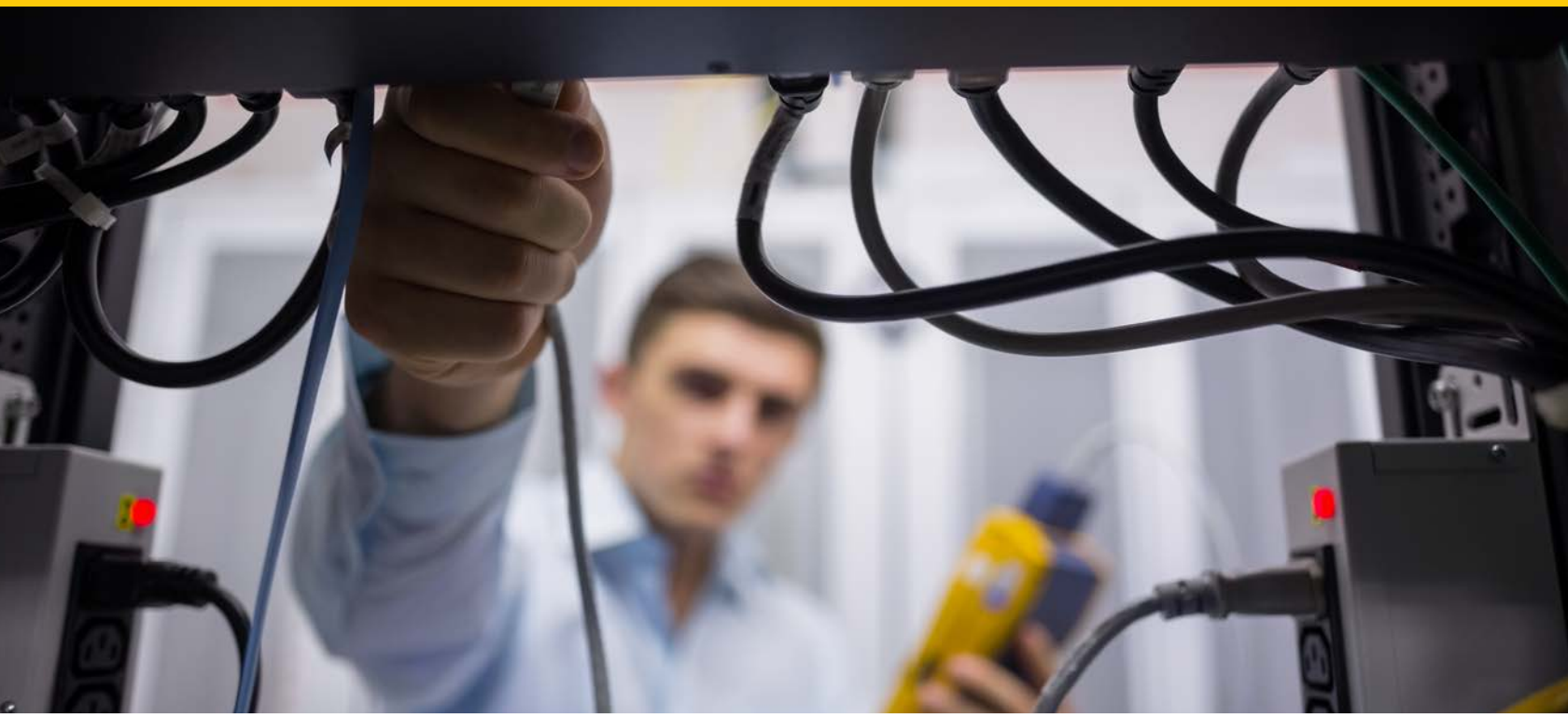
Doc 10057

Manual on Air Traffic Safety Electronics Personnel Competency-based Training and Assessment

First Edition, 2017



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INTERNATIONAL CIVIL AVIATION ORGANIZATION

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AMENDMENTS

Amendments are announced in the supplements to the *Products and Services Catalogue;* the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

AMENDMENTS		
No.	Date	Entered by

CORRIGENDA		
No.	Date	Entered by

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FOREWORD

The Next Generation of Aviation Professionals (NGAP) initiatives were launched to ensure that sufficient numbers of qualified and competent aviation professionals will be available to operate, manage and maintain the future international air transport system. In May 2009, the NGAP Task Force was created and was instrumental in supporting the preparatory work for the NGAP Symposium conducted at ICAO from 1 to 4 March 2010. Among the outcomes drawn from the NGAP Symposium were:

a) the need to develop regulatory frameworks that enable and support the use of modern training and learning technologies (competency-based training, evidence-based training and increased use of simulation) and that are not an obstacle to industry best practices; and

b) the need to define competencies for all aviation activities affecting safety in order to facilitate, through the use of internationally agreed upon standards and assessment practices, the free-flow of professionals.

The effective performance of the air traffic management (ATM) system depends on competent and qualified ATM professionals. The ATM system is evolving towards a globally integrated and collaborative system. Air traffic safety electronics personnel (ATSEP) involved in the installation, operation and maintenance of the communication, navigation, surveillance/air traffic management (CNS/ATM) system must have a shared understanding of what is expected of them in terms of performance wherever they may work in order to support a globally interoperable system and to achieve optimum capacity within acceptable safety limits. This shared understanding becomes critical when considering the increasing traffic and the growing complexity and interconnectedness of the systems involved. As controller-pilot and system-to-system interfaces evolve, the ATSEP installing, operating and managing the CNS/ATM system need common competencies and practices to ensure seamless operations.

In February 2015, procedures for the implementation of competency-based training and assessment for ATSEP were included in the *Procedures for Air Navigation Services — Training* (PANS-TRG, Doc 9868). These procedures provide States, air navigation service providers (ANSPs) and training providers with guidance on how to structure their approach to training and assessment of ATSEP. The procedures provide a flexible framework that stakeholders can adapt to their local operational contexts and requirements.

Some of the provisions already included in the PANS-TRG are of a generic nature and can apply to all aviation functions including ATM personnel. The purpose of this manual is to provide additional guidance to the provisions of the PANS-TRG and support stakeholders in the successful implementation of competency-based training and assessment for ATSEP.

Comments concerning the manual should be addressed to:

The Secretary General
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999 Robert-Bourassa Boulevard
Montréal, Québec Canada H3C 5H7

GLOSSARY

DEFINITIONS

Approved training. Training conducted under special curricula and supervision approved by a Contracting State.

Assessment (evidence) guide. A guide that provides detailed information (e.g. tolerances) in the form of evidence that an instructor or an evaluator can use to determine whether a candidate meets the requirements of the competency standard.

Competency. A combination of skills, knowledge and attitudes required to perform a task to the prescribed standard.

Competency-based training and assessment. Training and assessment that are characterized by a performance orientation, emphasis on standards of performance and their measurement, and the development of training to the specified performance standards.

Competency element. An action that constitutes a task that has a triggering event and a terminating event that clearly defines its limits, and an observable outcome.

Competency unit. A discrete function consisting of a number of competency elements.

Performance criteria. Simple, evaluative statements on the required outcome of the competency element and a description of the criteria used to judge whether the required level of performance has been achieved.

ACRONYMS

The following abbreviations are used in this document:

ACC	area control centre
ADS-B	automatic dependent surveillance — broadcast
ADS-C	automatic dependent surveillance — contract
AIP	aeronautical information publication
ANS	air navigation services
ANSP	air navigation service provider
ATC	air traffic control
ATCO	air traffic controller
ATM	air traffic management
ATS	air traffic services
ATSEP	air traffic safety electronics personnel
CNS	communication, navigation, surveillance
COM	communication
DF	direction finder
DME	distance measuring equipment
EMI	electro-magnetic interference
FAT	factory acceptance test
FIR	flight information region
GBAS	ground-based augmentation system
GNSS	global navigation satellite system
GPS	global positioning system
HHI	human-human interaction
HMI	human-machine interaction
IEEE	Institute of Electrical and Electronic Engineers
ILS	instrument landing system
IMS	integrated management system
LR	logging and reporting
LRM	lowest replaceable module
MLS	microwave landing system
MSSR	monopulse secondary surveillance radar
NavAid	navigation aid
NDB	non-directional beacon
OJT	on-the-job training
PO	position operation
QMS	quality management system
RF	radio frequency
RR	release and restoration
S/E	system/equipment
SAT	site acceptance test
SMC	system monitoring and control
SMS	safety management system
SS	site specific SMC task
SSR	secondary surveillance radar
TFI	technical flight inspector

TRM	team resource management
UAC	upper area control centre
UHF	ultra high frequency
VHF	very high frequency
VOR	very high frequency omnidirectional radio range

PUBLICATIONS

(referred to in this manual)

Annexes to the Convention on International Civil Aviation

Annex 1 — *Personnel Licensing*
Annex 3 — *Meteorological Service for International Air Navigation*
Annex 10 — *Aeronautical Telecommunications*
Annex 11 — *Air Traffic Services*
Annex 14 — *Aerodromes*
Annex 19 — *Safety Management*

Procedures for Air Navigation Services (PANS)

Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444)
Procedures for Air Navigation Services — Training (PANS-TRG, Doc 9868)

Manuals

Aeronautical Surveillance Manual (Doc 9924)
Global Navigation Satellite System (GNSS) Manual (Doc 9849)
Human Factors Training Manual (Doc 9683)
Manual on Testing of Radio Navigation Aids (Doc 8071)
Performance-based Navigation (PBN) Manual (Doc 9613)
Safety Management Manual (SMM) (Doc 9859)

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Chapter 1

INTRODUCTION

1.1 PURPOSE

1.1.1 This manual provides guidance to air navigation service providers (ANSPs) and training organizations on the development of air traffic safety electronics personnel (ATSEP) competency-based training and assessment programmes.

1.1.2 This chapter introduces concepts underlying the development of ATSEP competency-based training and assessment programmes.

1.2 CONTEXT

1.2.1 Regulatory environment

1.2.1.1 ATSEP are personnel proven competent in the installation, operation and/or maintenance of a communications, navigation, surveillance/air traffic management (CNS/ATM) system. It is the responsibility of the ANSP to define the scope of ATSEP activities (*Procedures for Air Navigation Services — Training* [PANS-TRG, Doc 9868] refers).

1.2.1.2 ATSEP play a significant role in the safe operation of CNS/ATM systems. All those involved in the development of competency-based training and assessment programmes for ATSEP should have a detailed understanding of the regulatory environment in which they work.

1.2.1.3 ATSEP training programmes should be clearly linked to ATSEP activities taking into consideration the ANSP's safety management and quality assurance systems as well as any security concerns.

1.2.1.4 National regulations may define the requirements with respect to age, knowledge, experience, skills and attitudes of ATSEP.

1.2.2 ATSEP scope of activities

1.2.2.1 ATSEP may perform tasks on a wide variety of CNS/ATM systems and equipment requiring a wide range of competencies, and expertise as well as knowledge and skills in electronics, computer sciences and networks. In addition, the ATSEP roles to be carried out may range from technician to high-level engineer.

1.2.2.2 Figure 1-1 illustrates the possible scope of ATSEP activities using as a basis the engineering life cycle from system conception through design, operation and, lastly, decommissioning.

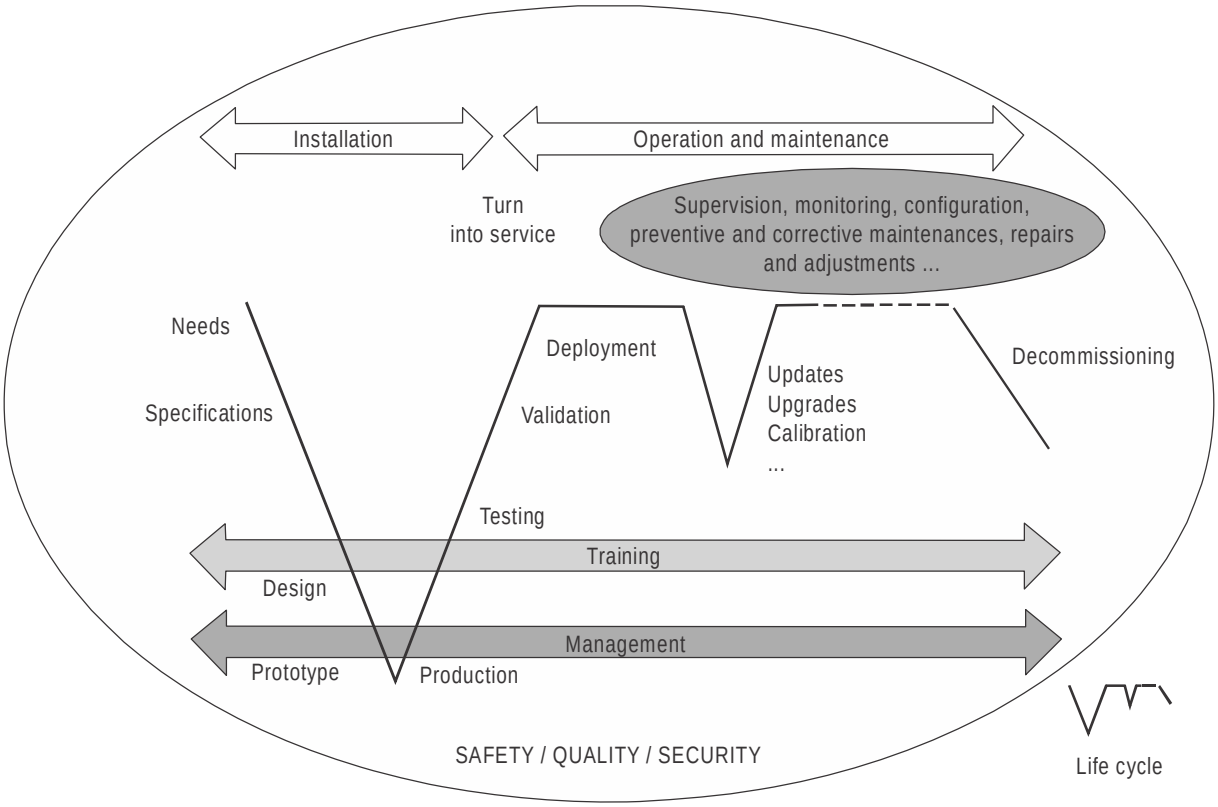

Figure 1-1. Scope of ATSEP activities

1.2.2.3 The ANSP is responsible for determining the scope of its ATSEP activities by selecting the activities from within the cycle depicted in Figure 1-1:

a) **Scope of operational activities.** Supervision, monitoring, control and reporting in real time of technical services, supported by electronic systems and/or equipment for CNS/ATM.

b) **Scope of maintenance activities.** Preventive maintenance, corrective maintenance and/or modification and updates of supporting electronic systems and/or equipment for CNS/ATM.

c) **Scope of installation activities.** Project management, specification, conception, validation, integration, test and acceptance, safety assessment, calibration, certification, optimization and upgrade of supporting electronic systems and/or equipment for CNS/ATM, engineering activities.

1.2.2.4 In addition to technical activities, others may be added related to management, teaching or assessment, safety management, security management (e.g. networks) and quality management.

1.2.2.5 The degree of responsibility given to ATSEP varies among States and ANSPs. In all cases, the ATSEP must be proven competent to work on CNS/ATM systems or equipment ensuring safety and quality through a documented process.

1.2.2.6 Once an ANSP has determined the scope of ATSEP activities, it can establish ATSEP job descriptions comprised of identified tasks.

1.2.2.7 With the introduction of new technologies, maintenance methods and design processes, States and ANSPs should regularly review the scope of ATSEP activities to ensure that ATSEP maintain competencies appropriate to their current activities and with an eye to future activities. Training programmes should be focused on the specific activities assigned to ATSEP within an ANSP.

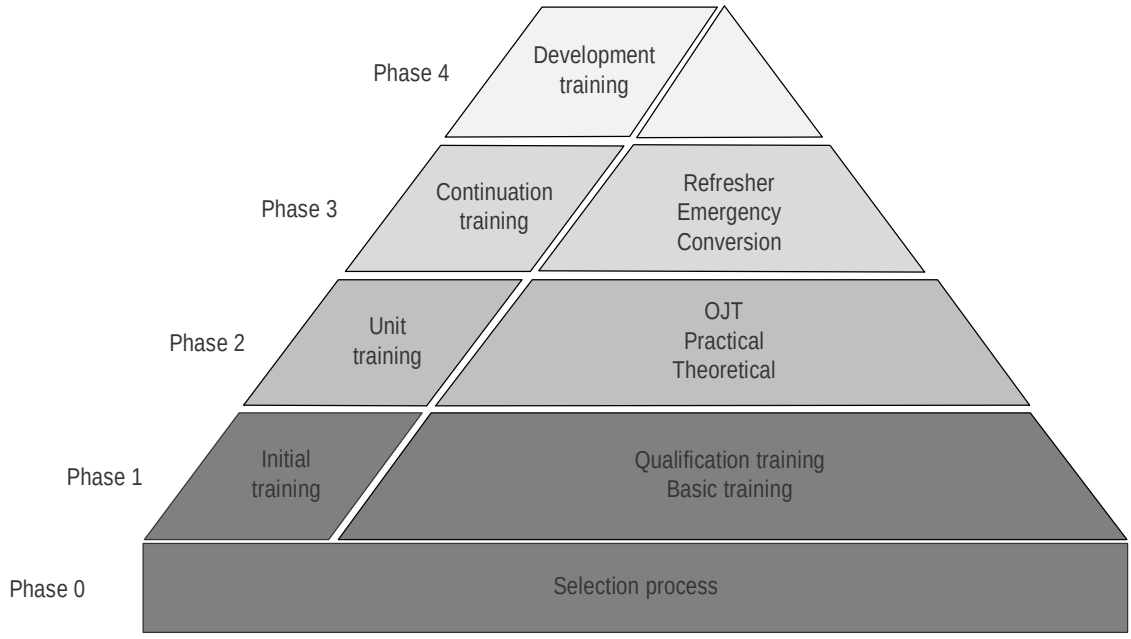

Figure 1-2. ATSEP training phases

1.3 ATSEP TRAINING PHASES

1.3.1 To ensure global standardization, it is recommended that ATSEP training be organized in the phases illustrated in Figure 1-2:

a) **Phase 0: Selection**
The selection process is not a training phase. However, the ANSP will select candidates in line with its ATSEP profiles and activities.

b) **Phase 1: Initial training**
Initial training is designed to provide underpinning knowledge and skills and is delivered in two parts: basic training applicable to all ATSEP and qualification training specific to ATSEP profiles.

c) **Phase 2: Unit training**
After successfully completing the initial training phase, ATSEP undergo unit training. This phase is oriented to the activities an ATSEP will perform in a specific environment. Unit training addresses theoretical and practical issues from equipment-specific and/or site-specific perspectives. It includes on-the-job training (OJT). It is in this phase that ATSEP competencies are developed and assessed.

d) **Phase 3: Continuation training**
The continuation training phase is designed to maintain competencies and prepare for system upgrades and/or modifications. It includes refresher, emergency and conversion training.

e) **Phase 4: Development training**
This phase focuses on the development of additional competencies required by a change to or an evolution of an ATSEP's profile.

1.3.2 The ATSEP competency framework can be found in the PANS-TRG.

1.4 ATSEP TRAINING PATHS

1.4.1 ATSEP will go through training at different points in their careers. Typically, ATSEP will progress from the selection phase to the completion of the unit training phase. In order to maintain competency, they will go through the continuation training phase. Additionally, an ATSEP will require training when:

a) There is a change within a system on which the ATSEP is already working. This is addressed through continuation training (see Chapter 5).

b) The ATSEP changes domains (e.g. from navigation to surveillance). This is addressed through either initial training or unit training (see Chapter 3, 4).

c) A change of activities and associated competencies (e.g. change from maintenance operations to system implementation) is addressed through development training (see Chapter 6).

d) Any additional system to be operated by an ATSEP is addressed through unit training (see Chapter 4).

1.4.2 The progression through ATSEP training is illustrated in Figure 1-3.

1.5 CERTIFICATES OF COMPETENCE

1.5.1 Certificates of competence can take several forms such as:

a) a license delivered by an authority;

b) a certificate delivered by an ANSP or training organization/academy; and/or

c) a diploma/academic degree delivered by an accredited educational institution.

1.5.2 Certificates of competence may be valid for a predetermined period. An ANSP should collect and maintain evidence that its ATSEP are competent to perform the activities assigned to them.

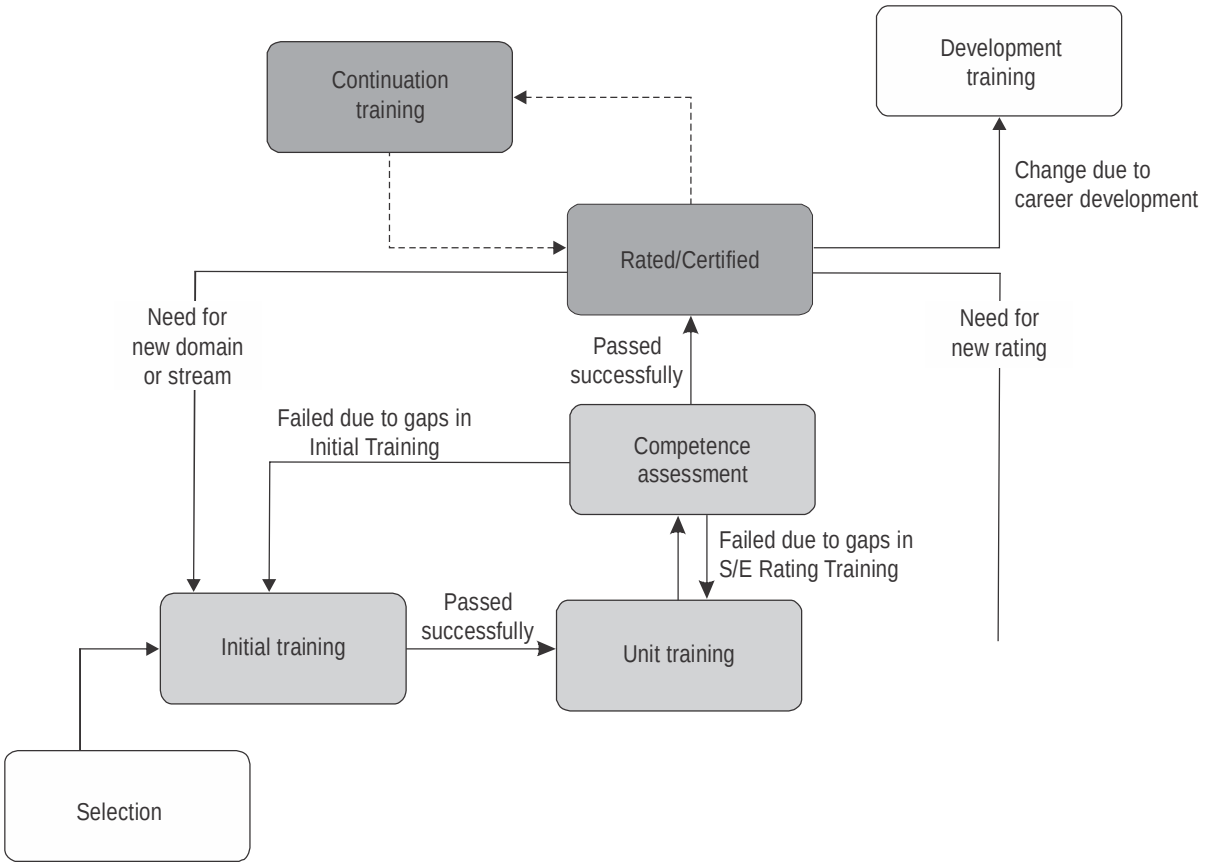

Figure 1-3. ATSEP training progression

Chapter 2

DEVELOPING A COMPETENCY-BASED TRAINING AND ASSESSMENT PROGRAMME FOR ATSEP

2.1 INTRODUCTION

2.1.1 PANS-TRG describes procedures for the design of a competency-based training and assessment programme including those for ATSEP. This chapter builds on these procedures and provides guidance to ANSPs and training organizations on steps to develop an ATSEP competency-based training and assessment programme.

2.1.2 Appendix A provides detailed examples of these steps for two different fictitious ANSPs.

2.2 STEPS TO DEVELOP ATSEP COMPETENCY-BASED TRAINING AND ASSESSMENT

2.2.1 This chapter outlines four steps in the development of an ATSEP competency-based training and assessment programme.

a) Step 1 — Define profiles and activities within the ANSP's predetermined ATSEP scope and develop job description(s);

b) Step 2 — Associate initial training modules to the ATSEP job objective as identified in the job description;

c) Step 3 — Associate competency units, competency elements and performance criteria to the ATSEP tasks; and

d) Step 4 — Develop training and assessment plans for unit training.

It is recognized that training and assessment plans should be developed for all training phases. However, Step 4 focuses specifically on unit training.

2.2.2 ***Step 1 – Define profiles and activities within the ANSP's predetermined ATSEP scope and develop job description(s)***

2.2.2.1 At the completion of this step, an ANSP should have grouped activities under ATSEP profiles in a way that suits the ANSP's needs and environment. Chapter 1 describes at a high level how an ANSP can identify the scope of its ATSEP operational, maintenance and installation activities and how this results in the development of ANSP-specific ATSEP profiles with corresponding job descriptions. The outcome of Step 1 can be used for many human resources functions including competency-based training and assessment.

2.2.2.2 ANSPs can group ATSEP activities by determining the activities that are conducted inside the organization by ATSEP, inside the organization by non-ATSEP and outside the organization by ATSEP. The composition of these groups will effectively define the scope of ATSEP activities within an ANSP.

2.2.2.3 These activities can be derived from operations manuals, equipment manuals, and/or manufacturer's documentation, if available. If these are not available, the ANSP should use the opportunity provided by the implementation of ATSEP competency-based training and assessment to develop or make available these documents. In small ANSPs, there can be a single ATSEP profile, while in large ones there may be several ATSEP profiles. These ATSEP profiles provide the basis of ATSEP job descriptions.

2.2.2.4 ATSEP activities can generally be grouped under installation, operation and maintenance. Groups of activities may be expanded or combined depending on the local ANSP environment.

2.2.2.5 The selection process and all phases of training are based on the ANSP-specific ATSEP profiles. ATSEP profiles are living documents: they should be adjusted continually to effectively address an ANSP's organizational needs. These updates may result in changes to the selection criteria, and to the training and assessment plan.

2.2.3 *Step 2 – Associate initial training modules to the ATSEP job objective as identified in the job description*

2.2.3.1 The purpose of initial training is to provide the underpinning knowledge and skills that ATSEP will need to achieve the job objective in accordance with the job description that the ANSP has developed in Step 1. At the completion of Step 2, ANSPs or training organizations will have identified the training modules of the initial training phase corresponding to the ATSEP job objective.

2.2.3.2 Initial training is made up of basic training and qualification training. This manual details recommended basic and qualification training modules in Appendix B. An ANSP or training organization should use as a starting point the job objective and identify which training modules in Appendix B apply. The knowledge and skills acquired through the initial training modules should have a clear link to the tasks the ATSEP will perform and the competencies they will need to demonstrate on the job.

2.2.3.3 Assessment at this stage will normally be conducted using assessment tools such as multiple choice questions, written/oral examinations, and practical examinations. At this stage, the evidence guide used for competency assessment would not be required as competencies are usually demonstrated during the unit training phase.

2.2.4 *Step 3 – Associate competency units, competency elements and performance criteria to the ATSEP tasks*

2.2.4.1 Once this step is completed, ANSPs and training organizations will have identified and adapted the relevant competency unit, competency elements and performance criteria required for the ATSEP to perform their tasks. With all of these elements, the ANSPs will have a clear view of what tasks their ATSEP should perform and what competencies they should demonstrate in the operational environment.

2.2.4.2 ANSPs and training organizations can find the ICAO ATSEP competency framework in the PANS-TRG and should use it as a reference for this step. The ICAO competency framework should be adapted to suit the ATSEP tasks identified by the ANSP. These competencies are structured in competency units, competency elements and performance criteria. See Appendix A for detailed examples.

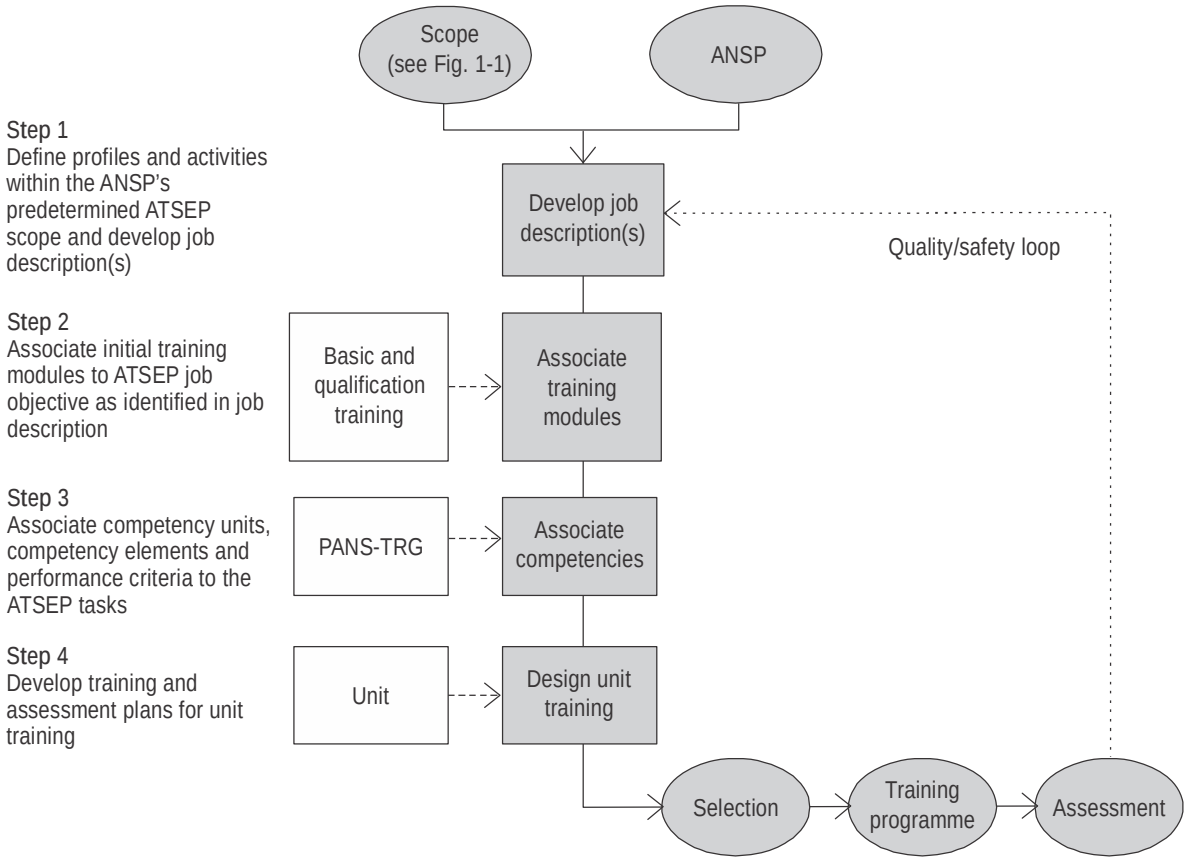

Figure 2-1. Process to design competency-based ATSEP training

2.2.5 ***Step 4 – Develop training and assessment plans for unit training***

2.2.5.1 At the completion of this step, ANSPs and training organizations will have developed a training plan based on the tasks and an assessment plan based on the performance criteria identified previously. This phase combines training specific to the system or equipment and will usually include site and on-the-job training. In unit training, trainees have to demonstrate the successful performance of the tasks, including:

a) knowledge of the local environment and relevant procedures;

b) practical skills related to the local environment, system and equipment; and

c) competencies identified as necessary for the ATSEP profile for the unit.

2.2.5.2 A unit training and assessment plan for each ATSEP job description should be developed.

2.2.5.3 The training plan is a document used for structuring, developing and delivering training. The purpose of the training plan is to detail the following:

a) composition and structure of the unit training course;

b) syllabus;

c) modules, training events and their delivery sequence; and

d) course schedule.

2.2.5.4 Training designers will use the training plan to develop the training and assessment materials.

2.2.5.5 When the duration or the complexity of unit training is such that it makes pedagogic sense to check that a trainee is progressing towards competence at an acceptable pace, the course may be divided into milestones. Milestones are cohesive building blocks of learning that are organized into a logical sequence that generally progresses from the simple to the complex. Each milestone is comprised of both training and assessment(s). Milestones build on one another; therefore a trainee would need to successfully complete the training and assessment for the first milestone before proceeding to the next one.

2.2.5.6 On successful completion of unit training, trainees will have achieved the final competency standard. They will have successfully completed all the required training and assessments that have been determined as necessary to demonstrate the competencies and meet the performance criteria as described in the competency framework of the ATSEP.

2.2.5.7 If unit training has been divided into milestones, it will be necessary to define an interim competency standard for each milestone. For practical assessments, this may be achieved by:

a) modifying the conditions and/or standards of accomplishment; and

b) stating the degree of achievement expected for each performance criterion.

2.2.5.8 An interim competency standard is achieved when all the required assessments for that milestone have been successfully achieved.

2.2.5.9 In unit training, the training plan should identify the relevant training objectives for the activities that the ATSEP will perform on the system or equipment of the operational unit. For identical activities, the training plan may be re-used for different ATSEP. Where an ANSP has a generic ATSEP job description, training plans become generic as well but may be adapted taking into account prerequisite knowledge, skills, competencies and experience.

2.2.5.10 Training materials include the course schedule, training notes, case studies, exercises, briefings, presentations, video clips, etc. Training organizations typically have their own practices for this development process.

2.2.5.11 The purpose of the assessment plan is to detail how competence is going to be determined during unit training based on the performance criteria. It supports the principles of assessment in a competency-based environment. The assessment plan details:

a) the final competency standard associated with the final milestone;

b) the interim competency standard associated with each milestone (if required);

c) the list of assessments (e.g. questionnaire, practical examination demonstration, written or oral examinations, test on position, test in simulation) that are required for each of the milestones that have been defined;

d) when these assessments should take place;

e) the pass marks for oral and written assessments, examinations and questionnaires;

f) the number of observations required, at the interim and final competency standard, to assess performance; and

g) tools used to collect evidence during practical assessment.

2.2.5.12 It is assumed that the organization has a training and procedures manual that describes the administrative procedures relating to:

a) which personnel may conduct assessments and their qualifications;

b) roles and responsibilities of personnel during the conduct of assessments;

c) assessment procedures (preparation, conduct and post-assessment);

d) conditions under which the assessment is undertaken;

e) record-keeping; and

f) actions to be taken when a trainee fails to meet the requirements of the assessment.

2.3 ASSESSMENT

2.3.1 Table 2-1 describes the principles that should drive competency-based assessments.

Table 2-1. Principles of competency-based assessments

Clear criteria for assessing competence	This is established using the ICAO ATSEP Competency Framework adapted to meet local requirements as detailed in Appendix 2 to Chapter 3 of the PANS-TRG, Second Edition.
An integrated performance of the competencies	This requires a demonstration by the trainee undergoing training and/or assessment of the seamless interaction of the competencies with each other. The assessment of whether or not the trainee has reached the competency required can only be made once all of the required competencies are demonstrated in an integrated manner.
Valid and reliable evidence	Documented guidelines of the performance to be observed and the conditions under which they are to be observed enables the same assessment result to be achieved by different assessors.
Multiple observations	Multiple observations must be carried out to determine whether or not a trainee has achieved the final or interim competency standard.

2.3.2 Assessment is an integral part of the competency-based training process. For the ATSEP, assessments provide incentive and motivation, and confirm that learning and competence have been achieved. From the instructor's point of view, assessment demonstrates if training objectives have been met. Performance during assessments also indicates whether the instruction methods used are effective or should be improved. The sole purpose of assessments is to measure whether or not the ATSEP trainee has achieved the training objectives and the relevant competencies.

2.3.3 ATSEP should always be informed as to how they will be assessed. The information should include the conditions that will exist during the assessment, the performance that is expected from the ATSEP and the standards of accomplishment that have to be met. ANSPs and/or authorities should have in place processes to deal with assessment failures. ATSEP should be informed of the result of their assessments, and instructors should offer feedback on how to correct a mistaken response or unsatisfactory practical performance.

2.3.4 The assessment plan should describe the process and tools that will be used to determine how an ATSEP's performance compares to the performance criteria. This evidence is needed to demonstrate that the ATSEP has attained the required competencies and also to provide feedback for process improvement. Tools such as periodic training reports or checklists on achievements of performance and competencies may be useful to document this process.

2.3.5 Once an ATSEP has demonstrated the required performance, it is necessary to maintain this level of performance and therefore maintain competency. Continuation training is a mechanism for ensuring competencies are maintained, and therefore a continuation training plan is required. The plan will be influenced by many factors, e.g. activity exposure, technical developments, new procedures or changes in the profile. Chapter 5 contains more information about continuation training.

2.3.6 As part of a safety and/or a quality management system, a process to benchmark, maintain and improve the efficiency and quality of training is required. A continuous feedback system gathering data from trainees, instructors, assessors, ANSPs and organizations should be implemented. The feedback system may use different methods (e.g. written feedback, moderated feedback) and technologies (e.g. handwritten, electronic). Any feedback should be documented and traceable.

2.3.7 Training objectives should indicate the conditions under which ATSEP performance will be performed and assessed and the standard of accomplishment that must be attained. For basic and qualification training, only the standard of accomplishment of training objectives should be achieved. In unit training, trainees should not only meet the standard of accomplishment, but also the competency standards associated with their job description.

2.3.8 The training provider can use a variety of assessment methods. Each assessment method should be selected according to the training objective, the competence to be achieved, and its impact on safety and/or quality. Possible assessment methods could be:

a) unique and/or multiple choice questionnaire;

b) written and/or oral examination;

c) practical examination (demonstration);

d) test on position; and

e) test in simulation.

2.3.9 Assessments should take into account the taxonomy level related to the training objective. The taxonomy levels are described in Appendix C.

2.3.10 Where possible, States or ANSPs should build an examination question repository or at least a comprehensive written list of all questions and performance exercises. Due to the rapid evolution of technology and systems, these questions and performance exercises must be kept up to date to ensure the currency of the ATSEPs' knowledge and skills.

2.4 EVIDENCE GUIDE

An evidence guide provides practical examples of what can be observed for given competency and performance criteria in certain conditions. The evidence guide also provides the criteria for assessment at the interim or final competency standard. It ensures that instructors and assessors interpret performance criteria consistently and that valid and reliable evidence is gathered.

Appendix A provides an example of an evidence guide.

2.4.1 Competency Checklist

A competency checklist is used to record evidence of multiple observations at different milestones during training. A sufficient number of checklists should be collected to ensure that the trainee demonstrates a consistent and integrated performance of competencies.

2.4.2 Assessment Form

The assessment form details the competencies and conditions for the assessment of performance. The assessment outcome is c*ompetent* or *not competent* for the assessment undertaken.

Chapter 3

INITIAL TRAINING PHASE

3.1 INTRODUCTION

3.1.1 The purpose of this chapter is to describe the modules considered necessary for initial training. Initial training provides underpinning knowledge and skills and is delivered in two parts: basic training applicable to all ATSEP and qualification training specific to ATSEP profiles as described in Chapters 1 and 2.

3.1.2 During this phase, ATSEP acquire the knowledge and skills required to subsequently undertake unit training. Initial training materials can be enhanced by including examples to illustrate real-life situations and using available systems and equipment. Training objectives can be added as required.

3.1.3 Section 3.2 describes the components of the basic training module and Section 3.3 of the qualification training modules. Proposed training objectives for these modules can be found in Appendix B.

3.2 BASIC TRAINING MODULE

3.2.1 All ATSEP should successfully complete basic training. At the end of basic training, trainees should have acquired general knowledge regarding:

a) international and national organizations and standards;

b) air traffic services, airspace standards, aeronautical information systems, meteorology and altimetry;

c) CNS/ATM concepts; and

d) human factors.

3.2.2 The training organization should ensure that ATSEP successfully achieve all basic training objectives before proceeding to the qualification training modules. Each training objective should be associated with a condition and a standard of accomplishment. A condition refers to anything that may qualify performance in the local environment. The standard of accomplishment relates to the taxonomy level identified for the training objective. See Appendix C.

International and national organizations and standards

3.2.3 CNS/ATM systems operations are regulated by international organizations that provide rules and standards to ensure the safe operation and interoperability of ANS worldwide. Among these organizations are ICAO, the European Civil Aviation Conference (ECAC), the European Aviation Safety Agency (EASA) and the Institute of Electrical and Electronic Engineers (IEEE). Achievement and maintenance of safety and efficiency in air navigation operations depend on the standardization of operational practices for international services. The syllabus should give a general view on aviation regulations as adopted by ICAO and implemented in international ANS operations.

Air traffic services, airspace standards and meteorology

3.2.4 CNS/ATM systems are vital to the safe, reliable and efficient delivery of air traffic services. ATSEP perform critical tasks on CNS/ATM systems or equipment which impact users. In order for ATSEP to fully understand the impact of their work on these systems, they must have a sound knowledge of the ATM operational environment. The consequences of system outages and their negative impact on users (i.e. pilots, air traffic controllers) may result in unsafe situations or cause excessive delays in airline operations.

CNS/ATM concepts

3.2.5 The ATSEP's main activities are to maintain, modify, repair and develop CNS/ATM systems, while keeping them fully operational and safe. The consequences of system outages and their direct impact on the users (i.e. pilots, air traffic controllers) may result in unsafe situations or cause excessive delays in airline operations. The syllabus gives a general view of these concepts, including power distribution.

Human factors

3.2.6 Lapses in human performance are cited as causal factors in the majority of accidents. A better understanding and knowledge of human factors in ATSEP work can potentially decrease the accident rate. This module introduces ATSEP to fundamental human factors concepts in ANS.

3.3 QUALIFICATION TRAINING MODULES

3.3.1 Following the successful completion of basic training, ATSEP will require qualification training relevant to the ATSEP profile for a given ANSP.

3.3.2 At the completion of the qualification modules, ATSEP must be able to explain the purpose of each system, each piece of equipment and its technical specifications. They must also be able to explain the effect and impact on the service when these systems or equipment are being worked on.

3.3.3 The training objectives for the qualification modules listed below are described in Appendix B. Each training objective should be associated with a condition and a standard of accomplishment. The training objectives should include in their conditions, as appropriate, a laboratory environment, exposure to specific equipment as well as access to appropriate training materials, reference documentation, test equipment and tools.

3.3.4 The training organization should ensure that ATSEP successfully achieve all training objectives in accordance with the standard of accomplishment and the approved standards and procedures.

3.3.5 Finally, ATSEP must understand the impact of their work on the users and on the overall ANS communication system.

Communication module

3.3.6 Communication systems provide a means of relaying essential information for the safe and orderly operation of the ANS. Communication involves much more than radio transmitters and receivers; it also includes communication protocols, networks, types of media, recorders and safety aspects.

Navigation module

3.3.7 Radio navigation systems provide a means of relaying essential information for the safe and orderly operation of the ANS. Radio navigation systems can be located anywhere on the airport, in its vicinity, at a great distance from the airport, or can be satellite-based systems.

Surveillance module

3.3.8 An aeronautical surveillance system provides the aircraft position and other essential information to ATM and/or airborne users to assist their safe and orderly operation. Surveillance systems can be located anywhere on the airport, in its vicinity, or at a great distance from the airport.

3.3.8.1 ATSEP should meet the standard of accomplishment whereby all maintenance, calibration and certification should be performed as per the approved standards and procedures.

Data processing/automation module

3.3.9 Data processing/automation systems provide the means of relaying essential information for the safe and orderly operation of ANS. Data processing/automation includes a combination of hardware platforms and operating system software. Proper hardware and software configurations are essential for a safe and orderly ANS. Data processing/automation systems can be located anywhere at the area control centre (ACC), on the airport, or in its vicinity, or remote from the ACC or airport.

System monitoring and control (SMC) module

3.3.10 The implementation of CNS/ATM systems and equipment has led to new ways of providing SMC. Most ANSP have centralized the SMC functions within a geographical area, typically the flight information region (FIR) or the area of responsibility. Many ACC/UAC have an SMC suite or position staffed by qualified SMC ATSEP. In other cases SMC suites or positions for CNS systems and equipment are centralized. Both options may co-exist. The SMC ATSEP are responsible for the day-to-day operation (normally 24 hours per day, 7 days per week) of all operational systems and equipment within their area of responsibility. The SMC ATSEP ensure a quick response to malfunctions or failures by diagnosing the problem, activating fall-back procedures and initiating the repair. The SMC ATSEP coordinates between the operational air traffic controller (ATCO) supervisor and the operational CNS/ATM ATSEP within the area of responsibility. The SMC ATSEP also coordinates between those responsible for different areas.

3.3.10.1 Training for the SMC ATSEP should emphasize the requirement to communicate appropriately with all relevant stakeholders such as the ATCO supervisor, rescue units, military units or others. Thus, training should address team resource management (TRM), human-machine interaction (HMI) and human-human interaction (HHI) skills.

3.3.10.2 SMC ATSEP activities can be categorized in a generic list. To complete each of these activities, ANSPs should describe site procedures, identify the activities in each of the areas of responsibility and number them. The following naming conventions should be used to categorize SMC activities:

a) LR — logging and reporting;

b) MC — monitor and control;

c) RR — release and restoration;

d) PI — problem isolation and service restoration;

e) PO — position operation; and

f) SS — site specific SMC tasks.

Note that based on Step 1 identified in Chapter 2, not all categories need to be served by the same SMC ATSEP or even by an SMC ATSEP as such.

3.3.10.3 The SMC qualification module will be developed, implemented and delivered based on the activities identified by the ANSP. Trainees shall perform SMC activities in accordance with approved procedures and apply TRM, HMI and HHI concepts.

3.3.10.4 Training objectives related to the SMC qualification module should include in their conditions exposure to specific SMC equipment equal to or representative of the SMC environment, as well as reference documentation and tools. Alternatively, simulation or scenarios could be used to enable the performance of the objective without the need for operational equipment. In addition, the performance of training objectives should be achieved in specific situations relating to an FIR/ACC. This module should include exercises on applied standards and procedures, as well as operational practices.

Infrastructure module

3.3.11 Infrastructure equipment and systems play a vital role in the operation of CNS/ATM systems and consequentially in the safe and orderly operation of ANS. The integrity and reliability of CNS/ATM systems depend on the quality, availability, capacity and reliability of electrical power supply sources, equipment and systems.

3.3.11.1 ATSEP must understand the impact of their work on the users and on the overall CNS/ATM power supply system.

3.3.11.2 Training objectives related to the infrastructure qualification module should include in their conditions that performance should be achieved in a laboratory environment, given an exposure to specific power supply equipment along with the appropriate and pertinent reference documentation, test equipment and tools.

Engineering module

3.3.12 Most States have regulatory requirements for ensuring that CNS/ATM systems and equipment are specified, researched, designed, developed, tested, validated and installed by qualified ATSEP. Generally, ANSPs establish a distinct group of specialized ATSEP who are responsible for the engineering and the installation of all CNS/ATM systems and equipment.

3.3.12.1 The engineering module will be developed, implemented and delivered in compliance with the ATSEP profile and activities required by an ANSP. The trainees shall perform their tasks in accordance with approved local and/or national standards and procedures.

Chapter 4

UNIT TRAINING PHASE

4.1 INTRODUCTION

4.1.1 The purpose of this chapter is to provide additional guidance regarding Step 4 described in Chapter 2 on developing training and assessment plans for unit training.

4.1.2 After successfully completing the initial training phase, ATSEP undergo unit training. This phase is oriented to the activities and competencies an ATSEP will perform in a specific technical and operational environment as defined during Step 3 described in Chapter 2.

4.1.3 Unit training addresses theoretical and practical issues specific to the equipment and site of an operations unit. Unit training includes on-the-job training (OJT). It is in this phase that ATSEP competencies are developed and assessed.

4.2 TRAINING PLAN

4.2.1 In principle, the training plan for unit training can be organized in three modules:

a) technical and operational environment;

b) system/equipment; and

c) OJT.

4.2.2 Training content should address:

a) functionality of the system/equipment;

b) actual and potential impact of ATSEP actions on the system/equipment; and

c) impact of the system/equipment on the operational environment.

4.2.3 Unit training builds on the theoretical knowledge and skills learned during the initial training phase. In addition, training objectives in the areas of human factors and teamwork should also be considered relevant in unit training.

4.2.4 The level of training must be appropriate to the ATSEP profile but would not normally go beyond the replacement of the lowest replaceable module (LRM) or electronic boards of the system and equipment. Normally, unit training should not cover repair of LRMs or boards. If required, training for repairs should be conducted outside the scope of unit training.

4.2.5 Unit training can be implemented at a specialized training centre, at the factory, on site or a combination thereof. However, OJT should be conducted on site in the operational environment.

4.2.6 Unlike initial training, detailed training objectives are not provided for the unit training phase because unit training is specific to an ATSEP job, a system or equipment for a given ANSP. Thus, only generalized training objectives can be provided.

4.2.7 Before new systems become fully operational, a sufficient number of ATSEP must be available to maintain the systems and should therefore have completed the relevant unit training. ATSEP initially qualified to start operation should participate in the factory acceptance test (FAT) and/or the site acceptance test (SAT) prior to receiving a manufacturer's training course.

4.3 ASSESSMENT PLAN

During unit training, competencies for an ATSEP profile are developed as identified in Step 3 of Chapter 2. The assessment plan for the unit training phase should describe the specific process and tools that will be used to determine how an ATSEP's performance compares to the training plan and to the competencies that have been identified in the ATSEP profile. Evidence is collected through a variety of assessment methods and tools to document an ATSEP's progression towards achieving competence. The assessment plan for unit training should comply with the principles outlined in Table 2-1 of Chapter 2. (For an example of an evidence guide, see Appendix A.)

4.4 UNIT TRAINING MODULES

Technical and operational environment module

4.4.1 ATSEP trainees should have detailed knowledge of the technical and operational environment which can directly influence ANS such as facilities, maintenance procedures, and quality, safety and security policies. At the end of this module and in accordance with the ATSEP profile, the trainee will be able to:

a) describe the infrastructure environment and system and equipment involved in the ANS;

b) apply rules for circulation (e.g. access to shelters, driving certificate, technical rooms, security rules);

c) identify facilities (power supply, air-conditioning, etc.);

d) use the proper vocabulary relative for communication with other services; and

e) apply safety rules and maintenance procedures.

4.4.2 For ATSEP with prior experience in the operational environment, unit training should only address the areas where a gap has been identified.

System/equipment module

4.4.3 Trainees should be familiar with the specific system or equipment for the unit, in particular with the principles of its design, the different hardware and software elements and their interactions and functionality.

4.4.3.1 This module builds on what was learned during qualification training and is specific to the equipment type on which the ATSEP will work.

4.4.3.2 At the end of this module and in accordance with the ATSEP profile, the trainee will be able to:

a) identify and explain the details of the different components of the system;

b) describe the protocols used and the data flow;

c) explain the different functionality and the performance of the system;

d) explain the significance of the parameters and error messages;

e) explain the functionality of the HMI and SMC and their operation; and

f) use appropriate action in installation and/or maintenance and/or operation activities.

On-the-job training module

4.4.4 The purpose of this module is to develop, consolidate and assess the competencies, knowledge and skills gained within the operational environment and on specific system/equipment required for the rating.

4.4.4.1 During OJT, the trainee will perform the activities for the job in the operational environment (e.g. operations, supervision, troubleshooting exercises, replacement, installations, testing of faulty modules, calibration). The trainee will also apply procedures for installation, maintenance and/or operation particular to the measurement, testing and restarting of the system or equipment in order to certify that it meets the standards.

4.4.4.2 This module includes practical exercises on systems and/or equipment where the trainee works on live equipment under the supervision of an experienced ATSEP or instructor.

4.4.4.3 At the end of this module and in accordance with the ATSEP tasks, the trainee will be able to:

a) follow the logistic processes and apply the safety procedures (access to the station, power supply, air-conditioning, safety rules, etc.);

b) operate the system or equipment, perform the necessary control and monitoring functions (periodic measurement, start or restart, configuration, etc.), including the HMI and SMC;

c) run all available built-in tests, diagnostics and checks on the system or equipment;

d) troubleshoot the system/equipment in the operational environment by:

1) analysing the warnings, errors, alarms or failure messages or indications;

2) identifying problem areas and faulty unit or LRM;

3) performing replacement of unit or LRM;

4) calibrating or reconfiguring the system if required;

5) restoring the system or equipment to an operational mode; and

6) conducting installation activities.

4.4.4.4 After the successful completion of unit training and competency assessment, the ATSEP will obtain certification and/or a rating of competence (proven competent status).

Chapter 5

CONTINUATION TRAINING

5.1 INTRODUCTION

5.1.1 This chapter provides guidelines to States and ANSPs in the preparation and provision of continuation training for ATSEP. The objective of continuation training is to ensure that the ATSEP maintains up-to-date operational competence.

5.1.2 Maintaining ATSEP competence is part of an Integrated Management System (IMS) in place in each ANSP. IMS is composed of a Quality Management System (QMS) and a Safety Management System (SMS) with a risk analysis and mitigation process. This last process takes into account all changes (minor or major) made by the ANSP. Gathering evidence on the maintenance of ATSEP competence is therefore vital from an IMS point of view and should comply with the principles identified in Table 2-1 of Chapter 2.

5.1.3 There are three types of continuation training:

a) refresher training which reviews or reinforces existing competencies;

b) emergency training which includes training for unusual situations; and

c) conversion training (system/equipment changes, upgrade and/or changes in procedures).

5.2 REFRESHER TRAINING

5.2.1 Refresher training is designed to review or reinforce existing ATSEP competencies. It should be site-specific, conducted on a regular basis and related to the rating and/or certification of the ATSEP. It should cover theoretical knowledge as well as practical skills which can be acquired through simulations or practical exercises.

5.2.2 Refresher training can be designed in a number of ways. It can be system-specific, domain-based or role-based training. For example:

a) ATSEP who hold only a single rating/certification should receive refresher training specific to that rating/certification.

b) ATSEP who hold ratings/certifications for a number of systems or equipment within the same unit could receive specific refresher training for each system or piece of equipment or follow a global training course covering all relevant systems and equipment.

c) In the case of multi-rated/multi-certified ATSEP (e.g. COM, NAV, SUR, SMC), refresher training specific to that rating/certification is likely to be most effective. However, a generic course to cover a number of ratings/certifications could be designed and provided to such ATSEP.

d) For ATSEP who are project managers in system installation or requirements, engineering role-based refresher training may be appropriate.

5.2.3 The ANSP should determine the frequency and duration of refresher training. It should be scheduled periodically for all ATSEP. The frequency of refresher training will depend on:

a) activity exposure;

b) complexity of the system/equipment/activity; and

c) impact of the loss of the system/equipment on the service provision.

5.2.4 Refresher training may be carried out either on-site or off-site, whichever is the most appropriate. Where possible, it is advantageous that part of the training be carried out on representative systems or equipment (e.g. on a spare system).

5.3 EMERGENCY TRAINING

5.3.1 Emergency training refers to training for the management of non-routine situations. It is linked to the competency unit “management of non-routine situations” and the subsequent competency elements and performance criteria.

5.3.2 Non-routine situations can be described by the following characteristics:

a) can be immediate or short term; and/or

b) engage or endanger human life; and/or

c) involve major degradation of service provision.

5.3.3 Training for these situations is aimed at dealing with causal factors impacting safety, such as but not limited to:

a) natural events (e.g. earthquakes, tornado, flood, fire);

b) security breach (e.g. terrorism, cyber-attack, sabotage); and

c) technology breach (e.g. major system failure, power failure).

5.3.4 Training for management of non-routine situations can be facilitated in a number of ways, including but not limited to:

a) recurrent training or exercises based on written procedures;

b) round-table discussion dealing with a hypothetical scenario;

c) lessons-learned exercises based on experience; and

d) debriefing after major events, incidents or accidents to enhance safety and/or security.

5.4 CONVERSION TRAINING

5.4.1 Conversion training should be triggered by a change to an existing system that impacts operations. Triggers for setting up of conversion training include:

a) updates on reference material from relevant regulatory provisions and from aeronautical information publications (AIPs);

b) new maintenance procedures;

c) new standards and operating procedures;

d) new factors affecting system performance;

e) system monitoring and control changes;

f) system modification (hardware, software, firmware);

g) new monitoring, calibrating and measuring equipment available for ATSEP; and

h) organizational changes leading to the identification of new competency elements.

5.4.2 Conversion training is system- or equipment-specific. It should be provided to all impacted ATSEP prior to the change being deployed. The ATSEP profile and competencies as well as other phases of training (e.g. unit training, refresher training) should be adjusted in accordance with the change.

5.4.3 Conversion training should be designed to familiarize the ATSEP with any change or update in the system, equipment, procedure or practice that may have occurred since the last training session. Training objectives should be derived from the difference between the current situation and the situation after deploying the change.

5.4.4 Typically, conversion training is related to a specific planned change and is scheduled once. The duration is dependent on the nature of the change and the ATSEP affected.

5.4.5 Conversion training can be delivered through various means ranging from dedicated training sessions to briefings, operational instructions, information papers or others. It may be carried out either on-site or off-site, whichever is the most appropriate. Where relevant, it is advantageous that part of the training be carried out on representative systems or equipment (e.g. on a spare system).

Chapter 6

DEVELOPMENT TRAINING

6.1 Development training consists in developing the additional competencies required when taking on new activities. Typically, this is initiated as a result of career progression.

6.2 These new activities may include:

a) carrying out a training function (e.g. OJT instructor);

b) managing staff;

c) writing requirements;

d) validating and testing equipment or systems;

e) managing quality, safety or security; and

f) auditing.

6.3 If a significant change of activities is identified, initial or unit training may be required. The process described in Chapter 2 to set up competency-based training also applies to development training provided that the ANSP considers these new activities as part of the ATSEP profile.

6.4 A number of examples for development training are outlined in Appendix D.

Appendix A

DEVELOPING ATSEP COMPETENCY-BASED TRAINING AND ASSESSMENT: EXAMPLES

In this appendix, two examples are given for the application of the steps to develop ATSEP competency-based training and assessment as described in Chapter 2. The organizational structures used are examples. ANSPs may choose organizational structures that are different from those represented. Their purpose is to describe in more detail how ATSEP competency-based training and assessment can be developed for a given organizational structure of an ANSP.

EXAMPLE 1: SMALL ANSP "ABC" OPERATING AT SEVERAL REGIONAL AIRPORTS

In this example, ANSP ABC operates CNS services at a number of regional airports in a country. The number of staff is small and, to limit costs, employees are generalists and not specialized. ATSEP have to serve several systems so that the number of staff is optimized. The ANSP's strategy is to concentrate on core activities and to procure support from external providers — mainly manufacturers — for in-depth maintenance activities.

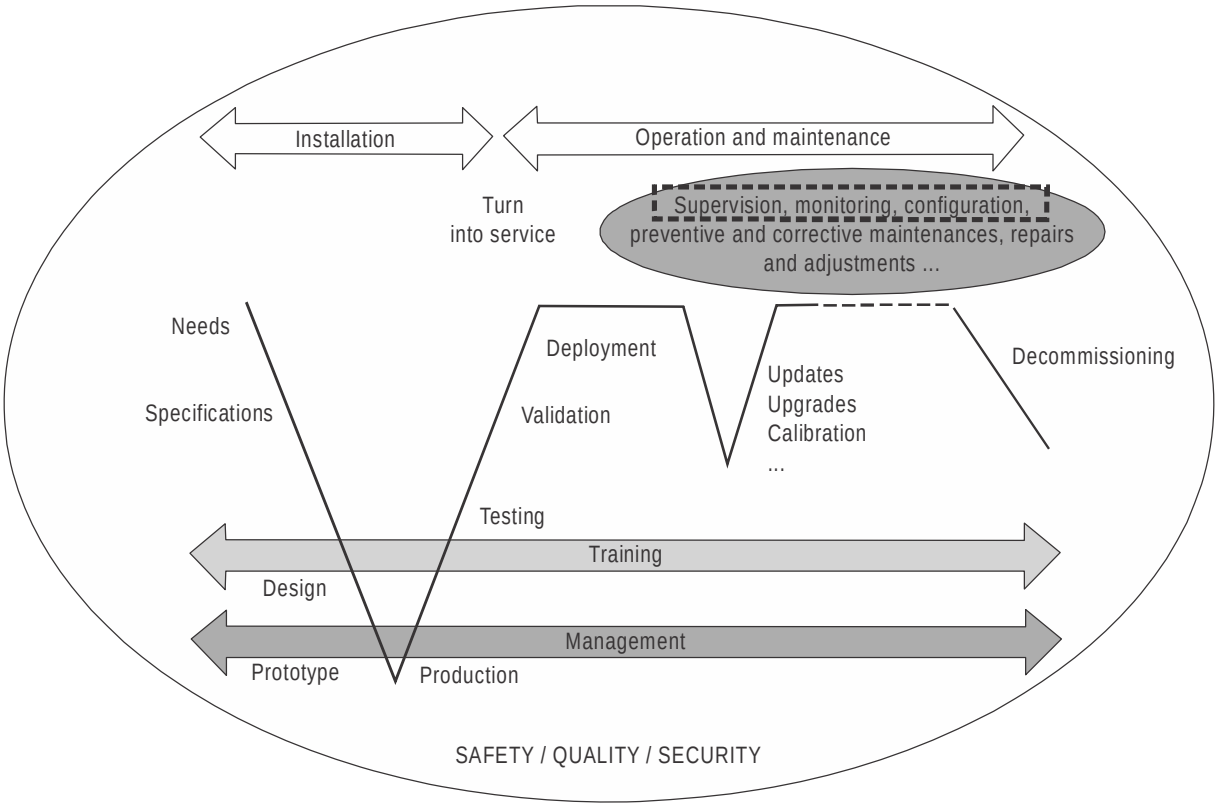

Figure A-1. ATSEP Scope within ANSP "ABC" (example)

Step 1 — Define profiles and activities within the ANSP's predetermined ATSEP scope and develop job description(s)

Within ANSP ABC, the ATSEP activities are scoped as supervision, monitoring and configuration (see dotted rectangle in Figure A-1).

Specifically, the ATSEP is designated to work at the regional airport SMALLAIRPORT, servicing a VOR, a DF, an r/t system and an ASR.

ATSEP job description within ANSP ABC

The following job description is used within ANSP ABC:

Item	*Description*
Job title	SMC ATSEP at regional airport SMALLAIRPORT
Job objective	Supervise, monitor and configure the related equipment (VOR, DF, r/t system, ASR)
Entry level	Technician with four years of previous job experience (minimum) or Bachelor of engineering with initial job experience
General nature of the job	Responsible execution of activities for supervision, monitoring and configuration of the related equipment
Key responsibilities	• Operational availability of the related equipment • Compliance to regulatory requirements • Compliance to internal procedures
List of tasks	a) Monitor the following systems: VOR, DF, r/t and ASR. b) Receive and forward error messages. c) Initiate maintenance activities based on error messages received. d) Relate to manufacturer for maintenance activities. e) Inform customers (airport) on status of troubleshooting process. f) Document and report.

This job description provides the basis for the selection of ATSEP for ANSP ABC.

Step 2 — Associate initial training modules to ATSEP job objective as identified in job description

ANSP ABC associates the ATSEP job objective identified above with the following pre-defined training modules (see Chapter 3):

Predefined Training Modules	*Job Objective*
	Supervise, monitor and configure the related equipment (VOR, DF, r/t system, ASR)
Basic	X
Qualification communication	X
Qualification navigation	X
Qualification surveillance	X
Qualification data processing/automation	
Qualification SMC	X
Qualification infrastructure	X
Qualification engineering	

Step 3 — Associate competency units, competency elements and performance criteria to the ATSEP tasks

ANSP ABC associates the ATSEP tasks identified above with the following competency units and competency elements:

ATSEP Tasks	*Competency Units / Competency Elements (See Appendix 2 to Chapter 3 of the PANS-TRG [Doc 9868] for the full descriptions of each Competency Unit and Competency Element)*									
	Engineering	*Situation Awareness*	*Service Provision*	*Coordination*	*Management of non-routine Situations*	*Problem Solving and Decision Making*	*Self-Management and Continuous Learning*	*Workload Management*	*Teamwork*	*Communication*
Monitor of the VOR, DF, r/t, ASR systems		2.1 2.2 2.3	3.1				7.2 7.5	8.4		
Receive and forward error messages		2.2	3.2	4.1	5.2		7.2 7.5			10.2
Initiate maintenance activities based on error messages received				4.1 4.2	5.2		7.2 7.5	8.4		
Relate to manufacturer for maintenance activities				4.2	5.2		7.2 7.5	8.4		10.2
Inform customers (airport) on status of troubleshooting process				4.2			7.2 7.5			10.2
Document and report			3.2				7.2 7.5	8.4		
Summary of competency elements		*2.1 2.2 2.3*	*3.1 3.2 3.3*	*4.1 4.2*	*5.2*		*7.2 7.5*	*8.4*		*10.2*

Performance criteria
In this step, we associate performance criteria to the competency elements identified above.

Competency Element	*Performance Criteria*
(See Appendix 2 to Chapter 3 of the PANS-TRG [Doc 9868] for the full descriptions of each Competency Element and Performance Criterion)	
CE2.1	PC2.1
CE2.2	PC2.2, PC2.3
CE2.3	PC2.4, PC2.5
CE3.1	PC3.1
CE3.2	PC3.2
CE3.3	PC3.4
CE4.1	PC4.1
CE4.2	PC4.2
CE5.2	PC5.3, PC5.4
CE7.2	PC7.2
CE7.5	PC7.7
CE8.4	PC8.4
CE10.2	PC10.2, PC10.3

Step 4 — Develop the training and assessment plans for unit training

The training plan for unit training is designed based on the tasks identified above. The assessment plan for unit training is designed based on the performance criteria identified above. As indicated in Chapter 2, 2.2.5, the training plan is used to develop the training materials. It is not intended in this example to provide a comprehensive set of training materials (i.e. course schedule, training notes, case studies, exercises, briefings, presentations, video clips) since these could be developed in a variety of ways depending on the ANSP and/or training organization. However, the “Training Content” table below provides an indication of the possible content of the unit training programme based on the ANSP ABC ATSEP job description. For this example, theory is taught first followed by OJT for each system. Training on Unix, network, tools and procedures can take place anywhere in the sequence.

Similarly, as indicated in Chapter 2, 2.2.5, an assessment plan details assessment events and tools that will be used to determine if an ATSEP achieves competence during and at the end of unit training. It is not intended in this example to provide a comprehensive list of all assessment events and tools since these could be developed in a variety of ways depending on the ANSP and/or training organization. However, the “Evidence Guide” table below provides an indication of the performance criteria associated with the expected performance at different milestones during unit training as well as at the end of unit training when all competencies should be demonstrated in an integrated manner. In this example, no competency assessment is applied in classroom courses. Peer review is used as the assessment for a final checkout.

In implementing competency-based training and assessment, ANSP ABC will identify lessons learned and feed them back in the relevant part of the process to ensure that the training programme remains relevant and effective.

Training content

Item	*Provider*	*Duration [d][1]*	*Type*	*Remarks*
Unix training course	External	3	Mediated training	Can be skipped if knowledge and skills already established
Network training course	External	2	Classroom	Can be skipped if knowledge and skills already established
Overview training on VOR	External, e.g. manufacturer	2	Classroom + lab	
Overview training on r/t system	External, e.g. manufacturer	2	Classroom + lab	
Overview training on ASR	External, e.g. manufacturer	5	Classroom + lab	
Field training on VOR	Own unit	3	On-the job	
Field training on DF	Own unit	3	On-the job	
Field training on r/t system	Own unit	3	On-the job	
Field training on ASR	Own unit	5	On-the job	
Overview on procedures	Internal	1	Classroom	
Overview on documentation tools	Internal	½	Classroom	

Evidence Guide

As part of the progression towards the final competency standard (FCS), it may be necessary to establish interim competency standards (ICSs). ICSs will be associated to milestones marking progression through the unit training phase. On successful completion of unit training, trainees will have achieved the FCS. This means that they will have successfully completed all the required training and assessments that have been determined as necessary to demonstrate the competencies and meet the performance criteria to meet the job objective identified in the ATSEP job description.

In this example, it has been decided to establish two ICSs towards the achievement of the FCS.

1. Some of the durations may depend on availability of external courses and thus may differ.

CU 2 — Situational Awareness				
PC		*ICS 1*	*ICS 2*	*FCS*
2.1	Monitors the CNS/ATM systems in own area of responsibility and contributing areas as well.	Consistently monitors individual systems (VOR, DF, r/t, ASR) and responds in a timely manner with appropriate actions at times of low alarms/event rates.	Consistently monitors individual systems (VOR, DF, r/t, ASR) and responds in a timely manner with appropriate actions at times of high alarms/event rates and abnormal conditions.	Consistently monitors all systems (VOR, DF, r/t, ASR) and responds in a timely manner with appropriate actions at times of high alarms/event rates and abnormal conditions.
2.2	Monitors the environmental conditions that have an impact on own and adjacent areas of responsibility and understands the impact on systems and services.	Consistently demonstrates, under supervision, an awareness of the potential impact of environmental conditions (weather) on systems and services in own area of responsibility.	Consistently demonstrates, under supervision, an awareness of the potential impact of environmental conditions (weather) on systems and services in own and adjacent areas of responsibility.	Independently monitors environmental conditions (weather) and responds with the appropriate actions in own and adjacent areas of responsibility.
2.3	Monitors the relevant elements of the ATC operational situation.	Demonstrates an awareness of the ATC operational situation with respect to traffic levels, equipment availability, open sectors, staffing levels.	Able to determine, under supervision, the most appropriate action taking into account the operational situation with respect to traffic levels, equipment availability, open sectors, staffing levels.	Able to independently execute the most appropriate action taking into account the operational situation with respect to traffic levels, equipment availability, open sectors, staffing levels.
2.4	Maintains awareness of the people involved in or affected by the operation.	Demonstrates the ability to name ATSEP involved in or affected by the operation.	On request, demonstrates the ability to name all people involved in or affected by the operation.	In all activities demonstrates awareness of the people involved in or affected by the operation.
2.5	Obtains information from all available monitoring sources.	Demonstrates awareness of different monitoring sources.	Demonstrates awareness of all different monitoring sources and obtains information from some of the monitoring sources.	Demonstrates awareness of different information sources and obtains information from all (relevant) monitoring sources.
CU — Competency Unit PC — Performance Criteria		ICS — Interim Competency Standard FCS — Final Competency Standard		

CU 3 — Service Provision				
PC		*ICS 1*	*ICS 2*	*FCS*
3.1	Uses systems monitoring and diagnostic capabilities effectively.	Demonstrates the ability to assess system status and interpret messages on all systems using the system management tools. Opening and closing of windows, etc.	Demonstrates the ability to interact with individual system management tools, using features in a safe and consistent manner.	Demonstrates the ability to interact with all system management tools, using all the features in a safe and consistent manner.
3.2	Evaluates the operational consequences of CNS/ATM system anomalies or failures.	Demonstrates an understanding of the consequences of system anomalies and failures post-event through debrief sessions with mentor.	Takes appropriate action in response to system anomalies and failures during low workload conditions. Intervention may be required by mentor during periods of high workload.	Independently takes appropriate action in response to system anomalies and failures in all workload conditions.
3.4	Uses prescribed operation procedures properly.	Demonstrates awareness of available operating procedures and ability to apply them in mentored session.	Demonstrates understanding of available operating procedures and applies them in low workload conditions.	Demonstrates understanding of all available operating procedures and applies them in all workload conditions.
CU — Competency Unit PC — Performance Criteria		ICS — Interim Competency Standard FCS — Final Competency Standard		

CU 4 — Coordination				
PC		*ICS 1*	*ICS 2*	*FCS*
4.1	Coordinates effectively with internal stakeholders.	Names all relevant internal stakeholders and needs for coordination.	Demonstrates the ability to coordinate effectively with a relevant internal stakeholder.	Demonstrates the ability to coordinate effectively with all relevant internal stakeholders in timely manner.
4.2	Coordinates effectively with external stakeholders.	Names all relevant external stakeholders and needs for coordination.	Demonstrates the ability to coordinate effectively with a relevant external stakeholder.	Demonstrates the ability to coordinate effectively with all relevant external stakeholders in timely manner.
CU — Competency Unit PC — Performance Criteria		ICS — Interim Competency Standard FCS — Final Competency Standard		

CU 5 — Management of non-routine situations				
PC		*ICS 1*	*ICS 2*	*FCS*
5.3	Prioritizes actions based on the urgency of the situation.	Demonstrates prioritization of actions in mentored session.	Demonstrates prioritization of actions taking into account the urgency of the situation in mentored session.	Demonstrates adequate prioritization of actions taking into account the urgency of the situation and all relevant options.
5.4	Follows prescribed procedures for responding to non-routine situations.	Demonstrates awareness of prescribed procedures in response to non-routine situations.	Demonstrates adherence to prescribed procedures in response to non-routine situations in mentored session.	Demonstrates adherence to prescribed procedures in response to non-routine situations.
CU — Competency Unit PC — Performance Criteria		ICS — Interim Competency Standard FCS — Final Competency Standard		

CU 7 — Self management and continuous learning				
PC		*ICS 1*	*ICS 2*	*FCS*
7.2	Improves performance through self-evaluation of the effectiveness of actions.	Demonstrates awareness of the need for improvement of performance by self-evaluation of the effectiveness of own activities.	Demonstrates improvement of performance by randomly self-evaluating the effectiveness of own activities.	Demonstrates continuous improvement of performance by always self-evaluating the effectiveness of own activities.
7.7	Participates in planned learning activities.	Demonstrates awareness of the need for participation in planned learning activities.	Demonstrates sporadic participation in planned learning activities.	Demonstrates organization and continuous participation in planned learning activities.
CU — Competency Unit PC — Performance Criteria		ICS — Interim Competency Standard FCS — Final Competency Standard		

CU 8 — Workload management				
PC		*ICS 1*	*ICS 2*	*FCS*
8.4	Selects appropriate tools, equipment and resources to support the efficient achievement of tasks.	Demonstrates knowledge about appropriate tools, equipment and resources to support the efficient achievement of activities.	Selects appropriate tools, equipment and resources to support the efficient achievement of activities in low workload conditions.	Independently selects appropriate tools, equipment and resources to support the efficient achievement of activities in all workload conditions.
CU — Competency Unit PC — Performance Criteria			ICS — Interim Competency Standard FCS — Final Competency Standard	

CU 10 — Communication				
PC		*ICS 1*	*ICS 2*	*FCS*
10.2	Speaks clearly, accurately and concisely.	On request, speaks clearly, accurately and concisely.	In standard situation, speaks clearly, accurately and concisely.	In any situation, speaks clearly, accurately and concisely.
10.3	Uses appropriate vocabulary and expressions for communications with stakeholders.	Demonstrates knowledge about appropriate vocabulary and expressions for communications with stakeholders.	Demonstrates the use of appropriate vocabulary and expressions for communications with stakeholders in low workload conditions.	Demonstrates the use of appropriate vocabulary and expressions for communications with stakeholders in all workload conditions.
CU — Competency Unit PC — Performance Criteria			ICS — Interim Competency Standard FCS — Final Competency Standard	

EXAMPLE 2: MAJOR ANSP "XYZ" OPERATING WITH DOMAIN-RELATED ATSEP TEAMS INCLUDING DIFFERENT EXPERT LEVELS

In this example, ANSP XYZ is a central services organization responsible for maintaining ground-based surveillance equipment for a number of ANSPs. Its business model requires a significant number of specialized ATSEP who jointly cover all expertise needed to perform planned and corrective maintenance on equipment at all remote sites.

In ANSP XYZ, ATSEP operate alone with full responsibility for their maintenance tasks. They are trained for in-depth maintenance on a few systems only. In addition, they are expected to deliver OJT and perform competency assessments both internally and externally. ANSP XYZ's strategy is to provide full service from SMC to in-depth maintenance activities, as well as additional services such as management of major procurement projects. While within this ANSP, ATSEP sometimes manage major procurement projects, being trained as an ATSEP is not mandatory for management of procurement projects.

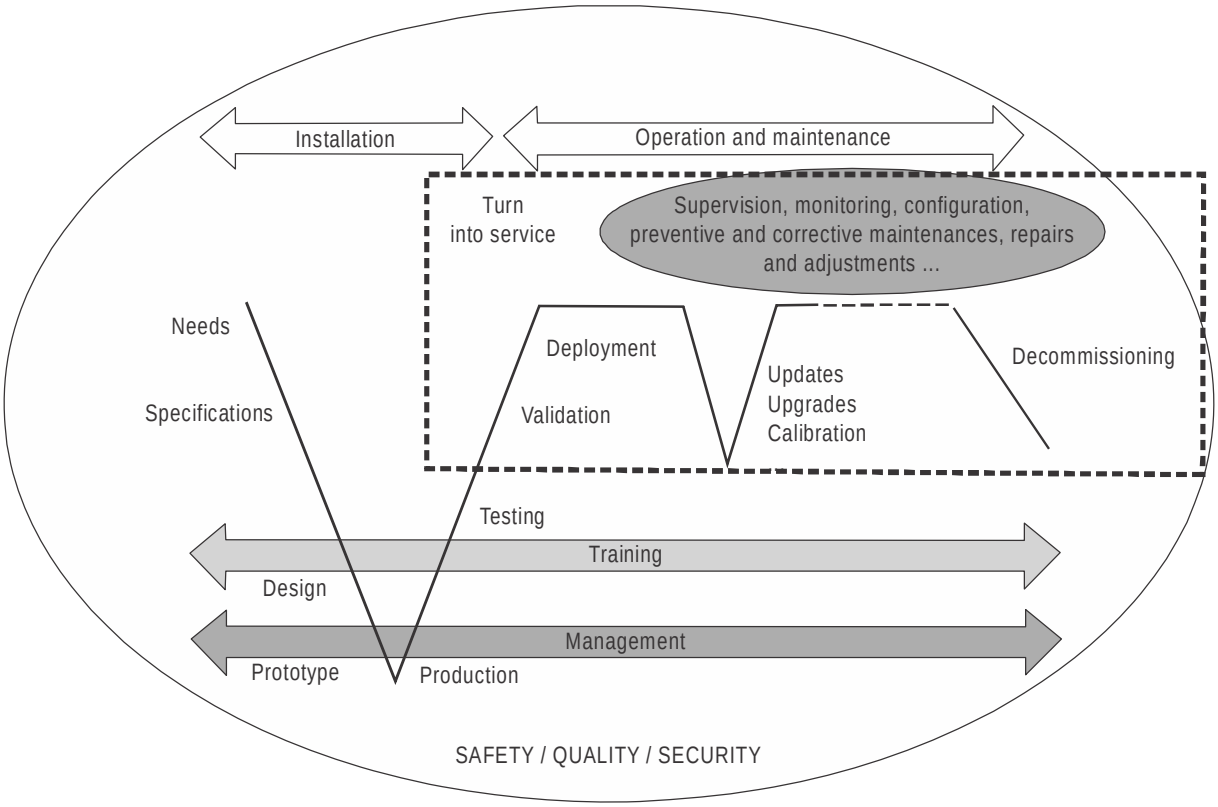

Figure A-2. ATSEP Scope within ANSP "XYZ" (example)

Step 1 — Define profiles and activities within the ANSPs predetermined ATSEP scope and develop job description(s)

Within ANSP XYZ, ATSEP activities are scoped as a broad range of activities (see dotted line rectangle in Figure A-2).

In order to meet this ANSP's wide scope of activities, each ATSEP addresses a narrow band of systems. Each ATSEP is designated to service a specific type of surveillance equipment used by customers out in the field.

ATSEP job description within ANSP XYZ

The following job description is used within ANSP XYZ:

Item	*Description*
Job title	In-depth maintenance ATSEP surveillance systems
Job objective	Perform comprehensive tasks in the maintenance of complex surveillance systems with ultimate responsibility for results
Entry level	Bachelor of Engineering with 6 years of previous job experience (minimum) or Master of Engineering with initial job experience

Item	*Description*
General nature of the job	Self-responsible execution of in-depth maintenance tasks of all levels in the field on Raytheon long range radar, primary and secondary
Key responsibilities	• Efficient maintenance and repair processes • Compliance to regulatory requirements • Compliance to internal procedures
List of tasks	• Monitor the surveillance system • Reduce primary radar false target rate due to weather conditions • Conduct fault analysis • Troubleshoot the system • Inspect and conduct in-depth maintenance according to system handbook (manufacturer) • Maintain hardware and repair fixed components • Install new software/firmware versions • Exchange faulty hardware • Adjust local adaptation data • Cooperate with relevant partners in the investigation of cross-device errors • Manage hardware configuration • Conduct initial turning of systems into service after validation • Conduct consultation with customers

The job description detailed provides a generic basis for vacant ATSEP posts. Selection criteria for an ATSEP in this ANSP are based on this job description and their experience in the ATSEP tasks listed.

Step 2 — Associate initial training modules to ATSEP job objective as identified in job description

ANSP XYZ associates the ATSEP job objective identified above with the following pre-defined training modules for initial training:

Predefined Training Modules	*Job Objective* *Perform comprehensive tasks in the maintenance of complex surveillance systems with ultimate responsibility for results*
Basic	X
Qualification communication	
Qualification navigation	
Qualification surveillance	X
Qualification data processing/automation	
Qualification SMC	X

Qualification infrastructure	
Qualification engineering	

Step 3 — Associate competency units, competency elements and performance criteria to the ATSEP tasks

ANSP XYZ associates the ATSEP tasks identified above with the following competency units and competency elements:

ATSEP Activity	*Competency Units/Competency Elements (See Appendix 2 to Chapter 3 of the PANS-TRG [Doc 9868] for the full descriptions of each Competency Unit and Competency Element*)									
	Engineering	*Situation Awareness*	*Service Provision*	*Coordination*	*Management of non-routine Situations*	*Problem Solving and Decision Making*	*Self-Management and Continuous Learning*	*Workload Management*	*Teamwork*	*Communication*
Monitor the surveillance system		2.1 2.3	3.1				7.2 7.5			
Reduce primary radar false target rate due to weather conditions			3.3				7.2 7.5	8.4		
Conduct fault analysis	1.7 1.8	2.1 2.2	3.3	4.2	5.3		7.2 7.5	8.1		
Troubleshoot the system	1.7	2.1 2.2	3.3	4.1 4.2	5.3	6.1 6.2	7.2 7.5	8.4		10.2
Inspect and conduct in-depth maintenance according to system handbook (manufacturer)	1.7	2.1	3.3	4.2	5.3	6.1 6.2	7.2 7.5	8.4		
Maintain hardware and repair of fixed components		2.1	3.3	4.2	5.3		7.2 7.5	8.4		
Install new software/firmware versions		2.1	3.3	4.2	5.3		7.2 7.5	8.4		

ATSEP Activity	*Competency Units/Competency Elements (See Appendix 2 to Chapter 3 of the PANS-TRG [Doc 9868] for the full descriptions of each Competency Unit and Competency Element)*									
	Engineering	*Situation Awareness*	*Service Provision*	*Coordination*	*Management of non-routine Situations*	*Problem Solving and Decision Making*	*Self-Management and Continuous Learning*	*Workload Management*	*Teamwork*	*Communication*
Exchange faulty hardware		2.1	3.3	4.2	5.3		7.2 7.5	8.4		
Adjust local adaptation data				4.2		6.1	7.2 7.5	8.4		
Cooperate with relevant partners in the investigation of cross-device errors	1.7 1.8					6.1 6.2	7.2 7.5		9.2	10.2
Manage hardware configuration			3.2				7.2 7.5	8.4		
Conduct initial turning of systems into service after validation	1.6	2.1				6.3	7.2 7.5	8.4	9.2	10.2
Conduct consultation with customers	1.1 1.3					6.1				10.1 10.2 10.4
Summary of Competency Elements	*1.1 1.3 1.6 1.7 1.8*	*2.1 2.2 2.3*	*3.1 3.2 3.3*	*4.1 4.2*	*5.3*	*6.1 6.2 6.3*	*7.2 7.5*	*8.4*	*9.2*	*10.1 10.2 10.4*

Performance criteria

Competency Element	*Performance Criteria*
(See Appendix 2 to Chapter 3 of the PANS-TRG [Doc 9868] for the full descriptions of each Competency Element and Performance Criterion)	
CE1.1	PC1.4
CE1.3	PC1.1
CE1.6	PC1.8, PC1.11
CE1.7	PC1.10
CE1.8	PC1.12
CE2.1	PC2.1
CE2.2	PC2.2
CE2.3	PC2.4
CE3.1	PC3.1
CE3.2	PC3.2
CE3.3	PC3.3
CE4.1	PC4.1
CE4.2	PC4.2
CE5.3	PC5.6
CE6.1	PC6.1, PC6.2
CE6.2	PC6.3
CE6.3	PC6.5
CE7.2	PC7.2
CE7.5	PC7.6, PC7.7
CE8.4	PC8.4
CE9.2	PC9.2
CE10.1	PC10.1
CE10.2	PC10.2, PC10.3
CE10.4	PC10.3

Step 4 — Develop training and assessment plans for unit training

The training plan for unit training is based on the tasks identified above. The assessment plan for unit training is based on the performance criteria identified above. As indicated in 2.2.5 of Chapter 2, the training plan is used to develop the training materials. It is not intended in this example to provide a comprehensive set of training materials (i.e. course schedule, training notes, case studies, exercises, briefings, presentations, video clips) since these could be developed in a variety of ways depending on the ANSP and/or training organization. However, the "Training Content" table below provides an indication of the possible content of the unit training programme based on the ANSP XYZ ATSEP job description. For this example, training is sequenced with theory first followed by OJT for the surveillance system. Training on Unix, network, wave propagation, tools and procedures can take place any time in the sequence.

Similarly, as indicated in Chapter 2, 2.2.5, an assessment plan details assessment events and tools that will be used to determine if an ATSEP achieves competence during and at the end of unit training. It is not intended in this example to provide a comprehensive list of all assessment events and tools since these could be developed in a variety of ways depending on the ANSP and/or training organization. However, the "Evidence Guide" table below provides an indication of the performance criteria associated with the expected performance at different milestones during unit training as well as at the end of unit training when all competencies should be demonstrated in an integrated manner. In this example, a written assessment is used for classroom courses. A peer review is used as the assessment for a final checkout. Results of the final assessment are recorded.

In implementing competency-based training and assessment, ANSP XYZ will identify lessons learned and feed them back in the relevant part of the process to ensure that the training programme remains relevant and effective.

Training content

Item	*Provider*	*Duration [d][2]*	*Type*	*Remarks*
Unix training course	External	5	Classroom	Can be skipped if knowledge and skills already established
Network training course	External	5	Classroom	Can be skipped if knowledge and skills already established
Training course on wave propagation	External	5	Classroom	Can be skipped if knowledge and skills already established
Overview training on surveillance system	External, e.g. manufacturer	15	Classroom + lab	
Field training on PSR	Own unit	20	On-the job	
Field training on MSSR	Own unit	15	On-the job	
Field training on Mode S	Own unit	10	On-the job	

2. Some of the durations may depend on availability of external courses and thus may differ.

Item	*Provider*	*Duration [d][2]*	*Type*	*Remarks*
Overview on procedures	Internal	2	Classroom	
Overview on documentation tools	Internal	1	Classroom	

Evidence guide

CU 1 — Engineering				
PC		*ICS 1*	*ICS 2*	*FCS*
1.1	Demonstrates technical knowledge and reasoning.	Demonstrates technical knowledge in non-time-critical situations.	Demonstrates technical knowledge and reasoning in non-time-critical situations.	Demonstrates consistently technical knowledge and reasoning in all situations.
1.4	Demonstrates ability to set system requirements.	Demonstrates awareness of system needs.	Demonstrates the ability to use system requirements in a formalized process.	Demonstrates the ability to comprehensively set system requirements.
1.8	Tests, verifies, validates and certifies new systems, equipment or installations.	Contributes to test, verification, validation and/or certification of new systems, equipment or installations.	Responsibly manages a test, verification, validation and/or certification of a new system, equipment or installation.	Responsibly manages test, verification, validation and/or certification of new systems, equipment or installations.
1.10	Optimizes systems and network elements.	Recognizes and names optimization capabilities of systems or network elements.	Optimizes a system or network element.	Routinely optimizes all systems and/or network elements in the area of responsibility.
1.11	Supports system life cycle.	Understands system life cycle of individual systems.	Supports system life cycle of individual systems.	Supports life cycle of all relevant systems in an integrated manner.
1.12	Anticipates and organizes system and equipment decommissioning.	Recognizes the need for an organized decommissioning process.	Demonstrates the ability to conduct a system or equipment decommissioning process.	Demonstrates the ability to anticipate, organize and conduct a system or equipment decommissioning process.
CU — Competency Unit PC — Performance Criteria		ICS — Interim Competency Standard FCS — Final Competency Standard		

CU 2 — Situational awareness				
PC		*ICS 1*	*ICS 2*	*FCS*
2.1	Monitors the CNS/ATM systems in own area of responsibility and contributing areas as well.	Consistently monitors individual systems (SUR) and responds in a timely manner with appropriate actions at times of low alarms/event rates.	Consistently monitors individual systems (SUR) and responds in a timely manner with appropriate actions at times of high alarms/event rates and abnormal conditions.	Consistently monitors all systems (SUR) and responds in a timely manner with appropriate actions at times of high alarms/event rates and abnormal conditions.
2.2	Monitors the environmental conditions that have an impact on own and adjacent areas of responsibility and understands the impact on systems and services.	Consistently demonstrates, under supervision, an awareness of the potential impact of environmental conditions (weather) on systems and services in own area of responsibility.	Consistently demonstrates, under supervision, an awareness of the potential impact of environmental conditions (weather) on systems and services in own and adjacent area of responsibility.	Independently monitors environmental conditions (weather) and responds with the appropriate actions in own and adjacent area of responsibility.
2.4	Maintains awareness of the people involved in or affected by the operation.	Demonstrates the ability to name ATSEP involved in or affected by operation.	On request, demonstrates the ability to name all people involved in or affected by operation.	In all activities demonstrates awareness of the people involved in or affected by the operation.
CU — Competency Unit PC — Performance Criteria			ICS — Interim Competency Standard FCS — Final Competency Standard	

CU 3 — Service provision				
PC		*ICS 1*	*ICS 2*	*FCS*
3.1	Uses systems monitoring and diagnostic capabilities effectively.	Demonstrates the ability to assess system status and interpret messages on all systems using the system management tools. Opening and closing of windows, etc.	Demonstrates the ability to interact with individual system management tools, using features in a safe and consistent manner.	Demonstrates the ability to interact with all system management tools, using all the features in a safe and consistent manner.
3.2	Evaluates the operational consequences of CNS/ATM system anomalies or failures.	Demonstrates an understanding of the consequences of system anomalies and failures post-event through debrief sessions with mentor.	Demonstrates an understanding of the consequences of system anomalies and failures in event moderated by a mentor.	Demonstrates an understanding of the consequences of system anomalies and failures online in all workload conditions.

CU 3 — Service provision				
PC		*ICS 1*	*ICS 2*	*FCS*
3.3	Switches from monitoring to intervention in a timely manner.	Demonstrates the ability to switch from monitoring to intervention.	Takes appropriate action in response to system anomalies and failures during low workload conditions. Intervention may be required by mentor during periods of high workload.	Independently takes appropriate action in response to system anomalies and failures in all workload conditions.
CU — Competency Unit PC — Performance Criteria			ICS — Interim Competency Standard FCS — Final Competency Standard	

CU 4 — Coordination				
PC		*ICS 1*	*ICS 2*	*FCS*
4.1	Coordinates effectively with internal stakeholders.	Names all relevant internal stakeholders and needs for coordination.	Demonstrates the ability to coordinate effectively with a relevant internal stakeholder.	Demonstrates the ability to coordinate effectively with all relevant internal stakeholders in a timely manner.
4.2	Coordinates effectively with external stakeholders.	Names all relevant external stakeholders and needs for coordination.	Demonstrates the ability to coordinate effectively with a relevant external stakeholder.	Demonstrates the ability to coordinate effectively with all relevant external stakeholders in a timely manner.
CU — Competency Unit PC — Performance Criteria			ICS — Interim Competency Standard FCS — Final Competency Standard	

CU 5 — Management of non-routine situations				
PC		*ICS 1*	*ICS 2*	*FCS*
5.6	Creates solutions when no procedure exists for responding to non-routine situations.	Demonstrates the capability to recognize when no procedure exists for responding to non-routine situations and to consider potential solutions through debrief sessions with mentor.	Demonstrates the capability to recognize when no procedure exists for responding to non-routine situations and to create a solution through debrief sessions with mentor.	Demonstrates the capability to recognize when no procedure exists for responding to non-routine situations, to create a solution for that situation and to implement it successfully.
CU — Competency Unit PC — Performance Criteria			ICS — Interim Competency Standard FCS — Final Competency Standard	

CU 6 — Problem solving and decision making				
PC		*ICS 1*	*ICS 2*	*FCS*
6.1	Takes into account the existing rules and operating procedures when determining possible solutions to a problem.	Demonstrates by explication that the existing rules and operating procedures are known.	Demonstrates by explication that the existing rules and operating procedures are considered for determining possible solutions to a problem in low workload conditions.	Demonstrates by explication that the existing rules and operating procedures are considered for determining possible solutions to a problem in all workload conditions.
6.2	Implements a chosen solution to a problem.	Demonstrates through mentored session that a chosen solution to a problem is intended to be implemented.	Demonstrates that a chosen solution to a problem is implemented in low workload conditions.	Demonstrates that a chosen solution to a problem is implemented in all workload conditions.
6.3	Organizes tasks in accordance with determined priorities.	Demonstrates through mentored session that priorities are considered to prioritize activities.	Demonstrates that activities are properly prioritized under low workload conditions.	Demonstrates that activities are properly prioritized under all workload conditions.
6.5	Works through problems without reducing safety.	Demonstrates awareness of impact on safety while working through a problem.	Works through problems without reducing safety. Intervention may be required by mentor during periods of high workload.	Independently works through problems without reducing safety in all workload conditions.
CU — Competency Unit PC — Performance Criteria			ICS — Interim Competency Standard FCS — Final Competency Standard	

CU 7 — Self-management and continuous learning				
PC		*ICS 1*	*ICS 2*	*FCS*
7.2	Improves performance through self-evaluation of the effectiveness of actions.	Demonstrates awareness of the need for improvement of performance by self-evaluation of the effectiveness of own activities.	Demonstrates improvement of performance by randomly self-evaluating the effectiveness of own activities.	Demonstrates continuous improvement of performance by always self-evaluating the effectiveness of own activities.
7.6	Maintains good knowledge of aviation and technological evolution.	Demonstrates awareness of the need to maintain good knowledge of aviation and technological evolution.	Partially demonstrates maintenance of knowledge of aviation and technological evolution by randomly contributing to relevant discussions.	Continuously demonstrates maintenance of knowledge of aviation and technological evolution by contributing to relevant discussions.
7.7	Participates in planned learning activities.	Demonstrates awareness of the need for participation in planned learning activities.	Demonstrates sporadic participation in planned learning activities.	Demonstrates organization and continuous participation in planned learning activities.
CU — Competency Unit PC — Performance Criteria		ICS — Interim Competency Standard FCS — Final Competency Standard		

CU 8 — Workload management				
PC		*ICS 1*	*ICS 2*	*FCS*
8.4	Selects appropriate tools, equipment and resources to support the efficient achievement of tasks.	Demonstrates knowledge about appropriate tools, equipment and resources to support the efficient achievement of activities.	Selects appropriate tools, equipment and resources to support the efficient achievement of activities in low workload conditions.	Independently selects appropriate tools, equipment and resources to support the efficient achievement of activities in all workload conditions.
CU — Competency Unit PC — Performance Criteria		ICS — Interim Competency Standard FCS — Final Competency Standard		

CU 9 — Teamwork				
PC		*ICS 1*	*ICS 2*	*FCS*
9.2	Shows respect and tolerance for other people.	Acknowledges the need for respect and tolerance for other people within the professional environment.	Demonstrates respect and tolerance for other people (within team/outside team) in a situation within the professional environment.	Demonstrates respect and tolerance for other people (within team/ outside team) in all situations within the professional environment.
CU — Competency Unit PC — Performance Criteria			ICS — Interim Competency Standard FCS — Final Competency Standard	

CU 10 — Communication				
PC		*ICS 1*	*ICS 2*	*FCS*
10.1	Selects communication methods that take into account the requirements of the situation.	Demonstrates knowledge of communication methods to be used in different situations.	Selects communication methods appropriate to the situation.	Independently selects communication methods appropriate to the situation in all workload conditions.
10.2	Speaks clearly, accurately and concisely.	On request, speaks clearly, accurately and concisely.	In standard situation, speaks clearly, accurately and concisely.	In any situation, speaks clearly, accurately and concisely.
10.3	Uses appropriate vocabulary and expressions for communications with stakeholders.	Demonstrates knowledge about appropriate vocabulary and expressions for communications with stakeholders.	Demonstrates the use of appropriate vocabulary and expressions for communications with stakeholders in low workload conditions.	Demonstrates the use of appropriate vocabulary and expressions for communications with stakeholders in all workload conditions.
CU — Competency Unit PC — Performance Criteria			ICS — Interim Competency Standard FCS — Final Competency Standard	

Appendix B

RECOMMENDED TRAINING OBJECTIVES FOR INITIAL TRAINING

This appendix outlines training objectives for the initial training modules described in Chapter 3. A number of training objectives are repeated because trainees need to learn aspects of two domains simultaneously. If a module covers a single domain, no double objectives will appear. If two or more domains are covered, objectives may be repeated. An efficient training plan will describe how these objectives will be taught once and applied through the rest of the modules.

B.1 — RECOMMENDED TRAINING OBJECTIVES FOR A BASIC TRAINING COURSE

SUBJECT 1. INDUCTION

TOPIC 1: INDUCTION

SUB-TOPIC 1.1: Training and assessment overview

1.1.1	Describe the training scheme and progression towards ATSEP competence.	2[1]	Initial (basic and qualification), S/E rating and continuation training. Course aims, objectives, and topics.
1.1.2	State the assessment requirements, procedures, and methods.	1	—

SUB-TOPIC 1.2: National organization

1.2.1	Describe the organizational structure, purpose and functions of the national service provider(s) and regulatory structures.	2	e.g. Headquarters, control centres, training facilities, airports, out stations, civil/military interfaces, regulatory interfaces.
1.2.2	Describe the structure and functions of the major departments within the service provider national organization.	2	e.g. Organizational handbook (plans, concepts and structure, finance model).
1.2.3	State appropriate accountabilities and responsibilities of the service provider(s) and competent authority.	1	—

1. Level of accomplishment. See Appendix C.

SUB-TOPIC 1.3: Workplace

1.3.1	State the role of trade unions and professional organizations.	1	e.g. International, regional, national.
1.3.2	Consider security of site facilities and personnel against unlawful interference.	2	Environmental, physical and information security measures, employee vetting, and reference checks.
1.3.3	Describe actions when suspecting a security breach.	2	e.g. Inform police, security agencies and managers. Security manual and/or contingency plan.

SUB-TOPIC 1.4: ATSEP role

1.4.1	Describe the key responsibilities of an ATSEP.	2	

SUB-TOPIC 1.5: National/regional/worldwide dimension

1.5.1	Explain the relationship between States and its relevance to ATM operations.	2	e.g. Harmonization, flow management, bilateral agreement, sharing of ATM relevant data, major studies, research programmes, and policy documents.
1.5.2	Define the regulatory framework of international and national ATM.	1	e.g. ICAO, regional and national concepts, responsibilities.
1.5.3	State the purpose of a range of international and regional bodies.	1	e.g. ICAO, EASA, FAA, RTCA, EUROCAE.

SUB-TOPIC 1.6: International Standards and Recommended Practices

1.6.1	Explain how the regulatory environment of ICAO notifies and implements legislation.	2	Annexes, SARPs.
1.6.2	State which major/key ATM engineering “standards” and “practices” are applicable.	1	e.g. ICAO Annex 10, ICAO Doc 8071, guidance material on reliability, maintainability and availability.

SUB-TOPIC 1.7: Data security

1.7.1	Explain the importance of ATM security.	2	—
1.7.2	Describe the security of operational data.	2	Secure restricted access by authorized personnel.
1.7.3	Explain security policies and practices for information and data.	2	Backup, storing, hacking, confidentiality, copyright.
1.7.4	Describe the possible external interventions which may interrupt or corrupt ATM services.	2	Introduction of software viruses, illegal broadcasts, jamming, spoofing.

SUB-TOPIC 1.8: Quality management

1.8.1	Explain quality management and the need for it.	2	e.g. ISO, EFQM.
1.8.2	Explain the need for configuration management.	2	Importance for safe operations, e.g. S/E build state, software adaption/version.

SUB-TOPIC 1.9: Safety management system

1.9.1	Explain why there is a need for high-level safety requirements for aeronautical activities.	2	Safety policy and rules, system safety cases, system safety requirements.

SUB-TOPIC 1.10: Health and safety

1.10.1	Explain personal safety responsibilities in the work environment.	2	Safety statement, first aid, rules about climbing.
1.10.2	Explain potential hazards to health and safety generated by equipment, or contained within the work environment.	2	e.g. Health consequences of electric shock and static discharges, precautions with chemical products (batteries), mechanical hazards (rotating machinery/antennas), toxic materials (beryllium), biological hazards, faulty earthing.
1.10.3	Describe fire safety and first-aid regulations and practices.	2	Requirements and rules, e.g. Standards.
1.10.4	State any applicable legal requirements and safety rules.	1	National, regional, international regulations, e.g. For working on power supply and/or air conditioning.
1.10.5	Describe the main features and uses of the different types of fire detectors and extinguishers.	2	e.g. VESDA, Type A, B, C, D extinguishers.

SUBJECT 2: AIR TRAFFIC FAMILIARIZATION

TOPIC 1:AIR TRAFFIC FAMILIARIZATION

SUB-TOPIC 1.1: Air Traffic Management

1.1.1	Define air traffic management.	1	ICAO, regional regulations.
1.1.2	Describe operational ATM functions.	2	ATFCM, ATS, ASM.
1.1.3	Describe ATM concepts and associated terminology.	2	e.g. Concepts: FUA, free flight, gate-to-gate, performance-based ATM operations (PBN, RCP), operational concepts (ICAO, SESAR, NextGen). Terminology: glossary.
1.1.4	Explain the operational importance of technical services required for ATM.	2	
1.1.5	State future developments in systems and/or ATM/ANS practices which may impact on services provided.	1	e.g. Data link, satellite-based navigation, gate-to-gate (CDM), ATC tools, continuous approach, 4D trajectory, business trajectory, SWIM, NOP, (UDPP, modes of separation), ASAS.
1.1.6	List the standard units of measurement used in aviation.	1	Speed, distance, vertical distance, time, direction, pressure, temperature.

SUB-TOPIC 1.2: Air traffic control

1.2.1	Define airspace organization.	1	ICAO Annex 11, e.g. additional regional regulations, FIR, UTA, TMA, CTR, ATS routes.
1.2.2	Describe commonly used airspace terminologies and concepts.	2	e.g. Sectorization, identification of ATS routes, restricted airspace, significant points.
1.2.3	State the general organization of aerodromes.	1	e.g. Obstacle limitation surfaces, different departure and arrival trajectories, approach and landing categories, operational status of radio navigation aids.
1.2.4	State the purpose of ATC.	1	ICAO Doc 4444.
1.2.5	State the organization of ATC services.	1	ICAO Doc 4444, e.g. area, approach, aerodrome control services.

SUB-TOPIC 1.3: Ground-based safety nets

1.3.1	Describe the purpose of ground-based safety nets.	2	e.g. STCA, MSAW, APW, runway incursion alerts.

SUB-TOPIC 1.4: Air traffic control tools and monitoring aids

1.4.1	Explain the main characteristics and use of ATC support and monitoring tools.	2	e.g. MTCD, sequencing and metering tools (AMAN, DMAN), A-SMGCS, CLAM, RAM, CORA.

SUB-TOPIC 1.5: Familiarization

1.5.1	Take account of ATC tasks.	2	e.g. Simulation, role play, PC, Part Task Trainer, observations in the operational environment.
1.5.2	Explain the need for good communication, coordination and cooperation between operational staff.	1	e.g. Handovers, MIL/CIV, planner/tactical, SV Tech (SMC) and SV ATCO, site visit(s) to ATC units.
1.5.3	Consider the purpose, function and role of various operational stations in respect of ATM-related operations.	2	Site visit(s) to ATC units, e.g. MET Office, e.g. Meteorological providers, remote sites, airport operations.
1.5.4	Define the phases of flight.	1	Take-off, climb, cruise, descent and initial approach, final approach and landing.
1.5.5	Recognize the cockpit environment and associated equipment, in relation to ATC.	1	Relevant pilot HMI e.g. Familiarization flight or cockpit simulator training (where practicable), antenna.
1.5.6	Define airborne collision avoidance systems.	1	ACAS, EGPWS, e.g. TCAS.

SUBJECT 3: AERONAUTICAL INFORMATION SERVICES (AIS)

TOPIC 1: AERONAUTICAL INFORMATION SERVICES

SUB-TOPIC 1.1: Aeronautical Information Services

1.1.1	State the organization of the AIS.	1	—
1.1.2	Define the AIP service.	1	e.g. Data contents of AIP, supplementary, AIC and types of publication: AIRAC, non-AIRAC, data collection and preparation, data format, distribution channels, supporting systems and tools.
1.1.3	Define the aeronautical charting service.	1	Types of aeronautical charts, operational use of charts, supporting systems and tools.
1.1.4	Define the NOTAM services.	1	—
1.1.5	Define the ATS Reporting Office.	1	e.g. Purpose of flight plans and other ATS. messages, types of flight plans (FPL and RPL),

			contents of flight plans and other ATS messages, distribution of flight plans and other ATS messages, supporting systems and tools.
1.1.6	Define the regional/national AIS database.	1	e.g. Paper/data, central single source, validated, redundancy.
1.1.7	Define procedures for providing Communications, Navigation, Surveillance (CNS) data to AIS.	1	Information of a permanent nature, information of a temporary nature, status report of NAVAIDs.

SUBJECT 4: METEOROLOGY

TOPIC 1: METEOROLOGY

SUB-TOPIC 1.1: Introduction to meteorology

1.1.1	State the relevance of meteorology in aviation.	1	Influence on the operation of aircraft, flying conditions, aerodrome conditions.
1.1.2	State the weather prediction and measurement systems available.	1	—

SUB-TOPIC 1.2: Impact on aircraft and ATS operation

1.2.1	State the meteorological conditions and their impact on aircraft operations.	1	e.g. Atmospheric circulation, wind, visibility, temperature/humidity, clouds, precipitation.
1.2.2	State the meteorological conditions hazardous to aircraft operations.	1	e.g. Turbulence, thunderstorms, icing, microbursts, squall, macro bursts, wind shear, standing water on runways (aquaplaning).
1.2.3	Explain the impact of meteorological conditions and hazards on ATS operations.	2	e.g. Effects on equipment performance (e.g. temperature inversion, rain density), increased vertical and horizontal separation, low visibility procedures, anticipation of flights not adhering to tracks, diversions, missed approaches.
1.2.4	Explain the effects of weather on propagation.	2	e.g. Anaprop, rain noise, sunspots.

SUB-TOPIC 1.3: Meteorological parameters and information

1.3.1	List the main meteorological parameters.	1	Wind, visibility, temperature, pressure, humidity.
1.3.2	List the most common weather messages and broadcasts used in aviation.	1	e.g. ICAO Annex 3. Meteorology messages: TAF, METAR, SNOWTAM Broadcasts: ATIS/flight meteorology broadcast (VOLMET).

SUB-TOPIC 1.4: Meteorological systems

1.4.1	Explain the basic principles of the main meteorological systems in use.	2	e.g. Weather display and information systems, wind speed (anemometer), wind direction (weather vane), visibility (types of IRVR, forward scatter), temperature probes, pressure (aneroid barometers), humidity, cloud base (laser ceilometers).

SUBJECT 5: COMMUNICATION

TOPIC 1: GENERAL INTRODUCTION

SUB-TOPIC 1.1: Introduction to communications

1.1.1	State the structure of the communication domain.	1	Voice communication, data communication.
1.1.2	State major substructures of the communication domain.	1	Air-ground, ground-ground, air-air communications.
1.1.3	State ATS requirements for safe communications.	1	Safety, reliability, availability, coverage, QoS, latency.
1.1.4	State the aeronautical communication services.	1	Mobile, fixed.

TOPIC 2: VOICE COMMUNICATION

SUB-TOPIC 2.1: Introduction to voice communications

2.1.1	Describe system architecture.	2	—
2.1.2	Explain the purpose, principles and role of voice communication systems in ATS.	2	e.g. Audio bandwidth, dynamic range, fidelity, routing, switching, lineside/deskside, coverage, communication chain between controller and pilot.

2.1.3	Describe the way in which voice communication systems function.	2	Analogue/digital comparisons, distortion, harmonics.
2.1.4	State methods used to route and switch voice communications.	1	e.g. Multichannels, multi-users, party lines, VHF/UHF linkage, HF, SELCAL.
2.1.5	State how systems interface to produce an integrated service to ATS.	1	—
2.1.6	State radio spectrum and frequency allocation constraints and procedures.	1	Spectrum, interference sources, commercial allocations, world radio conference, ITU, common aviation position, efficient utilization of frequency bands, channel spacing.
2.1.7	State voice recording systems in use.	1	e.g. Digital recording equipment, analogue recording.
2.1.8	State ICAO and local legal requirements regarding recording and retention of voice communications.	1	Regulatory requirements, incident recording and playback, recording equipment.
2.1.9	State the purpose of ATIS and VOLMET.	1	—

SUB-TOPIC 2.2: Air-ground communication

2.2.1	State the functions and basic operation of routing and switching equipment in use in the ATS environment.	1	Voice switching.
2.2.2	Describe the purpose and operation of the elements of a communication chain in use in the ATS environment.	2	Functionality, emergency systems, transmission/reception, CWP, on-board equipment e.g. channel spacing, antenna switching, CLIMAX, voting systems.
2.2.3	State ways of achieving quality of service.	1	e.g. Importance of coverage and redundancy of equipment, overlapping coverage, backup system, functional redundancy vs element redundancy.
2.2.4	Recognize the elements of the CWP that are used for air-ground communication.	1	Frequency selection, emergency, station selection, coupling, microphone, headset, loudspeaker, footswitch, PTT.
2.2.5	List future developments and techniques which may have an impact on ATS voice communications.	1	e.g. CPDLC, VDL Mode 2.

SUB-TOPIC 2.3: Ground-ground communication

2.3.1	State the functions and the basic operations of routing and switching equipment in use in ATS environment.	1	General architecture.
2.3.2	Describe how ground-ground systems interface to provide an integrated service to ATS environment.	2	International/national links, ACC interoperability, voice and data integration.
2.3.3	Describe the purpose and operation of the elements of a system.	2	Functionality, emergency systems, PTT interfaces e.g. MFC and ATS-Qsig, switching, local PABX equipment.
2.3.4	Recognize the elements of the CWP used for ground-ground communication.	1	Selection, emergency, loudspeaker, headset, microphone.
2.3.5	List developments in ground-ground technologies which may impact on ATS voice communication.	1	e.g. Protocols (TCP/IP, voice-over IP) future development.

TOPIC 3: DATA COMMUNICATIONS

SUB-TOPIC 3.1: Introduction to data communications

3.1.1	Explain the purpose, principles and role of data communication systems in ATS.	2	e.g. Terminology, principles and theory of networks, layering (e.g., OSI or TCP/IP), data links, LAN, WAN.
3.1.2	Define the concept of data transmission.	1	e.g. Packet switching, protocols, multiplexing, demultiplexing, error detection and correction, routing, switching, hops, cost, bandwidth/speed.
3.1.3	Describe the function of various elements of the data systems in use in the ATS environment.	2	Switch, router, gateways, end systems, redundancy.
3.1.4	Define protocols in current use.	1	e.g. TCP/IP, X.25, frame relay, asynchronous transfer mode.

SUB-TOPIC 3.2: Networks

3.2.1	State ATS requirements for safe data communications.	1	Reliability, availability.
3.2.2	Describe the different types of networks.	2	LAN, WAN, ATN, national network for ATM e.g. satellite-dedicated networks, AFTN.
3.2.3	State the functions of a network management system.	1	Priorities, rights e.g. SNMP.

SUB-TOPIC 3.3: Aviation specific networks, applications and ATM/ANS providers

3.3.1	Name a range of air-ground aviation related network concepts.	1	ATN e.g. Subnetworks: ATN air-ground subnetwork, AMSS, VDL, HFDL Protocols: ACARS Communication service providers: ARINC, SITA, States, LINK16.
3.3.2	Name a range of ground-ground aviation-related network concepts.	1	ATN, PENS e.g. Physical networks: PENS, AFTN/CIDIN, RAPNET e.g. Communication protocols: IP, X.25, ASTERIX, FMTP e.g. Communication service providers: SITA, ARINC, national carriers, ANSPs e.g. Applications: AMHS, AIDC, OLDI.

SUBJECT 6: NAVIGATION

TOPIC 1: INTRODUCTION

SUB-TOPIC 1.1: Purpose and use of navigation

1.1.1	Explain the need for navigation in aviation.	2	Positioning, guidance, planning.
1.1.2	Characterize navigation methods.	2	e.g. Historical overview, visual, celestial, electronic (on-board, radio, space-based and relative).

TOPIC 2: THE EARTH

SUB-TOPIC 2.1: Form of the Earth

2.1.1	Name the shape of the Earth.	1	
2.1.2	Explain the Earth's properties and their effects.	2	East, West, North and South, polar axis, direction of rotation.
2.1.3	State the accepted conventions for describing 2D position on a globe.	1	Meridians, parallels of latitude, equatorial plane.

SUB-TOPIC 2.2: Coordinate systems, direction and distance

2.2.1	State the general principles of reference systems.	1	Geoid, reference ellipsoids, WGS 84 Latitude and longitude, undulation.
2.2.2	Explain why a global reference system is required for aviation.	2	—

SUB-TOPIC 2.3: Earth's magnetism

2.3.1	State the general principles of Earth's magnetism.	1	True North, magnetic North e.g. Variation, declination, deviation, inclination.

TOPIC 3: NAVIGATIONAL SYSTEM PERFORMANCE

SUB-TOPIC 3.1: Factors affecting electronic navigation performance

3.1.1	State how radio waves propagate.	1	Ground, sky, direct.
3.1.2	State why the siting of a terrestrial navigation aid is important.	1	Multipath, blanking.

SUB-TOPIC 3.2: Performance of navigation systems

3.2.1	State the performance of navigation systems.	1	Coverage, accuracy, integrity, continuity of service, availability.
3.2.2	Explain the need for redundancy in navigation systems.	2	Ensuring continuity of service, maintainability, reliability.

SUB-TOPIC 3.3: Means of navigation

3.3.1	State the different means of navigation.	1	Sole, primary, supplementary.

TOPIC 4: NAVIGATION SYSTEMS

SUB-TOPIC 4.1: Terrestrial navigation aids

4.1.1	Explain the basic working principles of electronic positioning.	2	Distance measurements (time and phase), angular measurements.
4.1.2	Describe ground-based navigation systems.	2	NDB, VOR, DME, ILS, DF e.g. Loran C, MLS, TACAN, marker beacons.

4.1.3	Recognize how the navigation information is displayed on the relevant pilot HMI.	1	—
4.1.4	Explain the operational use of ground-based navigation systems in the different phases of flight.	2	NDB, VOR, DME, ILS, DF.
4.1.5	Recognize the frequency bands used by the ground-based navigation systems.	1	—
4.1.6	State the need for calibration.	1	Flight calibration, ground-based calibration and/or maintenance.

SUB-TOPIC 4.2: On-board navigation systems

4.2.1	State the use of on-board navigation systems.	1	e.g. Barometric altimetry, radio altimetry, INS/IRS, compass.

SUB-TOPIC 4.3: Space-based navigation systems

4.3.1	Explain the basic working principles of satellite positioning.	2	GPS e.g. Galileo.
4.3.2	Recognize the basic architecture of a core satellite positioning system.	1	GPS e.g. Galileo.
4.3.3	Recognize the frequency bands used by the space-based navigational systems.	1	—
4.3.4	State the benefits of satellite-based navigation.	1	Global coverage, accuracy, time dissemination e.g. Redundancy, interoperability, single set of avionics.
4.3.5	State the current limitations of space-based navigation systems.	1	e.g. Single frequency, weak signal, ionospheric delay, institutional, military, multipath.
4.3.6	State the basic working principles of satellite augmentation.	1	e.g. ABAS (RAIM, AAIM), SBAS (WAAS, EGNOS), GBAS (GRAS, S-CAT 1)
4.3.7	State the current implementations of satellite-based navigation systems.	1	GPS, GLONASS, GALILEO and augmentations e.g. ABAS, GBAS, SBAS

TOPIC 5: PERFORMANCE-BASED NAVIGATION

SUB-TOPIC 5.1: PBN

5.1.1	Describe the basic principle of area navigation.	2	ICAO RNAV definition and PBN concept Conventional and area navigation e.g. Navigation computer and FMS functionality.
5.1.2	List the navigation applications in use in the region.	1	e.g. B-RNAV-5, P-RNAV-1, RNP approaches.

SUB-TOPIC 5.2: Future developments

5.2.1	State future navigation developments.	1	e.g. 4D-RNAV, free routes, rationalization plans, advanced RNP1.

SUBJECT 7: SURVEILLANCE

TOPIC 1: INTRODUCTION TO SURVEILLANCE

SUB-TOPIC 1.1: Introduction to surveillance

1.1.1	Define surveillance in the context of ATM.	1	What (positioning/identification) and why (maintain separation).
1.1.2	Define the various surveillance domains.	1	Air-air, ground-air, ground-ground.
1.1.3	List the surveillance techniques.	1	Non-cooperative, cooperative, dependent, independent techniques.
1.1.4	Define the current and emerging surveillance systems in use in ATM.	1	Radar technology, ADS technology, multilateration, TIS.
1.1.5	Explain the role and the current use of surveillance equipment by ATM.	2	Separation, vectoring, data acquisition, Detection and ranging, safety nets, e.g. Weather mapping.
1.1.6	State ICAO and any local legal requirements.	1	e.g. ICAO SARPS, Annex 10 Vol. IV.
1.1.7	List the main users of surveillance data.	1	HMI, safety nets, FDPS, air defense systems, flow management.

SUB-TOPIC 1.2: Avionics

1.2.1	State the avionics used for the surveillance in ATM and their interdependencies.	1	Transponder, GNSS, data link equipment, ACAS, ATC control panel, e.g. FMS.
1.2.2	Define the role of TCAS as a safety net.	1	e.g. FMS.

SUB-TOPIC 1.3: Primary radar

1.3.1	Describe the need for and the use of primary radar in ATC.	2	Non-cooperative detection, improvement of detection and tracking e.g. Types of PSR (en-route, terminal, SMR, weather).
1.3.2	Explain the principles of operation, basic elements and overall architecture of a primary radar.	2	Detection, range measurement, azimuth indication. Doppler shift. Antenna system, TX/RX, signal processing, plot extraction, local tracking, data transmission e.g. Use of the parameters of the radar equation.
1.3.3	State the limitations of primary radar.	1	Line of sight, environmental, clutter, no identification of the target, no height information (in case of 2D radar).

SUB-TOPIC 1.4 Secondary radars

1.4.1	Describe needs for and the use of secondary radars in ATC.	2	Cooperative detection, ICAO-defined standard, IFF, military and civil modes (include Mode S) and related code protocols, code limitations e.g. Identification, SPI, flight level, BDS, specific and emergency codes.
1.4.2	Explain the principles of operation, basic elements and overall architecture of a secondary radar.	2	SSR, MSSR, Mode S antenna, TX/RX, extractor, tracking processor e.g. Use of the parameters of the radar equations.
1.4.3	State the limitations of secondary radar.	1	FRUIT, garbling, ghost reply, code shortage, cooperation by the aircraft needed.

SUB-TOPIC 1.5: Surveillance data message format

1.5.1	State the need for harmonization.	1	Surveillance data sharing, interoperability.
1.5.2	State the techniques used for transmission of surveillance data.	1	e.g. Point-to-point, network, microwave, satellite.
1.5.3	State main formats in use.	1	e.g. ASTERIX.

SUB-TOPIC 1.6: Automatic dependent surveillance (ADS)

1.6.1	State surveillance-related FANS concepts and their impact on ATM.	1	Sources of aircraft parameters (e.g. FMS outputs), communication mediums. Application within oceanic and other non-radar airspace, ATC requirements.
1.6.2	Explain the principles of operation, basic elements and overall architecture of ADS-C and ADS-B and the differences between them.	2	Advantages/disadvantages, standards, data update rates.
1.6.3	State the data link technologies proposed and the current situation of deployment.	1	Extended squitter 1 090 MHz, e.g. VDL 4, HFDL,UAT, AMSS.

SUB-TOPIC 1.7: Weather radar

1.7.1	Define the use of weather radar in ATM.	1	e.g. Role in adverse weather in dense airspace, antenna, coverage, polarization, multi elevation scanning, frequency band.

SUB-TOPIC 1.8: Integration of surveillance information

1.8.1	Describe complementary use of different sensors.	2	—

SUB-TOPIC 1.9: Multilateration

1.9.1	State the use of MLAT in ATC.	1	LAM and WAM.
1.9.2	Explain the principles of operation, basic elements and overall architecture of MLAT.	2	TDOA principle, hyperbolic positioning, accuracy, transmissions used.

SUB-TOPIC 1.10: Airport surface surveillance

1.10.1	State typical ATC requirements.	1	e.g. Safety (aircraft and mobiles), clear runway, low visibility, collision warnings, displays, mapping, data merging, aircraft identification, ground mobiles.
1.10.2	State the current technologies for airport surface surveillance.	1	Radar-based and MLAT-based technologies, example layout of airport surveillance infrastructure. e.g. Other systems (acoustic, vibration, induction loop, video, infrared, GNSS, ADS-B).

SUB-TOPIC 1.11: Display of surveillance information

1.11.1	Recognize surveillance information on a display.	1	e.g. PSR and MSSR tracks, position identification, FL, speed vector, RDP and FDP information.

SUB-TOPIC 1.12: Analysis Tools

1.12.1	State analysis tools.	1	e.g. SASS-C.

SUBJECT 8: DATA PROCESSING/AUTOMATION

TOPIC 1: DATA PROCESSING/AUTOMATION

SUB-TOPIC 1.1: Introduction to data processing

1.1.1	Describe the functions and generic architecture of the systems.	2	Generic FDP and SDP overall functional block diagrams.
1.1.2	Describe how the systems interface with other systems.	2	Surveillance sensors, displays, flight plan distribution systems, recording, international ATM networks. e.g. Safety nets, military interfaces.
1.1.3	Define basic software functions/applications.	1	FDP (route processing, code/call sign correlation, code allocation, strip distribution, track labelling) SDP (coordinate conversion, plot and track processing, MRP, safety nets, track labelling).
1.1.4	State the legal aspects for data processing in ATM.	1	Traceability and recording of data and actions, configuration control.
1.1.5	State the additional data used by ATM system.	1	e.g. MET, airlines
1.1.6	State current developments and future possibilities.	1	e.g. Coflight, iTEC, SESAR, NextGen, multisensor tracking.

SUB-TOPIC 1.2: System software and hardware principles

1.2.1	Describe the current hardware configurations used in ATM.	2	Redundancy and backup e.g. Driver, interfaces, hardware platforms, fault tolerant systems.
1.2.2	Describe the current software platforms, used in ATM.	2	Operating systems.

SUB-TOPIC 1.3: Surveillance data processing (SDP)

1.3.1	State ATC requirements.	1	QoS, mandatory data recording, dependability.
1.3.2	Explain the principles of SDP.	2	e.g. Single, multi, plot, track.
1.3.3	Describe the functions of SDP.	2	Plot processing, tracking, single sensor and multisensor tracker (e.g. radar, ADS, MLAT), estimating limits and accuracy of multisensor tracker, recording e.g. ARTAS tracker.
1.3.4	Describe radar data inputs/outputs.	2	Tracks, plots, messages, code/call sign, time, control and monitoring, conflict alerts, FDP interface, maps, adaptation.
1.3.5	Describe the surveillance data-based monitoring functions.	2	Safety nets, ATC tools e.g. Safety nets: STCA, MSAW, APW, runway incursion alerts ATC Tools: MTCD, AMAN, DMAN, A-SMGCS.

SUB-TOPIC 1.4: Flight data processing (FDP)

1.4.1	State ATC requirements.	1	QoS, unambiguous, accurate, error free, timely.
1.4.2	Explain the functions of FDP.	2	Flight strip production, flight plan data updates, code/call sign correlation, flight progress monitoring, coordination and transfer e.g. CIV/MIL coordination.
1.4.3	Define inputs and outputs.	1	Flow control flight strips/data displays, MRT, environmental data, static data, airspace adaptation.
1.4.4	Describe the basic software functions/applications.	2	FDP (route processing, code/call sign correlation, code allocation, strip distribution, track labelling).
1.4.5	Describe the FPL data update process.	2	Automatic and manual update.

SUB-TOPIC 1.5: Human machine interface systems

1.5.1	Describe the different display technologies.	2	Raster scan, common graphic display interface, LCD, plasma, TFT, Touch Input Device.
1.5.2	Recognize what information is normally displayed on the ATCO and ATSEP HMI.	1	—

SUB-TOPIC 1.6: Miscellaneous information

1.6.1	State the additional data used by ATM system.	1	e.g. MET, airlines.

SUBJECT 9: SYSTEM MONITORING AND CONTROL

TOPIC 1: SYSTEM MONITORING AND CONTROL (SMC)

SUB-TOPIC 1.1: Overview of SMC Function

1.1.1	Describe the principles and purpose of the operational management of the technical services.	2	Service requirements, interfaces, boundaries of tactical responsibility e.g. Hierarchy of authority for the technical and ATC structures.
1.1.2	Describe the technical system architecture of the SMC function and its subordinate systems.	2	Main monitoring and control architecture e.g. Surveillance: Radar stations, communications, processing, display Communications: TX/RX, circuit management, networks, HMI, standby facilities, recording Navigation: NDB, VOR, ILS, DF DP: FDPS, data communications Facilities: Power, generators, UPS, battery, environmental (heating, cooling), fire and security.
1.1.3	Describe the transfer of responsibility for a service.	2	Operational and technical responsibility, configuration and monitoring access and responsibility.

SUB-TOPIC 1.2: System configuration:

1.2.1	Describe the range of configurations that can be used.	2	Equipment or channel switching, parameter settings.
1.2.2	Describe the general techniques that are employed to make configuration changes.	2	e.g. Physical switching.
1.2.3	State procedures required to implement a planned major system change.	1	e.g. Safety requirement, authorization, coordination, implementation plan, fallback strategies, major system change, activation of new version of software in a subordinate system, transfer of a service to a new system, change of a database.

SUB-TOPIC 1.3: Monitoring and control functions

1.3.1	State the monitoring functions that are available.	1	e.g. BITE, status, parameters, software and hardware watchdogs.
1.3.2	State the control functions that are available.	1	e.g. Switching, parameters, set configurations.
1.3.3	Explain the importance of SMC management and coordination of maintenance activities.	2	—
1.3.4	State analysis tools associated with SMC.	1	e.g. Possible malfunctions (SASS-C track and noise monitoring tools).

SUB-TOPIC 1.4: Coordination and reporting

1.4.1	State why coordination and reporting is required and how it is achieved.	1	Facility interrupts, deconflict multiple outages, legal requirements e.g. Causes: service failure, planned outage, loss of backup, software upgrade Relevant parties: external service providers, ATC, other centres Relevant information: NOTAM, logbook.

SUB-TOPIC 1.5: Emergency coordination

1.5.1	Describe situations where coordination and reporting will be necessary.	2	e.g. Hijack, mayday, r/t fail, loss of aircraft, MIL action, fire, flood, security, terrorist threat or action, medical.
1.5.2	State which parties may be involved in the coordination and reporting of emergency situations.	1	e.g. ATC supervisors (local and remote), ATSEP supervisors (local and remote), management, police, MIL, medical, accident investigation branch.
1.5.3	Explain the responsibilities and/or duties of SMC members during an emergency situation by using an example scenario.	2	—
1.5.4	State the succession of authorities and responsibilities in the event that the nominated person or function is not available.	1	Hierarchy of responsibility.

SUB-TOPIC 1.6: Equipment operating

1.6.1	Define the principles and ergonomics of the HMI of the SMC central system and its subordinate systems.	1	Permissions, control tokens, ergonomic conventions (e.g. Green is good or safe, red is fail or unsafe).
1.6.2	State the routine tasks required and the criticality of their completion and any legal requirements.	1	e.g. Audio circuit voice checking, audio recording checking, archive media changing and storage, VOLMET.

SUBJECT 10: MAINTENANCE PROCEDURES

TOPIC 1: MAINTENANCE PROCEDURES

SUB-TOPIC 1.1: Maintenance procedures

1.1.1	Explain handling precautions to be taken to ensure equipment protection.	2	Isolation, protection devices, electrostatic sensitive devices, power supplies, heavy loads, high voltage.
1.1.2	Explain the classifications of maintenance.	2	e.g. Preventative, corrective, service configuration.
1.1.3	Explain the maintenance strategy and rules.	2	Organization and planning of maintenance, rules controlling deviation from planned maintenance, intervention tracking, return to service.
1.1.4	State the scope or responsibility of an S/E rated person.	1	e.g. Tracing maintenance actions and objectives, liability of maintenance personnel actions, safety of service, safety of equipment.

SUBJECT 11: INFRASTRUCTURE

TOPIC 1: FACILITIES

SUB-TOPIC 1.1: Power supplies

1.1.1	Define the performance for power supply systems in the operational environment.	1	Availability, quality, Continuity of Service.
1.1.2	Define the main features of current power supply systems.	1	e.g. UPS systems, batteries and emergency generators, high voltage, earthing techniques, power provider(s).
1.1.3	Describe the power distribution system at an example operational site.	2	e.g. Power distribution redundancy, input, output, protections, measurements and monitoring, block schematic.

SUB-TOPIC 1.2: AIR CONDITIONING

1.2.1	State the function, appropriate terminology and performance of current air conditioning systems in use.	1	e.g. Air conditioning, water cooling, humidity control, air filtering system, visit to stations.
1.2.2	State the importance and criticality of maintaining a controlled environment.	1	Short- and long-term effect on people and equipment.

SUBJECT 12: SAFETY

TOPIC 1: SAFETY MANAGEMENT

SUB-TOPIC 1.1: Policy and principles

1.1.1	Explain the underlying need for safety management policy and principles.	2	ICAO Annex 19, lessons learnt from events, evolving environment, requirements.
1.1.2	State the safety management policy.	1	ICAO Annex 19, priority of safety, the safety objective of ATM, roles and responsibilities.
1.1.3	Explain safety management principles.	2	ICAO Annex 19, safety achievement, safety assurance, safety promotion.
1.1.4	Appreciate the reactive and proactive nature of safety management policy and principles.	3	e.g. ICAO Annex 19 e.g. Nature of events, reason model, events investigation, safety assessment.
1.1.5	Explain the link between safety management principles and the life cycle of an ATM system.	2	ICAO Annex 19, safety occurrences, setting of safety levels, system safety assessment, safety surveys, safety monitoring, system safety assessment documentation, lesson dissemination, safety improvement, use of safety data to assist in decommissioning or replacement of system.
1.1.6	Relate the ATSEP role and responsibilities to safety management.	4	Competency, occurrence reporting e.g. “just culture” (ref.:EAM2 GUI6), risk assessment.
1.1.7	State the role and content of a typical SMS within an ANSP.	1	ICAO Annex 19.
1.1.8	Explain the “just culture” concept.	2	Benefits, prerequisites, constraints, e.g. EAM2 GUI6.

SUB-TOPIC 1.2: Concept of risk and principles of risk assessment

1.2.1	Describe the concept of risk.	2	Types of risk, components of risk, risk contributors (people, procedure, organizations and equipment).
1.2.2	State ways of assessing risk.	1	Risk comparisons, risk analysis.
1.2.3	Describe the concept of risk tolerability.	2	Risk assessment and mitigation, ALARP Principle e.g. Risk perception, risk management.

SUB-TOPIC 1.3: Safety assessment process

1.3.1	Explain the methods for the assessment of hazards and possible failures.	2	e.g. Failure and hazard brainstorm session, Fault tree analysis.
1.3.2	Appreciate the importance of adopting a total system approach covering human, procedure, organization and equipment elements.		ATM system description (including scope definition and limitation), end-to-end integrity of safety assessment e.g. Concept of TRM.
1.3.3	Describe the overall safety assessment process and its relationships with risk assessment during the total life cycle of ANS system.	2	Collection and presentation of results, contingency arrangements, back-up procedures e.g. Risk-based process, FHA, (safety objectives), preliminary system safety assessment PSSA (safety requirements), system safety assessment SSA (safety monitoring and evidence).

SUB-TOPIC 1.4: Air navigation system risk classification scheme

1.4.1	Describe the ATM system risk classification scheme.	2	e.g. Scenario of failure of air navigation system (incident chain), component of a risk classification scheme, severity classes, probability classes (qualitative and quantitative).

SUB-TOPIC 1.5: Safety regulation

1.5.1	Describe the role of safety regulation.	2	The purpose of national regulations and international standards, objective of the national regulator.
1.5.2	Explain the relationship between the safety regulation documents.	2	ICAO SARPS, regional regulations, national regulations.
1.5.3	Explain how the safety regulation documents affect ATM service provision.	2	ICAO documentation (SARPS), regional Regulations, AMCs and GM, national regulation.

1.5.4	Explain the interface between the safety regulator and the ANSP.	2	Information to be provided to regulator by ANSP and vice versa, importance of incident reporting.

SUBJECT 13: HEALTH AND SAFETY

TOPIC 1: HAZARD AWARENESS AND LEGAL RULES

SUB-TOPIC 1.1: Hazard awareness

1.1.1	State potential hazards to health and safety generated by equipment used in CNS/ATM.	1	e.g. COM/SUR/SMC: mechanical hazards, electrical hazards (LV, HV, EMI), chemical hazards NAV: includes RF energy DP: none.

SUB-TOPIC 1.2: Regulations and procedures

1.2.1	State applicable international requirements.	1	
1.2.2	State any applicable national requirements.	1	—
1.2.3	State safety procedure for the persons working on or near relevant equipment.	1	e.g. COM/NAV/SUR/SMC: isolation (clothing, tools), fire extinction types, safety man presence, safety interlocks, isolating switches, security of the site, climbing procedures, earthing, direct or indirect contact with HV.

SUB-TOPIC 1.3: Handling of hazardous material

1.3.1	State regional and local regulations for electronic device disposal.	1	Protection of environment e.g. Recycling.

SUBJECT 14: HUMAN FACTORS

TOPIC 1: INTRODUCTION TO HUMAN FACTORS

SUB-TOPIC 1.1: Introduction

1.1.1	Explain why human factors are particularly important in the ATM environment.	2	Historical background, safety impact on ATM, incidents.
1.1.2	Define human factors.	1	e.g. ICAO Human Factors Training Manual.
1.1.3	Explain the concept of systems and its relevance in the ATM environment.	2	People, procedures, equipment.

1.1.4	Explain the use of the SHELL model.	2	e.g. ICAO Doc 9683, visits to OPS and technical rooms.
1.1.5	State the factors which can affect personal and team performance.	1	e.g. Psychological, medical, physiological, social, organizational, communication, stress, human error, working knowledge and skills.

TOPIC 2: WORKING KNOWLEDGE AND SKILLS

SUB-TOPIC 2.1: ATSEP knowledge, skills and competence

2.1.1	Explain the importance of maintaining and updating professional knowledge and skills.	2	Assure safety.
2.1.2	Explain the importance of maintaining non-technical skills and professional competence.	2	e.g. Communication, human relationship, knowledge of environment, human limit awareness.
2.1.3	State the available means to maintain professional knowledge and skills.	1	e.g. Practice, personal study, briefing, seminars, courses, technical periodicals, technical books, OJT, simulation, CBT, e-learning, visits, feedback, TRM.

TOPIC 3: PSYCHOLOGICAL FACTORS

SUB-TOPIC 3.1: Cognition

3.1.1	Describe major aspects of human information processing.	2	Perception, attention, memory, judgement, decision-making, response execution, control of execution.
3.1.2	Describe the factors which influence information processing.	2	e.g. Stress and strain, experience, knowledge, distraction, interpersonal relations, working environment, risk perception, attitude, workload, fatigue, confidence, job security.
3.1.3	Appreciate factors which influence information processing.	3	e.g. Case study, simulation, role playing.

TOPIC 4: MEDICAL

SUB-TOPIC 4.1: Fatigue

4.1.1	Describe the effect of fatigue on human performance.	2	Physiological, cognitive and relational effects e.g. Lack of concentration, irritability, frustration.
4.1.2	Recognize the signs of fatigue in oneself and in others.	1	e.g. Making frequent mistakes, unable to concentrate, lack of normal humour, sleeping and/or eating disorders.
4.1.3	Explain how to respond to indications of fatigue in an appropriate manner.	2	Take time off, rest for short periods of time, seek professional help.

SUB-TOPIC 4.2: Fitness

4.2.1	Describe signs of lack of personal fitness.	2	—
4.2.2	Describe actions to prevent or resolve lack of personal fitness.	2	Healthy lifestyle e.g. Healthy diet, sleeping, physical and mental activities.
4.2.3	Explain the influence of psychoactive substances on human performance.	2	e.g. Nervous system, medication, smoking, alcohol, habitual and occasional use of psychoactive substances.

SUB-TOPIC 4.3: Work environment

4.3.1	Describe the influence of the work environment on human performance.	2	Ergonomics, effects of noise, electromagnetic waves, temperature, working circumstances.

TOPIC 5: ORGANIZATIONAL AND SOCIAL FACTORS

SUB-TOPIC 5.1: Basic needs of people at work

5.1.1	Explain basic needs of people at work.	2	e.g. Balance between individual ability and workload, working time and rest periods; adequate working conditions, positive working environment.
5.1.2	Characterize the factors of work satisfaction.	2	e.g. Money, motivation, achievement, recognition, advancement, challenge.

SUB-TOPIC 5.2: Team resource management (TRM)

5.2.1	State the objectives of TRM.	1	Experience sharing, feedback, improved interpersonal relations, indirect increase in safety.

SUB-TOPIC 5.3: Teamwork and team roles

5.3.1	Describe the differences between social human relations and professional interactions.	2	—
5.3.2	Identify reasons for loss of team effectiveness and actions to prevent it and prevent repetition.	3	e.g. Roles poorly defined, goals poorly identified, bad planning, too many leaders or not enough, respect for others, divergence in values, misunderstandings.
5.3.3	Describe the principles of teamwork.	2	e.g. Team membership, group dynamics, advantages/disadvantages of teamwork.
5.3.4	Identify reasons for conflict.	3	—
5.3.5	Describe actions to prevent human conflicts.	2	—
5.3.6	Describe strategies to cope with human conflicts.	2	e.g. In your team.

TOPIC 6: COMMUNICATION

SUB-TOPIC 6.1: Written report

6.1.1	Appreciate the importance of recording information by writing effectively.	3	ATSEP technical report, logs, system degradation reports, specification, system manager report.
6.1.2	Use appropriate terminology to communicate effectively in writing.	3	Be concise, clear; common technical terms; convey key points.

SUB-TOPIC 6.2: Verbal and non-verbal communication

6.2.1	Describe the human communication process.	2	—
6.2.2	Characterize the factors which affect verbal communication.	2	e.g. Cognitive: lack of knowledge of the procedures, of technical terms, workload, poor receiver references. Affective: being shy, feelings of not being listened to, not being part of the group, not being assertive, poor eye contact while talking, stress. Physiological: stuttering, low voice level.

6.2.3	Describe factors which affect non-verbal communication.	2	e.g. Touch, noise, interruption, body language.
6.2.4	Use appropriate vocabulary to communicate effectively on technical matters.	3	Technical jargon, language differences, standard words/phrases.
6.2.5	Use appropriate language for professional communication with non-ATSEP.	3	Term sharing, translation, being concise, simple words, selection of information and detail level according to the receiver.

TOPIC 7: STRESS

SUB-TOPIC 7.1: Stress

7.1.1	Explain the process of stress.	2	Causes, stress mechanism, consequences in different work situations (e.g. online intervention, maintenance, training).
7.1.2	State the symptoms of stress.	1	e.g. Frustration, anger, irritability, aggressive and/or irrational behaviour, helplessness.

SUB-TOPIC 7.2: Stress management

7.2.1	Act to relieve or minimize stress in self and/or others.	3	The effect of personality in coping with stress, benefits of active stress management.
7.2.2	Appreciate how assistance is obtained in stressful situations.	3	Benefits of asking, offering and accepting help in stressful situations e.g. CISM.
7.2.3	Recognize the effects of shocking and stressful situations.	1	For oneself and for others, abnormal situations.
7.2.4	Consider the benefits of critical incident stress management.	2	—

TOPIC 8: HUMAN ERROR

SUB-TOPIC 8.1: Human error

8.1.1	Describe human error.	2	—
8.1.2	Explain the relationship between human error and safety.	2	Mechanism, error-prone conditions, consequences e.g. Reason model, feedback.

8.1.3	State different types of errors using an appropriate model.	1	e.g. Rasmussen model, Gagne model.
8.1.4	Differentiate between errors and violations.	2	—
8.1.5	Explain how to detect errors.	2	e.g. Individual and collective strategy, event report, procedure.
8.1.6	Explain, in general terms, how errors are mitigated.	2	—
8.1.7	Appreciate two significant ATM incidents/accidents involving ATSEP/engineering contributory factors.	3	—

B.2 — RECOMMENDED TRAINING OBJECTIVES FOR A QUALIFICATION TRAINING COURSE ON COMMUNICATION

SUBJECT 1: VOICE

TOPIC 1: AIR-GROUND

SUB-TOPIC 1.1: Transmission/reception

1.1.1	Perform typical measurements on a transmitter.	3	Frequency (single carrier, offset carrier), modulation, channel spacing, output power, SWR.
1.1.2	Adjust a generic radio transmitter.	4	Noise, intermodulation, harmonics, power, bandwidth.
1.1.3	Analyse the block diagram of a generic radio transmitter.	4	Characteristics (modulation, single carrier, channel spacing), functionalities.
1.1.4	Perform typical measurements on a receiver.	3	Frequency, modulation, channel spacing, sensitivity, selectivity.
1.1.5	Adjust a generic radio receiver.	4	Signal to noise ratio, harmonics.
1.1.6	Analyse the block diagram of a generic radio receiver.	4	Characteristics (single carrier, channel spacing, sensitivity, selectivity).

SUB-TOPIC 1.2: Radio antenna systems

1.2.1	Explain antenna parameters.	2	Impedance, polar diagram, bandwidth, polarization, types of antennas.
1.2.2	Characterize the coverage of the radio system.	2	Polar diagram, types of antennas, frequency bands, propagation mode.
1.2.3	Characterize budget link according to various conditions.	2	Output power, antennae, propagation, geographic, meteorological, day and night.
1.2.4	Characterize the elements of a generic antenna system.	2	Filters, combiners, multi-cavity system.
1.2.5	Check the conformity of a system to ITU and national regulation.	3	Ref.: ICAO Annex 10 (VHF, UHF).
1.2.6	Perform measurements with generic radio test equipment.	3	Spectrum analyser e.g. Scanner.

SUB-TOPIC 1.3: Voice switch

1.3.1	Analyse switching functionalities.	4	General architecture, digital, analogue, multiplex types, PCM e.g. Cross-coupling, split headset (radio both ears, telephone single ear).
1.3.2	Explain the principles of non-blocking switches.	2	Advantages, disadvantages, delays (digital).
1.3.3	Describe the signal processing all along the chain.	2	Signal tracing treatment, protocols (a few), data flow.

SUB-TOPIC 1.4: Controller working position

1.4.1	Describe the most common features of a controller working position.	2	Frequency selection, emergency, station selection, coupling, headset, loudspeaker, footswitch, Push to Talk e.g. Microphone (noise cancelling), short time recording.

SUB-TOPIC 1.5: Radio interfaces

1.5.1	Describe the different types of interface.	2	Internal, external, phantom keying, in-band signal.

TOPIC 2: GROUND-GROUND

SUB-TOPIC 2.1: Interfaces

2.1.1	Describe the different types of interfaces.	2	Analogue (2, 4, 6 and 8 wires), digital (ISDN; 64 Kb, 2 Mb).
2.1.2	Explain the advantages and disadvantages of each type.	2	Analogue (2, 4, 6 and 8 wires), digital (ISDN; 64 Kb, 2 Mb).
2.1.3	Operate measuring equipment.	3	e.g. dB meters, level meters, generators, sniffer.

SUB-TOPIC 2.2: Protocols

2.2.1	Operate standard protocol analysers.	3	e.g. MFC R2 and/or ATS QSIG (rerouting), impulse dialling and DTMF dialing, ISDN.
2.2.2	Analyse communication protocol with appropriate tools and documentation.	4	e.g. MFC R2 , ATS QSIG (rerouting), impulse dialling and DTMF dialling, ISDN, national protocols.

SUB-TOPIC 2.3: Switch

2.3.1	State the similarities between ground-ground and air-ground switches.	1	Switching techniques.
2.3.2	Describe the most commonly used functionality of PABX.	2	General architecture, digital, analogue, multiplex types, PCM30.
2.3.3	Analyse conversion analogue-digital, digital-analogue.	4	General architecture, analogue-digital-analogue.

SUB-TOPIC 2.4: Communication chain

2.4.1	Appreciate the replacement of components in a communication chain in a safe way.	3	Continuity of service, communication chain integrity.

SUB-TOPIC 2.5: Controller working position

2.5.1	Describe the most common features of a controller working position and the HMI.	2	—

SUBJECT 2: DATA

TOPIC 1: INTRODUCTION TO NETWORKS

SUB-TOPIC 1.1: Types

1.1.1	State the evolution of network topologies.	1	LAN, WAN e.g. Architectures, size of the segments, length of the systems, quality of service.
1.1.2	Explain how networks meet requirements.	2	Redundancy, bandwidth, BER, time delay, network security.

SUB-TOPIC 1.2: Networks

1.2.1	Analyse the features of a network.	4	Routing scheme, rate, internal networking, routers, bridges, gateways, modems, switches, firewalls e.g. wireless networks.
1.2.2	Describe network standards and devices.	2	Ethernet, fibre optic, wireless.
1.2.3	Appreciate the replacement of components in a network in a safe way.	3	Continuity of service, network integrity.

SUB-TOPIC 1.3: External network services

1.3.1	Define aspects of external network services.	1	Provided QoS e.g. SLAs.

SUB-TOPIC 1.4: Measuring tools

1.4.1	Operate the usual set of network measuring or monitoring tools to find the values of the main parameters.	3	Data analyser (sniffer) e.g.net scout.
1.4.2	Perform analysis to support fault-finding for correction.	3	Data analyser (sniffer) e.g.net scout.

SUB-TOPIC 1.5: Troubleshooting

1.5.1	Appreciate how to troubleshoot a network.	3	e.g. Broken lines, unusable network components, overload, integrity problems.

TOPIC 2: PROTOCOLS

SUB-TOPIC 2.1: Fundamental theory

2.1.1	Apply the principles of layers.	3	Differences between layers e.g. Layer(s) of sniffer information.
2.1.2	Apply the principles of addressing strategy.	3	Masks, subnets, IP addressing, MAC addressing e.g. Same logical network computers and systems.
2.1.3	Apply the principles of routing strategy.	3	Routing tables, priorities, fault tolerance, management of routing strategy, static and dynamic routing e.g. Unicast, multicast, broadcast.

SUB-TOPIC 2.2: General protocols

2.2.1	Describe the general protocols.	2	TCP/IP (segments, packets, addressing) e.g. X25, LAPB, pdH, sdH.
2.2.2	Analyse the general protocols using the appropriate tools and documentation.	4	TCP/IP e.g. X25, LAPB.

SUB-TOPIC 2.3: Specific protocols

2.3.1	Describe the specific protocols.	2	e.g. BATAP — ARINC 620, FMTP.

TOPIC 3: NATIONAL NETWORKS

SUB-TOPIC 3.1: National networks

3.1.1	Name the national networks to which the organization is connected.	1	e.g. ANSP, MET, military, PTT, airlines, national network(s).
3.1.2	Describe the interfaces between national and global networks.	2	—

TOPIC 4: NETWORKS

SUB-TOPIC 4.1: Network technologies

4.1.1	State emerging network technologies.	1	e.g. As used in EAN, NEAN, AMHS, PENS.
4.1.2	Describe the characteristics of current networks.	2	Surveillance data, flight plan data and AIS networks e.g. CIDIN, quality of service, architecture, AMHS.

TOPIC 5: GLOBAL NETWORKS

SUB-TOPIC 5.1: Networks and standards

5.1.1	List the global networks and the standards on which they are based.	1	e.g. ICAO for AFTN/CIDIN/AMHS, ICAO for ATN, FANS 1 and FANS A for ACARS applications (SITA and ARINC).

SUB-TOPIC 5.2: Description

5.2.1	Describe the characteristics of the AFTN networks.	2	Users and data, architectures, quality of service.

SUB-TOPIC 5.3: Global architecture

5.3.1	Describe the architecture of the ATN.	2	Air-ground subnetworks, ground-ground subnetworks, airborne networks.

SUB-TOPIC 5.4: Air-ground subnetworks

5.4.1	Describe the air-ground subnetworks.	2	VDL (mode 2), HFDL, AMSS, SATCOM.

SUB-TOPIC 5.5: Ground-ground subnetworks

5.5.1	Describe the composition of ground-ground subnetworks.	2	PTT, commercial telecom providers, ARINC, SITA.

SUB-TOPIC 5.6: Networks on board of the aircraft

5.6.1	State the existence of subnetworks inside the aircraft relevant for ATM communications.	1	e.g. AFDX — ARINC 429.

SUB-TOPIC 5.7: Air-ground applications

5.7.1	State the main communication applications using data link systems.	1	e.g. CPDLC, DLIC/AFN, ATIS, DCL.

SUBJECT 3: TRANSMISSION PATH

TOPIC 1: LINES

SUB-TOPIC 1.1: Lines theory

1.1.1	Calculate parameters of a line.	3	e.g. Equation, attenuation, impedance, S-parameters, Smith chart, bandwidth, HF specifics (dipoles, multipoles), SWR.

SUB-TOPIC 1.2: Digital transmission

1.2.1	Calculate parameters for digital transmission.	3	e.g. Signal definition, Fourier Theory, signal processing (sampling, etc.), bandwidth, carrier, modulation, noises, S/N, delays, group delay, line quality (signal distortion, rate of failure), transmission speed.

SUB-TOPIC 1.3: Types of lines

1.3.1	Describe the different types of lines and their physical characteristics.	2	e.g. Copper wires (twisted pairs, symmetrical cables), optic fibres (monomodes or multimodes, connectors, splicer), coaxial attenuation, losses, bending, characteristic impedance, EMC and noise immunity.
1.3.2	Appreciate the appropriate type of line for a given specific application.	3	e.g. Bandwidth, noise immunity.
1.3.3	Check the typical parameters of lines.	3	e.g. Impedance, insulation, signal level, time delay.

TOPIC 2: SPECIFIC LINKS

SUB-TOPIC 2.1: Microwave link

2.1.1	Describe a microwave link.	2	e.g. Carrier frequency, type of modulation, Fresnel Theory, loss, atmospheric influences.

SUB-TOPIC 2.2: Satellite

2.2.1	Describe the parameters of a satellite link.	2	Uplinks, downlinks, antennas, footprint, delays, atmospheric influences.

SUBJECT 4: RECORDERS

TOPIC 1: LEGAL RECORDERS

SUB-TOPIC 1.1: Regulations

1.1.1	Explain the international regulations.	2	ICAO (recording and reproducing).
1.1.2	Explain national regulations.	2	Appropriate national regulations.
1.1.3	Explain how service providers comply with the regulations.	2	e.g. Confidentiality when handling recorders, procedures for access to recorders, storage media, access to recording and reproducing room, time to store information (overwrite/erase voice or data), procedure to reproduce information.

SUB-TOPIC 1.2: Principles

1.2.1	Explain the principles of recording and reproducing.	2	e.g. Storage media (tape, optical and magnetic disc, hard disk, USB media), A/D-D/A converters, frequency range (300 to 3 400 Hz), channel capacity, time synchronization, connection to a network, synchronization of radar and voice recording, replay limitations.

SUBJECT 5: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes.	1	Safety assessment documentation related to communication system, safety reports and occurrences, safety monitoring.

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe the implications of functional failures in terms of exposure time, environment, effect on controller and effect on pilot.	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output. Ref.: safety policy and implementation.

B.3 — RECOMMENDED TRAINING OBJECTIVES FOR A QUALIFICATION TRAINING COURSE ON NAVIGATION

SUBJECT 1: PERFORMANCE-BASED NAVIGATION

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: Operational requirements

1.1.1	Explain the main performance characteristics of a navigation system.	2	Accuracy, precision, stability, integrity, availability, continuity of service, coverage, robustness e.g. Time To First Fix.
1.1.2	Explain the relationship between performance measures and the phases of flight.	2	ICAO Doc 9613.

SUB-TOPIC 1.2: Performance-based navigation

1.2.1	Describe the PBN concept.	2	ICAO documents, airspace concept, application supported by navigation infrastructure and navigation specifications, functionality of the avionics.
1.2.2	Differentiate between an RNAV and an RNP navigation specification.	2	On-Board Performance Monitoring and Alerting.

1.2.3	State which navigation applications support the different phases of flight.	1	ICAO Doc 9613.

SUB-TOPIC 1.3 Area navigation concept (RNAV)

1.3.1	Differentiate between conventional navigation and area navigation.	2	Fixed route vs flexible route structure.

SUB-TOPIC 1.4: NOTAM

1.4.1	Explain the need for NOTAMs.	2	—

SUBJECT 2: GROUND-BASED SYSTEMS — NDB

TOPIC 1: NDB/LOCATOR

SUB-TOPIC 1.1: Use of the system

1.1.1	Appreciate the principles of NDB.	3	Relative bearing, measuring method.
1.1.2	Describe the overall performance.	2	Coverage, accuracy, availability of the system, integrity, continuity.
1.1.3	Explain the technical limitations of NDB.	2	Lack of accuracy, lack of integrity, sensitivity to interference.
1.1.4	Describe the current situation.	2	e.g. Number, type, users, user groups, regional context.

SUB-TOPIC 1.2: Ground station architecture

1.2.1	Describe the main components of an NDB ground station.	2	Electronic cabinet, antennas, power supply, remote controls and monitoring e.g. auto-tune antenna units.
1.2.2	Relate NDB station design to operational requirements.	4	Coverage, ID code, VOR backup, double beacon approach, siting.

SUB-TOPIC 1.3: Transmitter subsystem

1.3.1	Characterize the main NDB signal parameters.	2	Carrier and ident frequency, output power, depth of modulation.
1.3.2	Perform typical measurements on the main NDB signal parameters.	3	e.g. Carrier and ident frequency, power measurements, depth of modulation, audio distortion, antenna current, spectrum measurements, ID code.

SUB-TOPIC 1.4: Antenna subsystem

1.4.1	Explain NDB antenna characteristics.	2	Impedance, polar diagram, polarization, ground reflections.
1.4.2	Appreciate the interface between power stage and the antenna.	3	SWR, radiated power.

SUB-TOPIC 1.5: Monitoring and control subsystems

1.5.1	Describe the purpose of monitoring.	2	Integrity, continuity of service, availability.
1.5.2	Describe which parameters are used for the monitoring.	2	Antenna current, ID code, depth of modulation.
1.5.3	Appreciate how the operational status of the NDB monitoring system is checked.	3	System status.
1.5.4	Describe the issues associated with NDB obstacle limitations and obstacle removal.	2	Siting.

SUB-TOPIC 1.6: On-board equipment

1.6.1	Describe the on-board equipment (ADF).	2	Receiver, antenna, displays.
1.6.2	Describe how NDB information is used on board.	2	ADF indicator, RMI, HSI, ND.

SUB-TOPIC 1.7: System check and maintenance

1.7.1	Appreciate the conformity to international and national regulations.	3	ITU regulations (EMC + SAR), ICAO Annex 10.
1.7.2	Appreciate calibration tasks and flight inspection results.	3	e.g. Maintenance and flight inspection manuals, procedures and reports.

1.7.3	Appreciate troubleshooting of an NDB.	3	e.g. Maintenance and flight inspection manuals, procedures and reports.
1.7.4	Appreciate the origins of NDB errors.	3	e.g. Multipath, EMC, interference with radio broadcast transmissions

SUBJECT 3: GROUND-BASED SYSTEMS — DFI

TOPIC 1: DF

SUB-TOPIC 1.1: Use of the system

1.1.1	State the different types of DF.	1	VDF, DDF, IDF.
1.1.2	Describe the user HMI.	2	Indication on radar picture, DF indicator.
1.1.3	Appreciate the principles of DF.	3	Bearing, measuring method (standard, Doppler, interferometry).
1.1.4	Describe the overall performance.	2	Coverage, accuracy, availability of the system, integrity, continuity.
1.1.5	Explain the technical limitations of DF.	2	Sensitivity to interference.
1.1.6	Describe the current situation.	2	e.g. Number, type, users, national context.

SUB-TOPIC 1.2: VDF/DDF equipment architecture

1.2.1	Describe the main components of DF equipment.	2	Electronic cabinet, antennas, power supply, remote controls and monitoring.

SUB-TOPIC 1.3: Receiver subsystem

1.3.1	Explain the main signal parameters.	2	Frequency band (UHF, VHF).

SUB-TOPIC 1.4: Antenna subsystem

1.4.1	Explain DF antenna characteristics.	2	Impedance, polar diagram, polarization, types of antennas.
1.4.2	Appreciate protection areas.	3	Obstacles, ICAO Annex 10 e.g. manufacturers manuals.

SUB-TOPIC 1.5: Monitoring and control subsystems

1.5.1	Describe the purpose of monitoring.	2	Integrity, continuity of service, availability.
1.5.2	Describe which parameters are used for the monitoring.	2	Noise figure, stability of measurement.
1.5.3	Appreciate how the operational status of the DF monitoring system is checked.	3	System status.
1.5.4	Describe the issues associated with DF obstacle limitations and obstacle removal.	2	Surrounding environment, protection of bearing accuracy.

SUB-TOPIC 1.6: System check and maintenance

1.6.1	Appreciate the conformity to international and national regulations.	3	ITU regulations (EMC + SAR), ICAO Annex 10.
1.6.2	Perform typical measurements on a DF system.	3	Frequency, channel spacing, sensitivity, selectivity, bearing accuracy.
1.6.3	Appreciate calibration tasks and flight inspection results.	3	Ground-based bearing checks, test oscillator e.g. North setting, range, multipath maintenance and flight inspection manuals, procedures and reports.
1.6.4	Appreciate troubleshooting of DF.	3	e.g. Sensitivity, local oscillator level maintenance and flight inspection manuals, procedures and reports.
1.6.5	Appreciate the origin of DF errors.	3	e.g. Multipath, EMC, interference with radio broadcast transmissions.

SUBJECT 4: GROUND-BASED SYSTEMS — VOR

TOPIC 1: VOR

SUB-TOPIC 1.1: Use of the system

1.1.1	State the types of VOR systems.	1	Conventional, Doppler.
1.1.2	Describe the overall performance.	2	Coverage, accuracy, availability of the system, integrity, continuity.
1.1.3	Explain the technical limitations of CVOR.	2	Type of information (azimuth), accuracy, integrity, suitable for a network of fixed routes.
1.1.4	Appreciate the differences between CVOR and DVOR.	3	Signal broadcast differences, bearing information robustness.

1.1.5	Describe the current situation.	2	e.g. Number, type, users, user groups, national context, regional context.

SUB-TOPIC 1.2: Fundamentals of CVOR and/or DVOR

1.2.1	Appreciate the mathematical signal description.	3	Declination, equations of CVOR and/or DVOR, reference and variable signals.
1.2.2	Appreciate the principles for generating the variable signal.	3	CVOR Rotating antenna principle Generating a rotating radiation pattern with static antennas and/or DVOR Frequency modulation through switching antenna.

SUB-TOPIC 1.3: Ground station architecture

1.3.1	Describe the main components of a CVOR and/or DVOR ground station.	2	Electronic cabinet, antenna system, power supply, remote controls and monitoring.
1.3.2	Relate VOR station design to operational requirements.	4	Siting, coverage, ID code, NDB backup.

SUB-TOPIC 1.4: Transmitter subsystem

1.4.1	Characterize main signal parameters for a CVOR and/or DVOR.	2	Carrier frequency stability, output power, signals generated.
1.4.2	Perform typical transmitter measurements on VOR signals.	3	Radiation pattern accuracy, power and modulation measurements, spectrum measurements, ID coding.

SUB-TOPIC 1.5: Antenna subsystem

1.5.1	Explain VOR antenna characteristics.	2	Impedance, polar diagram, polarization, types of antennas.
1.5.2	Appreciate the interface between power stage and the antennae.	3	SWR, radiated power.
1.5.3	Appreciate protection areas.	3	Obstacles, ICAO Annex 10 e.g. Manufacturers manuals.

SUB-TOPIC 1.6: Monitoring and control subsystem

1.6.1	Describe the purpose of monitoring.	2	Integrity, continuity of service, availability.
1.6.2	Describe which VOR parameters are monitored.	2	ICAO and RTCA/EUROCAE requirements e.g. NSA requirements.
1.6.3	Describe the principles of the CVOR and/or DVOR monitoring systems.	2	Near field sensors, far field sensors, recombination Local and remote monitoring.
1.6.4	Appreciate how the operational status of the CVOR and/or DVOR monitoring systems are checked.	3	Near field sensors, far field sensors, recombination Local and remote monitoring e.g. BITE, Watchdog.
1.6.5	Describe the issues associated with VOR obstacle limitations and obstacle removal.	2	Surrounding environment, multipath prevention.
1.6.6	Explain the optional ILS interface.	2	—

SUB-TOPIC 1.7: On-board equipment

1.7.1	Describe the on-board equipment.	2	Antenna, receiver HMI e.g. CDI, RMI, HSI, ND, PFD.
1.7.2	Describe how the VOR information is used on board.	2	e.g. Single VOR, VOR-VOR, approach procedures, manual mode, automatic mode.

SUB-TOPIC 1.8: System check and maintenance

1.8.1	Appreciate the conformity to international and national regulations.	3	ITU regulations (EMC + SAR), ICAO Annex 10.
1.8.2	Perform typical system measurements.	3	In space modulation, phase sideband/carrier, ground check for bearing errors.
1.8.3	Appreciate calibration tasks and flight inspection results.	3	Flight inspection (coverage, flight check for bearing errors and modulation) e.g. Maintenance manuals, procedures and reports.
1.8.4	Appreciate troubleshooting of a CVOR and/or DVOR.	3	Carrier frequency deviation, depth of modulation, lack of power, harmonics ratio e.g. Maintenance and flight inspection manuals, procedures and reports.

1.8.5	Analyse the origins of CVOR and/or DVOR errors.	4	CVOR System-dependent, adjustments, drifts, multipath, onboard errors and/or DVOR North Adjustment e.g. DVOR: antenna feeding DVOR and CVOR: multipath, EMC, interference with radio broadcast transmissions.

SUBJECT 5: GROUND-BASED SYSTEMS — DME

TOPIC 1: DME

SUB-TOPIC 1.1: Use of the system

1.1.1	Describe the overall performances for DME.	2	Coverage, accuracy, availability of the system, integrity, continuity, number of users.
1.1.2	Explain the limitations of DME.	2	Accuracy, integrity, capacity.
1.1.3	Describe the current situation.	2	e.g. Number, types, users, user groups, national context, regional context.
1.1.4	State the role of the DME infrastructure in the future navigation applications.	1	PBN.
1.1.5	Explain the differences between DME and TACAN for civilian use.	2	e.g. Azimuth and range.

SUB-TOPIC 1.2: Fundamentals of DME

1.2.1	Describe the key elements of DME system operation.	2	Two-way ranging technique, slant range, time measurement A/c interrogation, pulse pairs, ground reply, fixed time delay, interrogation stagger, ‘X’ and ‘Y’ channels.
1.2.2	Explain the frequency spectrum and the channel spacing allocated.	2	ICAO Annex 10, L-band.

SUB-TOPIC 1.3: Ground station architecture

1.3.1	Describe the main components of a DME ground station.	2	Electronic cabinet, antenna system, power supply, remote controls and monitoring.
1.3.2	Relate DME station design to operational requirements.	4	Coverage, ID code, siting.

SUB-TOPIC 1.4: Receiver subsystem

1.4.1	Explain the main receiver parameters for a DME.	2	Sensitivity, selectivity, dynamic range, jamming immunity.
1.4.2	Perform the typical measurements on the interrogation signals.	3	Sensitivity, selectivity, dynamic range, jamming immunity.

SUB-TOPIC 1.5: Signal processing

1.5.1	Explain the functions performed by a DME/N signal processor.	2	Decode, Reply Delay, Automatic Reply Rate Control, Encode, priority (Ident, DME signal, Squitter).
1.5.2	Perform the typical measurement on the DME/N transponder signals.	3	Reply delay, Reply delay offset, decode parameters, rate of replies.

SUB-TOPIC 1.6: Transmitter subsystem

1.6.1	Characterize the main signal parameters from the ground station.	2	Carrier frequency, output power, pulse shape, pulse spacing, pulse repetition frequency, main delay, ID code.
1.6.2	Perform the typical measurements on a DME.	3	Power and pulse measurements, spectrum measurements, modulation measurements.

SUB-TOPIC 1.7: Antenna subsystem

1.7.1	Explain DME antenna characteristics.	2	Patterns, antennas.
1.7.2	Appreciate the interface between power stage and the antenna.	3	SWR, radiated power, propagation delay, distribution circuit (e.g. duplexer, circulator).
1.7.3	Appreciate protection areas.	3	ICAO Annex 10, protection area criteria and enforcement e.g. Manufacturers manuals.

SUB-TOPIC 1.8: Monitoring and control subsystem

1.8.1	Describe the purpose of monitoring.	2	Integrity, continuity of service.
1.8.2	Describe which DME parameters are monitored.	2	ICAO and RTCA/EUROCAE requirements e.g. Regional and national requirements.

1.8.3	Appreciate how the operational status of the DME monitoring system is checked.	3	
1.8.4	Describe the issues associated with DME obstacle limitations and obstacle removal.	2	Multipath, blanking.

SUB-TOPIC 1.9: On-board equipment

1.9.1	Describe the on-board equipment.	2	Transmitter, antenna, receiver, HMI e.g. HSI, DME range indication, ND.
1.9.2	Describe how the DME information is used on board.	2	e.g. Single DME, multi-DME navigation (rho rho), approach procedures, manual mode, automatic mode.

SUB-TOPIC 1.10: System check and maintenance

1.10.1	Appreciate the conformity to international and national regulations.	3	ITU regulations (EMC + SAR), ICAO Annex 10.
1.10.2	Appreciate calibration tasks and flight inspection results.	3	e.g. Maintenance and flight inspection manuals, procedures and reports.
1.10.3	Appreciate troubleshooting of a DME.	3	Carrier frequency deviation, depth of modulation, lack of power, harmonics ratio e.g. Main delay and monitor shutdown errors, interference Maintenance and flight inspection manuals, procedures and reports.
1.10.4	Appreciate the origin of DME errors.	3	e.g. Multipath, EMC, interference with radio broadcast transmissions (harmonics).

SUBJECT 6: GROUND-BASED SYSTEMS — ILS

TOPIC 1: ILS

SUB-TOPIC 1.1: Use of the system

1.1.1	Describe the overall performance for ILS.	2	ICAO Annexes 10 and 14 Coverage, accuracy, availability of the system, integrity, continuity, number of users.
1.1.2	Explain the limitations of ILS.	2	ICAO Annexes 10 and 14 Only 40 channels, no segmented paths of approach, beam corruption due to multipath.

1.1.3	Interpret ILS facility performance categories.	5	ICAO Annexes 10 and 14 CAT I, CAT II, CAT III Different operational category depending on operational minima, equipment and airport facilities.
1.1.4	Define obstacle-free zones for ILS components.	1	ICAO Annexes 10 and 14 Dimensions e.g. regional and national regulations.
1.1.5	Explain the importance and need for ILS obstacle-free zones.	2	ILS beam protection, increased significance during LVP conditions.
1.1.6	Explain the current situation.	2	e.g. Number, type, users, national context.
1.1.7	Consider the need for ATC ILS status indications.	2	No continuous monitoring by ATSEP.

SUB-TOPIC 1.2: Fundamentals of ILS

1.2.1	Explain how to obtain a change in depth of modulation of an amplitude modulated signal as a function of angular position.	2	Addition of a carrier signal and a side band signal in space.
1.2.2	Characterize the signals to be radiated.	2	Amplitude and phase relationship, antenna systems.
1.2.3	Relate the adjustment of signals generated to the resulting beam patterns and standards.	4	Phases and amplitudes in antenna array, modulations on carrier signal, phase and amplitude of side band.
1.2.4	Describe the required performance of an antenna array.	2	Beam bend potential, coverage, impact on location of critical and sensitive area.

SUB-TOPIC 1.3: 2F-Systems

1.3.1	Explain the limitations of a 1F system.	2	Multipath in adverse environment and terrain.
1.3.2	Describe the capture effect.	2	Capture effect in receiver circuits.
1.3.3	Describe radiation parameters for 2FLOC and 2F-GP.	2	Types of antenna arrays, patterns, coverage, signal distribution, radiated power.

SUB-TOPIC 1.4: Ground station architecture

1.4.1	Describe the layout of an ILS.	2	—
1.4.2	Describe the main components of the LOC (1F and 2F), GP (1F and 2F), markers and field monitors.	2	Electronic cabinet, antennas, power supply, remote controls and monitoring, tower indication e.g. DME.
1.4.3	Relate ILS station design to operational requirements.	4	Coverage, ID code, siting.

SUB-TOPIC 1.5: Transmitter subsystem

1.5.1	Describe the main components of the LOC (1F and 2F), GP (1F and 2F), markers and field monitors.	2	Electronic cabinet, antennas, power supply, remote controls and monitoring, tower indication e.g. DME.
1.5.2	Relate ILS station design to operational requirements.	4	Coverage, ID code, siting.

SUB-TOPIC 1.6: Antenna subsystem

1.6.1	Explain ILS antenna characteristics: LOC, GP and Marker Beacons.	2	Types, position, polarization, patterns, coverage, antenna matching, distribution circuits, radiated power, ground reflection.

SUB-TOPIC 1.7: Monitoring and control subsystem

1.7.1	Describe the purpose of monitoring.	2	Integrity, continuity of service.
1.7.2	Describe the parameters for the monitoring according to ICAO Annex 10: LOC, GP and Marker Beacons.	2	RF level, DDM, SDM on position and width.
1.7.3	Explain the key additional required monitoring: LOC and GP.	2	External, internal and integral monitoring.
1.7.4	Explain the purpose, advantages and disadvantages of the FFM system.	2	e.g. Content position, width, requirement for Cat III operations (some States).
1.7.5	Draw a diagram of the monitoring system: LOC, GP, FFM and Marker Beacons.	1	Near-field, integral network, internal network, monitor signal processor e.g. DME.
1.7.6	Explain the optional DME interface.	2	Identity coding ratio.

SUB-TOPIC 1.8: On-board equipment

1.8.1	Describe the on-board equipment associated with LOC, GP and Marker Beacon.	2	Antennas, receiver, pilot interface (cross pointer) e.g. FMS.
1.8.2	Describe how ILS information is used on board.	2	e.g. Approach procedures, landing, roll-out, manual, automatic mode (auto-pilot).

SUB-TOPIC 1.9: System check and maintenance

1.9.1	Appreciate the conformity of LOC, GP and marker beacons to international and national regulations.	3	ITU regulations (EMC + SAR), ICAO Annex 10.
1.9.2	Justify the occasions when it is necessary to downgrade an ILS facility performance category.	4	e.g. System failures, environmental changes/disturbance.
1.9.3	Explain the implications of ILS facility performance categories to the pilot.	2	Link with prevailing Instrument RVR, weather dictating decision height.
1.9.4	Perform some typical measurements.	3	Output power, spectrum analysis, modulation, ID code.
1.9.5	Appreciate calibration tasks and flight inspection results.	3	LOC, GP and marker beacons Flight inspection and ground calibration results, LOC Centreline measurement, width and centreline field measurements e.g. RF interference monitoring maintenance and flight inspection manuals, procedures and reports.
1.9.6	Appreciate troubleshooting of ILS LOC, GP and marker beacons.	3	DDM and SDM misalignment, coverage pilot reported errors, field checks, monitor checks e.g. Lack of power, carrier frequency deviation, harmonic ratio, depth of modulation maintenance and flight inspection manuals, procedures and reports.
1.9.7	Appreciate the origin of ILS errors.	3	e.g. Multipath, EMC, interference with radio broadcast transmissions (harmonics).

SUBJECT 7: GNSS

TOPIC 1: GNSS

SUB-TOPIC 1.1: General view

1.1.1	Explain the importance and continuing development of GNSS.	2	FANS CNS/ATM concept, ICAO Doc 9849, Navigation Application and NAVAID Infrastructure Strategy.

1.1.2	Describe the elements of GNSS.	2	Core constellations, ABAS, SBAS (EGNOS) e.g. GBAS, SCAT 1, APV, ICAO Annex 10.
1.1.3	Appreciate the sources of interference to GNSS signals.	3	Intentional, unintentional, ionospheric interference, solar activity.
1.1.4	Explain who has responsibility for GNSS oversight in your State and how it is carried out.	2	e.g. RSOO, GSA, National regulator.
1.1.5	Appreciate the impact of the modernization of GNSS on the ARNS bands.	3	Introduction of L5, E5A, E5B e.g. COMPASS.
1.1.6	Explain the need for a minimum number of visible satellites to provide integrity monitoring.	2	e.g. AUGUR.
1.1.7	Describe the purpose of the GNSS NOTAM.	2	ICAO Annex 10, Volume 1.

SUBJECT 8: ON-BOARD EQUIPMENT

TOPIC 1: ON-BOARD SYSTEMS

SUB-TOPIC 1.1: On-board systems

1.1.1	Explain the purpose and use of a navigation computer.	2	Sensors, navigation database.
1.1.2	Explain the purpose and use of an FMS.	2	Sensors, navigation database, path steering, displays.

TOPIC 2: AUTONOMOUS NAVIGATION

SUB-TOPIC 2.1: Inertial navigation

2.1.1	Describe the principles and key features of INS/IRS navigation.	2	Gyros, accelerometer, accuracy, drift, updating.

TOPIC 3: VERTICAL NAVIGATION

SUB-TOPIC 3.1: Vertical navigation

3.1.1	Describe the different types of vertical sensors and their limitations.	2	Barometric, radio altimetry, geodetic e.g. Air data computers, manual intervention, dynamic information (AGL), undulation (WGS84).

SUBJECT 9: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes.	1	Safety assessment documentation related to navigation systems, safety monitoring.

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe in terms of exposure time, environment, effect on controller and effect on pilot, the types of functional failures.	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation.

B.4 — RECOMMENDED TRAINING OBJECTIVES FOR A QUALIFICATION TRAINING COURSE ON SURVEILLANCE

SUBJECT 1: PRIMARY SURVEILLANCE RADAR (PSR)

TOPIC 1: ATC SURVEILLANCE

SUB-TOPIC 1.1: Use of PSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach PSR.	2	Range, resolution, coverage, availability.
1.1.2	Relate key parameters of PSR to system performance.	4	Key parameters: PRF, signal energy, frequency diversity, antenna gain, update rate, polarization, receiver MDS, beam width Performance: range, accuracy, resolution, extractor minimum target threshold, weather influence, PD, blind speed, ambiguities, capacity e.g. weather channel.

SUB-TOPIC 1.2: Antenna (PSR)

1.2.1	Describe antenna types, accuracy and problems.	2	Antenna beam(s), side lobes, reflector antenna, active (phased array) antenna, rotating joints, waveguide interface, pressurization, dehumidification, polarization, azimuth encoding, drive systems.

SUB-TOPIC 1.3: Transmitters

1.3.1	Describe the basic characteristics of a transmitter.	2	Supply, EHT, RF source (appropriate to type chosen), modulation, interlocks.
1.3.2	Describe the signals at all key points.	2	Supply, EHT, RF source (appropriate to type chosen), modulation, interlocks.
1.3.3	Describe a generic transmitter block diagram for both compressed and non-compressed system.	2	e.g. Solid state, klystron, magnetron, travelling wave tube.
1.3.4	State possible failures and where they can occur in the transmitter system.	1	e.g. Solid state modules, arcing, corona discharge, component stress, control loops, isolation.
1.3.5	State constraints and problems on the high voltage circuitry.	1	e.g. Corona discharge, dielectric stress, isolation, arcing, ageing, interlocks, stability (including control loop).

SUB-TOPIC 1.4: Characteristics of primary targets

1.4.1	Appreciate the characteristics of targets detected by PSR.	3	Backscatter, radar cross section (such as reflectivity, stealth technologies, aspect), Doppler shift, ground speed, wind turbines e.g. Swerling Case.

SUB-TOPIC: 1.5: Receivers

1.5.1	Describe the basic characteristics of a receiver.	2	Low noise, high dynamic range, bandwidth, detection, frequency, sensitivity, selectivity.
1.5.2	Describe the basic elements of a generic receiver.	2	LNA, local oscillator, coherent oscillator, downconverter, filtering, rejection, IF, PSD, AGC, STC, beam switching.
1.5.3	Appreciate the importance of STC.	3	Saturation, RF-IF dynamic range.

SUB-TOPIC 1.6: Signal processing and plot extraction

1.6.1	Describe the basic function of data processing.	2	Plot extraction (range bin reports, range correlation, azimuth correlation), target reports, sliding window, weighted centre, local tracking.
1.6.2	Appreciate the basic functions of a current radar signal processor.	3	A/D conversion, I/Q matching, target detection, detection criteria (fixed, adaptive), MTD and clutter maps.

1.6.3	Describe the processing techniques to improve the quality of target reports using scan-to-scan information.	2	Tracking, environment mapping, adaptive feedback to extraction parameters.

SUB-TOPIC 1.7: Plot combining

1.7.1	Describe the basic function of plot combining.	2	Secondary/primary combining, secondary/primary assigning, prime target, range and azimuth collimation.
1.7.2	Describe the basic functions of a current radar plot combiner.	2	Scan-to-scan correlation, angel filtering, vehicle filtering, output format.

SUB-TOPIC 1.8: Characteristics of primary radar

1.8.1	Explain the basic principles of electromagnetism, propagation, signal detection, RF power generation and distribution.	2	Frequency and phase, electromagnetic radiation, spectrum and bandwidth, noise, HPA, waveguide problems.

TOPIC 2: SMR

SUB-TOPIC 2.1: Use of SMR for Air Traffic Services

2.1.1	Describe the operational requirements of SMR.	2	Range, resolution, coverage, MTBF, availability.
2.1.2	Relate key parameters and necessity to achieve performances.	4	Specific equations for ranging and power budget, PRF, frequency with respect to range and accuracy, PD, frequency diversity, range with respect to TX power, antenna gain, receiver MDS, update rate, beam width, extractor minimum target threshold, polarization, influence to meteorology.

SUB-TOPIC 2.2: Radar sensor

2.2.1	Explain the layout of the SMR.	2	Dual system, service display.
2.2.2	Describe the basic functions of the receiver/transmitter unit.	2	Hardware/function overview.
2.2.3	Describe how to operate a sensor.	2	e.g. Block diagram, timing relations, video path, frequency diversity, polarization, controller structure.

2.2.4	Describe the basic functions of the antenna unit.	2	e.g. Hardware function overview, control/switch unit, external interface, azimuth encoding, monopulse techniques.

TOPIC 3: TEST AND MEASUREMENT

SUB-TOPIC 3.1: Test and measurement

3.1.1	Appreciate how measurements can be made on PSR and SMR.	3	e.g. Spectrum analyser, vector voltmeter, oscilloscope, SWR meter, sensor analysis tools.

SUBJECT 2: SECONDARY SURVEILLANCE RADAR (SSR)

TOPIC 1: SSR AND MSSR

SUB-TOPIC 1.1: Use of SSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach SSR.	2	Range, coverage, resolution, performance, update rate ICAO Doc 9924.
1.1.2	Relate key parameters of SSR to system performance.	4	Key parameters: rotation rate, PRF, interlaced modes, capacity, frequencies, power budget (uplink, downlink), monopulse techniques Consequences: FRUIT, garbling, side lobes reception and transmission, transponder availability, PD, 2nd recurrence replies.

SUB-TOPIC 1.2: Antenna (SSR)

1.2.1	Describe the principles of SSR/MSSR antenna.	2	Monopulse antenna techniques, coaxial connection, sum, difference and control pattern, error angle measurement, azimuth encoding, beam sharpening, side lobes.

SUB-TOPIC 1.3: Interrogator

1.3.1	Describe the characteristics of an interrogator.	2	Frequency, spectrum, interrogation modes, duty cycle, ISLS, IISLS, staggering.
1.3.2	Explain a generic interrogator.	2	Timing, interface, modulator, BITE.
1.3.3	Explain the need for integrity monitoring.	2	Safeguards against erroneous transmission, BITE.

SUB-TOPIC 1.4: Transponder

1.4.1	Explain the operational use of the transponder.	2	Diagram of interaction between transponder and aeroplane.
1.4.2	Define the global performances.	1	Range, accuracy, fixed delay to respond.
1.4.3	Describe the basic characteristics of a transponder.	2	Transceiver, aerial location, switching and polar diagram, size ACAS Mode S and ADS compatibility, maximum reply rate, ISLS compatibility.
1.4.4	Explain the advantages of the transponder.	2	Longer range, more information.
1.4.5	Explain the limitations of the transponder.	2	Hundreds of feet precision, 3A limited codes.
1.4.6	Describe the conformity to regulations.	2	Equipage obligations, ICAO Annex 10.
1.4.7	Describe the data format of the received transponder messages.	2	P1, P2, P3, P4, P5, P6 signals and DPSK modulation (P6).
1.4.8	Describe the data format of the transmitted transponder messages.	2	Field lengths, data bits, Gray code, unused bits, Mode S reply (preamble and data).
1.4.9	Describe the basic characteristics of a transmitter.	2	Timing, modulation, pulse width, power output.
1.4.10	Describe the use of the transponder as a field monitor.	2	—

SUB-TOPIC 1.5: Receivers

1.5.1	Describe the basic characteristics of an SSR receiver.	2	Standard/MSSR receiver, sensibility, bandwidth, dynamic range, GTC (normal, sectorised), monopulse processor, RSLS, multi-path and interferences.

SUB-TOPIC 1.6: Signal processing and plot extraction

1.6.1	Describe monopulse extraction.	2	Phase and amplitude modulation, off boresight angle calculation, azimuth encoding.
1.6.2	Describe sliding window SSR extraction.	2	Leading edge, trailing edge, azimuth accuracy, azimuth encoding.
1.6.3	Describe the signal processing.	2	Video digitizer, pulse processor, reply decoder (bracket pair detector), synchronous reply correlator.
1.6.4	Decode a transponder message.	3	Standard message with SPI set e.g. Mode S.

1.6.5	Describe the SSR processing techniques.	2	Discrete code correlation, general association, zones, categories, code swapping, general correlation Mode A code data, Mode C data, target position report.
1.6.6	Explain the reasons for surveillance processing and the key options.	2	False target identification and elimination, data validation, data correction, reflection identification and processing, enhanced resolution performance.

SUB-TOPIC 1.7: Plot combining

1.7.1	Describe the basic function of plot combining.	2	Secondary/primary combining, secondary/primary assigning, prime target, range and azimuth collimation.
1.7.2	Describe the basic functions of a current radar plot combiner.	2	—

SUB-TOPIC 1.8: Test and measurement

1.8.1	Appreciate how measurements can be made on SSR.	3	e.g. Spectrum analyser, vector voltmeter, oscilloscope, SWR meter, sensor analysis tools.

TOPIC 2: MODE S

SUB-TOPIC 2.1: Introduction to Mode S

2.1.1	Explain the need for and benefits of Mode S.	2	Classical SSR limitations, resolution, accuracy, integrity, enhanced data (e.g. 25 ft resolution, aircraft ID, BDS information).
2.1.2	Explain the working principles of Mode S.	2	Mode S interrogation, Mode S reply, Mode S uplink and downlink capability, Mode S formats/protocols, ELS, EHS.
2.1.3	Explain the complementary use of Mode S and conventional SSR.	2	Mode interlace pattern, operational use of all-call, roll-call.
2.1.4	Explain Mode S implementation.	2	Elementary and enhanced surveillance, II and SI codes, use of BDS.

SUB-TOPIC 2.2: Mode S system

2.2.1	Describe the theory of operation of Mode S hardware and software.	2	Performance of the system, theory of operation of the system, interfaces to customer equipment.
2.2.2	Describe testing possibilities for Mode S.	2	e.g. SASS-C.

TOPIC 3: MULTILATERATION

SUB-TOPIC 3.1: MLAT in use

3.1.1	Explain how pilot and controller operations are impacted by the use of an MLAT system.	2	Mode A assigned at gate, coverage of MLAT.
3.1.2	Describe the ground mode of transponders.	2	Aircraft interrogations, squitters, change of transponder mode.

SUB-TOPIC 3.2: MLAT principles

3.2.1	Explain the MLAT system architecture.	2	Standards, transmitters and receivers, data processing/fusion, redundancy, performance, costs, timing solutions, etc.
3.2.2	Appreciate the principles of MLAT system.	3	Triangulation, coverage, position calculation e.g. SCAS.
3.2.3	Describe how to operate the system.	2	Tracking, map creation and blanking.
3.2.4	Describe testing possibilities for MLAT.	2	e.g. SASS-C.

TOPIC 4: SSR ENVIRONMENT

SUB-TOPIC 4.1: SSR Environment

4.1.1	Explain the operational use of ACAS and implications for pilots and controllers.	2	Traffic Advisories, Resolution Advisories, pilot responses and controller information.
4.1.2	Describe the users of the 1 030 MHz – 1 090 MHz channels.	2	Modes 1, 3, A, C and S, military, Mode S uplink and downlink capability, ACAS (TCAS), acquisition and extended squitter, PRF-FRUIT ratios, DME and other interferences.

SUBJECT 3: AUTOMATIC DEPENDENT SURVEILLANCE (ADS)

TOPIC 1: GENERAL VIEW ON ADS

SUB-TOPIC 1.1: Definition of ADS

1.1.1	Describe the basic characteristics of an ADS.	2	Performance, integrity, latency, QoS, implementation options (e.g. ATN/FANS).
1.1.2	List the types of navigation sensors.	1	GNSS, INS, radio NAVAIDs, navigation solutions from FMS, FoM.
1.1.3	State the latest developments, implementation plans and projects.	1	e.g. Current and recent test and trials, ICAO status, EUROCONTROL, FAA and other authorities positions, airline and equipment manufacturer positions, ATC procedures, time scales.

TOPIC 2: ADS-B

SUB-TOPIC 2.1: Introduction to ADS-B

2.1.1	Explain the basic principles of ADS-B.	2	Autonomous operation, navigation solutions, link options, aircraft situation awareness.
2.1.2	Identify the major elements of ADS-B.	3	e.g. ADS-B global chain (from the aircraft to the controller HMI), GNSS, FMS, encoding, scheduling, link.

SUB-TOPIC 2.2: Techniques of ADS-B

2.2.1	Explain the characteristics of the data links used in ADS B.	2	VDL Mode 4, Mode S extended squitter, UAT.
2.2.2	Describe the major ADS-B applications.	2	e.g. ADS-B-NRA, ADS-B-RAD, ASAS.

SUB-TOPIC 2.3: VDL Mode 4 (STDMA)

2.3.1	Describe the use of VDL Mode 4.	2	High-level description.

SUB-TOPIC 2.4: Mode S extended squitter

2.4.1	Describe the use of the Mode S extended squitter.	2	High-level description.

2.4.2	Explain the principles related to signals in space.	2	Modulation scheme, signal structure, key data and frequency.
2.4.3	Explain the principles related to random access technology.	2	Consequences on the RF environment (1 090 MHz).
2.4.4	Explain the relevant messages.	2	Information in each field, information encoding and decoding.
2.4.5	Recognize the structure of a Mode S extended squitter signal.	1	Signal timing and sequencing, data encoding.
2.4.6	Explain the interface between the BDS and the extended squitter message.	2	—

SUB-TOPIC 2.5: UAT

2.5.1	State the use of the UAT.	1	High-level description.

SUB-TOPIC 2.6: ASTERIX

2.6.1	Decode and analyse a signal coded according to the ASTERIX category 21 standard.	3	Reference to ASTERIX standard Decode position, call sign, Mode S address, etc.

TOPIC 3: ADS-C

SUB-TOPIC 3.1: Introduction to ADS-C

3.1.1	Explain the basic principles of ADS-C.	2	Contract, multi-contract, time, event triggering.
3.1.2	Identify the major elements of the ADS-C system.	3	ADS-C global chain (from the aircraft to the controller HMI), GNSS, processor, link, ground station.

SUB-TOPIC 3.2: Techniques in ADS-C

3.2.1	Explain the characteristics of the data links used in ADS-C.	2	e.g. Subnetworks (VDLs, AMSS, HFDL).

SUBJECT 4: HUMAN MACHINE INTERFACE (HMI)

TOPIC 1: HMI

SUB-TOPIC 1.1: ATCO HMI

1.1.1	Describe the display types available.	2	Video, synthetic, mixed.
1.1.2	State the type of selections available.	1	Source, range, maps, filters.
1.1.3	Describe the advantages of different display types.	2	Clarity, configurability, fallback, data integration.

SUB-TOPIC 1.2: ATSEP HMI

1.2.1	Describe the user interface scope and ergonomics as seen by different users and at different locations.	2	System management displays characteristics both control and monitoring.
1.2.2	Describe the analytical and status data available to the users.	2	Radar video, front panel and CMS data, HMI on each subsystem.

SUB-TOPIC 1.3: Pilot HMI

1.3.1	Describe the transponder interface.	2	Mode A, change procedure, SPI, Mode C, deselection, hijack.
1.3.2	Be aware of the ACAS/TCAS display and future potential developments.	0	Characteristics, accuracy, alerts, ADS B, CDTI.
1.3.3	Be aware of the EGPWS display and of future potential developments.	0	—

SUB-TOPIC 1.4: Displays

1.4.1	Describe the display types available and their advantages and disadvantages.	2	Raster/rotating, raw/synthetic, monochrome/colour, CRT/LCD, performances (cost, availability, maintainability, ergonomics).

SUBJECT 5: SURVEILLANCE DATA TRANSMISSION

TOPIC 1: SURVEILLANCE DATA TRANSMISSION

SUB-TOPIC 1.1: Technology and protocols

1.1.1	Describe the implementation of formats and protocols.	2	Network protocols, Surveillance Data Networks e.g. RADNET, messages CAT 1+.
1.1.2	Decode ASTERIX messages.	3	e.g. Categories 1, 2, 20, 21, 34, 48, 62.
1.1.3	Identify the data transmission architecture in a multisensor environment.	3	Fault tolerance, redundancy of line equipment e.g. Software fallback capability, contingency of service, RADNET.
1.1.4	Characterize the degradations of the surveillance transmission network.	2	e.g. Saturation, excess latency.

SUB-TOPIC 1.2: Verification methods

1.2.1	Identify the causes of a fault, based on test tool measurements.	3	e.g. Data analyser, line analyser.

SUBJECT 6: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes.	1	Safety assessment documentation related to the surveillance systems, safety reports and occurrences, safety monitoring.

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe the implications of functional failures in terms of exposure time, environment, effect on controller and effect on pilot.	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output. Ref.: Safety policy and implementation.

SUBJECT 7: DATA PROCESSING SYSTEMS

TOPIC 1: SYSTEM COMPONENTS

SUB-TOPIC 1.1: Surveillance data processing (SDP) systems

1.1.1	Identify all functions of an SDP system.	3	Plot processing, tracking, single-sensor and multisensor tracker. e.g. Radar, ADS, MLAT, estimating limits and accuracy of multisensor tracker, recording e.g. ARTAS tracker.
1.1.2	Describe all major components of an SDP.	2	Functional architecture, technical architecture.
1.1.3	Differentiate SDP features in the ATS units.	2	Area control centres Approach control units Aerodrome control towers.
1.1.4	Appreciate how to operate the system.	3	e.g. Configuration, adjust parameters, start up and shut down, monitoring.
1.1.5	Explain the principles of emergency switching.	2	—

B.5 — RECOMMENDED TRAINING OBJECTIVES FOR A QUALIFICATION TRAINING COURSE ON DATA PROCESSING/AUTOMATION

SUBJECT 1: COMMUNICATION DATA

TOPIC 1: INTRODUCTION TO NETWORKS

SUB-TOPIC: 1.1 Types

1.1.1	State the evolution of network topologies.	1	LAN, WAN e.g. Architectures, size of the segments, length of the systems, quality of service.
1.1.2	Explain how networks meet requirements.	2	Redundancy, bandwidth, BER, time delay, network security.

SUB-TOPIC 1.2: Networks

1.2.1	Analyse the features of a network.	4	Routing scheme, rate, internal networking, routers, bridges, gateways, modems, switches, firewalls e.g. Wireless networks.

1.2.2	Describe network standards and devices.	2	Ethernet, fibre optic, wireless.
1.2.3	Appreciate the replacement of components in a network in a safe way.	3	Continuity of service, network integrity.

SUB-TOPIC 1.3: External network services

1.3.1	Define aspects of external network services.	1	Provided QoS e.g. SLAs.

SUB-TOPIC 1.4: Measuring tools

1.4.1	Operate the usual set of network measuring or monitoring tools to find the values of the main parameters.	3	Data analyser (sniffer) e.g. net scout.
1.4.2	Perform analysis to support fault-finding for correction.	3	Data analyser (sniffer) e.g. net scout.

SUB-TOPIC 1.5: Troubleshooting

1.5.1	Appreciate how to troubleshoot a network.	3	e.g. Broken lines, unusable network components, overload, integrity problems.

TOPIC 2: PROTOCOLS

SUB-TOPIC 2.1: Fundamental theory

2.1.1	Apply the principles of layers.	3	Differences between layers e.g. Layer(s) of sniffer information.
2.1.2	Apply the principles of the addressing strategy.	3	Masks, subnets IP addressing, MAC addressing e.g. Same logical network computers and systems.
2.1.3	Apply the principles of the routing strategy.	3	Routing tables, priorities, fault tolerance, management of routing strategy, static and dynamic routing e.g. Unicast, multicast, broadcast.

SUB-TOPIC 2.2: General protocols

2.2.1	Describe the general protocols.	2	TCP/IP (segments, packets, addressing) e.g. X25, LAPB, pdH, sdH.
2.2.2	Analyse the general protocols using the appropriate tools and documentation.	4	TCP/IP e.g. X25, LAPB.

SUB-TOPIC 2.3: Specific protocols

2.3.1	Describe the specific protocols.	2	e.g. BATAP — ARINC 620, FMTP.

TOPIC 3: NATIONAL NETWORKS

SUB-TOPIC 3.1: National networks

3.1.1	Name the national networks to which the organization is connected.	1	e.g. ANSP, MET, military, PTT, airlines, national network(s).
3.1.2	Describe the interfaces between national and global networks.	2	—

SUBJECT 2: SURVEILLANCE PRIMARY

TOPIC 1: ATC SURVEILLANCE

SUB-TOPIC 1.1: Use of PSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach PSR.	2	Range, resolution, coverage, availability.

SUBJECT 3: SURVEILLANCE SECONDARY

TOPIC 1: SSR AND MSSR

SUB-TOPIC 1.1: Use of SSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach SSR.	2	Range, coverage, resolution, performance, update rate ICAO Doc 9924.

TOPIC 2: MODE S

SUB-TOPIC 2.1: Introduction to Mode S

2.1.1	Explain the need for and benefits of Mode S.	2	Classical SSR limitations, resolution, accuracy, integrity, enhanced data (e.g. 25 ft resolution, aircraft ID, BDS information).
2.1.2	Explain the working principles of Mode S.	2	Mode S interrogation, Mode S reply, Mode S uplink and downlink capability, Mode S formats/protocols, ELS, EHS.
2.1.3	Explain the complementary use of Mode S and conventional SSR.	2	Mode interlace pattern, operational use of all-call, roll-call.
2.1.4	Explain Mode S implementation.	2	Elementary and enhanced surveillance, II and SI codes, use of BDS.

TOPIC 3: MULTILATERATION

SUB-TOPIC 3.1: MLAT principles

3.1.1	Explain the MLAT system architecture.	2	Standards, transmitters and receivers, data processing/fusion, redundancy, performance, costs, timing solutions, etc.
3.1.2	Appreciate the principles of MLAT system.	3	Triangulation, coverage, position calculation e.g. SCAS.
3.1.3	Describe how to operate the system.	2	Tracking, map creation and blanking.
3.1.4	Describe testing possibilities for MLAT.	2	e.g. SASS-C.

SUBJECT 4: SURVEILLANCE — HMI

TOPIC 1: HMI

SUB-TOPIC 1.1: ATCO HMI

1.1.1	Describe the display types available.	2	Video, synthetic, mixed.
1.1.2	State the type of selections available.	1	Source, range, maps, filters.
1.1.3	Describe the advantages of different display types.	2	Clarity, configurability, fallback, data integration.

SUBJECT 5: SURVEILLANCE DATA TRANSMISSION

TOPIC 1: SURVEILLANCE DATA TRANSMISSION

SUB-TOPIC 1.1: Technology and protocols

1.1.1	Describe the implementation of formats and protocols.	2	Network protocols, surveillance data networks (e.g. RADNET), messages CAT 1+.
1.1.2	Decode ASTERIX messages.	3	e.g. Categories 1, 2, 20, 21, 34, 48, 62.
1.1.3	Identify the data transmission architecture in a multisensor environment.	3	Fault tolerance, redundancy of line equipment e.g. Software fallback capability, contingency of service, RADNET.
1.1.4	Characterize the degradations of the surveillance transmission network.	2	e.g. Saturation, excess latency.

SUBJECT 6: FUNCTIONAL SAFETY

TOPIC 1: FUNCTIONAL SAFETY

SUB-TOPIC 1.1: Functional safety

1.1.1	Describe the implications of functional failure in terms of exposure time, environment, effect on controller and effect on pilot.	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation.

SUB-TOPIC 1.2: Software integrity and security

1.2.1	Appreciate how a system can be defended against potential hostile intent via the data processing systems.	3	Input verification, secure sources e.g. Leased lines, private networks, eligibility.
1.2.2	Explain how the normal output of a system could be used by unauthorized persons with hostile intent.	2	e.g. Terrorists using radar data to coordinate an attack.
1.2.3	Estimate the impact of security and integrity failure to the operational service.	3	e.g. System crashes due to incorrect input data, main and standby and fallback systems all have same input, possible loss in total of system, results in capacity reductions and safety consequences.
1.2.4	Appreciate error detection and handling in data, hardware and process.	3	Identification, consequence, scope, reporting, fault tolerance, soft fail, failsafe, monitoring, fallback.

TOPIC 2: SAFETY ATTITUDE

SUB-TOPIC 2.1: Safety attitude

2.1.1	State the role of ATSEP in safety management routines and in reporting processes.	1	Safety assessment documentation related to data processing systems, safety monitoring.

SUBJECT 7: DATA PROCESSING SYSTEMS

TOPIC 1: USER REQUIREMENTS

SUB-TOPIC 1.1: Controller requirements

1.1.1	Explain ATCO missions and services needed in an area control centre.	2	Operational requirements e.g. Separation, flight progress monitoring and coordination, trajectory prediction, coordination with adjacent centres.
1.1.2	Explain ATCO missions and services needed in an approach control unit.	2	Operational requirements e.g. Vectoring, sequencing, AMAN, CDM.
1.1.3	Explain ATCO missions and services needed in an aerodrome control tower.	2	Operational requirements e.g. Runway management, DMAN.

SUB-TOPIC 1.2: Trajectories, prediction and calculation

1.2.1	State different types of trajectories.	1	e.g. FPL-based, surveillance data-based, FMS-based.
1.2.2	Explain the main processes for trajectory prediction.	2	SDP trajectory, FPL trajectory, merged trajectory, predicted trajectory.

SUB-TOPIC 1.3: Ground safety nets

1.3.1	Describe the function of safety nets and their legal status.	2	STCA, APW, MSAW, ASMGCS-based safety nets.

SUB-TOPIC 1.4: Decision support

1.4.1	Explain the major steps in the air traffic planning process.	2	ATFCM with strategic, pre-tactical and tactical, ATC sector planning, tactical control.
1.4.2	Explain the principles of trajectory prediction, conformance monitoring and medium-term conflict detection processes.	2	Route adherence monitoring e.g. CORA, MTCD, CLAM, Level adherence monitoring.

1.4.3	Explain the benefit of these tools for safety and efficiency.	2	—

TOPIC 2: SYSTEM COMPONENTS

SUB-TOPIC 2.1: Processing systems

2.1.1	Describe all major components of a data processing system.	2	Functional architecture, technical architecture, supervision.

SUB-TOPIC 2.2: Flight data processing systems

2.2.1	Identify all functions of an FDP system.	3	FDPS reference model, message handling, initial flight data handling, relationship with other functions, air-ground data link processing, trajectory prediction, flight data management and distribution, SSR Mode A code assignment and management, correlation, coordination and transfer.
2.2.2	Describe all major components of an FDP.	2	Functional architecture, technical architecture e.g. HMI, ATC tools, support tools (technical supervision, QoS monitors and logging).
2.2.3	Differentiate FDP features in the ATS units.	2	Area control centres Approach control units Aerodrome control towers.
2.2.4	Appreciate how to operate the system.	3	e.g. Configuration, adjust parameters, start up and shut down, monitoring.
2.2.5	Explain the principles of emergency switching.	2	—

SUB-TOPIC 2.3: Surveillance data processing systems

2.3.1	Identify all functions of an SDP system.	3	Plot processing, tracking, single sensor and multisensor tracker (e.g. radar, ADS, MLAT), estimating limits and accuracy of multisensor tracker, recording e.g. ARTAS tracker.
2.3.2	Describe all major components of an SDP.	2	Functional architecture, technical architecture.
2.3.3	Differentiate SDP features in the ATS units.	2	Area control centres Approach control units Aerodrome control towers.

2.3.4	Appreciate how to operate the system.	3	e.g. Configuration, adjust parameters, start up and shut down, monitoring.
2.3.5	Explain the principles of emergency switching.	2	—

SUBJECT 8: DATA PROCESS

TOPIC 1: SOFTWARE PROCESS

SUB-TOPIC 1.1: Middleware

1.1.1	Define middleware.	1	Additional specialized functional built on the OS.
1.1.2	List the middleware used on the national major systems.	1	e.g. CORBA, UBSS, OTM, EJB.
1.1.3	Demonstrate the use of a middleware in an ATM environment.	2	Dual processing system.

SUB-TOPIC 1.2: Operating systems

1.2.1	Describe the major aspects of a relevant operating system.	2	e.g. Design, start-up, configuration, back-up and restore.
1.2.2	Perform relevant operating system commands.	3	—
1.2.3	Characterize typical consequences of an OS upgrade.	2	Some possible implications on HW (performance, memory), middleware (compatibility) and SW components.
1.2.4	Explain downward compatibility.	2	Checks on embedded SW modules ability to run under new OS version.
1.2.5	Take account of hardware/software compatibility.	2	Examples of HW requirements of specific SW implementations.
1.2.6	Describe interactions between application and OS.	2	Examples of OS calls by the application software if no middleware is in use.
1.2.7	Describe the life cycle management of an operating system.	2	e.g. Versions, releases, patches, migration.

SUB-TOPIC 1.3: Configuration control

1.3.1	Describe the principles of configuration control.	2	Clear identification of all versions, proof of testing and “build state”, tool and mechanisms to aid control, authorization, audit trail, appropriate quality standard requirements of the administration.

SUB-TOPIC 1.4: Software development process

1.4.1	State the main software development processes.	1	SWALs e.g. Life cycle, waterfall model, RUP.
1.4.2	List the main steps of two of the main software development processes.	1	—
1.4.3	Explain the main differences between two software development processes.	2	e.g. Advantages/disadvantages.

TOPIC 2: HARDWARE PLATFORM

SUB-TOPIC 2.1: Equipment upgrade

2.1.1	Explain the key factors that have to be considered when data processing equipment is upgraded or changed.	2	Specification, compatibility, “proven” or “state-of-the art” technology, maintenance and operating consequence (e.g. personnel, training, spares, procedures), environmental requirements (e.g. size, power requirements, temperature, interfaces), testing.

SUB-TOPIC 2.2: COTS

2.2.1	Explain the advantages and disadvantages of commercial off-the-shelf equipment.	2	Cost, multiplicity of suppliers, quality, maintainability, life cycle, liability.

SUB-TOPIC 2.3: Interdependence

2.3.1	Describe the technical issues regarding the interdependence of various equipment and systems.	2	Interface requirements, common point of failure, data conditioning, response time.

SUB-TOPIC 2.4: Maintainability

2.4.1	Identify the issues that will affect the maintainability of hardware for the planned life of a system.	3	Commercial product life, commercial support commitments, company volatility, spares provision, shelf life and logistics.

TOPIC 3: TESTING

SUB-TOPIC 3.1: Testing

3.1.1	Appreciate the techniques available for system and performance requirements testing.	3	e.g. Code walkthrough, modelling, simulation real time and fast time, black box testing, formal methods, use of independent test personnel, data corruption simulation, hardware failure simulation.
3.1.2	Appreciate the techniques available for system testing and integration.	3	e.g. System integration testing, load testing, regression testing.

SUBJECT 9: DATA

TOPIC 1: DATA ESSENTIALS FEATURES

SUB-TOPIC 1.1: Data significance

1.1.1	Explain the significance of data.	2	Criticality (critical/non critical), legality (ICAO, CAA, organization), use (advisory, control).

SUB-TOPIC 1.2: Data configuration control

1.2.1	Explain the control procedures for changes to operational data.	2	Designated roles/persons for authorizing changes and verifying/checking changes.

SUB-TOPIC 1.3: Data standards

1.3.1	Name the authority responsible for standards.	1	e.g. ICAO, ISO, RSOO, national authority.
1.3.2	State the standards related to ATM data, their sources and their status.	1	e.g. ASTERIX, WGS84, OLDI, FMTP, AMHS, ADEX-P, FPL.
1.3.3	Decode a typical OLDI message.	3	e.g. ACT, PAC.
1.3.4	State the nature of ATM processing requirements.	1	Data volatility (e.g. radar), system integrity, consequence of failure.

TOPIC 2: ATM DATA DETAILED STRUCTURE

SUB-TOPIC 2.1: System area

2.1.1	Describe how a system area is defined.	2	e.g. Size, system centre (reference point).
2.1.2	Describe the data related to the system area.	2	e.g. Radar data, flight plan data, maps, coordinates.

SUB-TOPIC 2.2: Characteristic points

2.2.1	State types of characteristic points used in an ATM system and their structure.	1	Geographic, routing, sector e.g. Geographic: airports and runways, ILS, radar, limit points Routing and sectors: coded routes, SID allocation parameters, area navigation waypoints, adjacent FIRs, holding, sectors.
2.2.2	Explain the importance of characteristic points in the correct presentation of data.	2	—
2.2.3	Describe the process by which amended adaptation files are introduced.	2	—

SUB-TOPIC 2.3: Aircraft performances

2.3.1	List the performance data used in FDPS.	1	Example of data from in-house system.
2.3.2	Describe the structure of aircraft performance data.	2	—
2.3.3	Define speeds, rates and levels.	1	—
2.3.4	Explain the consequences of the use of the wrong type of aircraft.		—

SUB-TOPIC 2.4: Screen manager

2.4.1	Describe how the screen manager is used to set up the ATC HMI.	2	—

SUB-TOPIC 2.5: Auto-coordination messages

2.5.1	Describe the meaning of coordination messages in the control process.	2	Coordination parameters, conditions groups, OLDI conditions groups, characteristics of remote centres.
2.5.2	Describe the characteristics of the remote centres relevant to OLDI.	2	Civil and military.

SUB-TOPIC 2.6: Configuration control data

2.6.1	Explain the structure of the configuration data.	2	Sector CSU link, sectorization plan, control parameters.

SUB-TOPIC 2.7: Physical configuration data.

2.7.1	Explain the structure of the physical configuration data.	2	External configuration, device configuration.

SUB-TOPIC 2.8: Relevant meteorology data

2.8.1	Explain the organization of the data related to meteorology.	2	Meteorology, QNH TL areas, CB activity.

SUB-TOPIC 2.9: Alert and error messages to ATSEP

2.9.1	Explain the importance of alert and error messages.	2	—
2.9.2	Describe different categories of two alert and error messages.	2	—

SUB-TOPIC 2.10 Alert and error messages to ATCO

2.10.1	Describe the structure of the data used in these types of message.	2	MSAW, conflict alert parameters.
2.10.2	Explain alerts and error messages, and their importance from an ATCO point of view.	2	e.g. MSAW, conflict alert, MTCD.

B.6 — RECOMMENDED TRAINING OBJECTIVES FOR A QUALIFICATION TRAINING COURSE ON SYSTEM MONITORING AND CONTROL

SUBJECT 1: COMMUNICATION VOICE

TOPIC 1: AIR-GROUND

SUB-TOPIC 1.1: Controller working position

1.1.1	Describe the most common features of a controller working position.	2	Frequency selection, emergency, station selection, coupling, headset, loudspeaker, footswitch, push to talk e.g. Microphone (noise cancelling), short time recording.

TOPIC 2: GROUND-GROUND

SUB-TOPIC 2.1: Interfaces

2.1.1	Describe the different types of interfaces.	2	Analogue (2, 4, 6 and 8 wires), digital ISDN (64 Kb, 2 Mb).

SUB-TOPIC 2.2: Switch

2.2.1	State the similarities between ground-ground and air-ground switches.	1	Switching techniques.
2.2.2	Describe the most commonly used functionality of PABX.	2	General architecture, digital, analogue, multiplex types, PCM30.
2.2.3	Analyse conversion analogue-digital, digital-analogue.	4	General architecture, analogue-digital-analogue.

SUB-TOPIC 2.3: Controller working position

2.3.1	Describe the two most common features of a controller working position and the HMI.	2	—

SUBJECT 2: COMMUNICATION DATA

TOPIC 1: NETWORKS

SUB-TOPIC 1.1: Network technologies

1.1.1	State emerging network technologies.	1	e.g. As used in EAN, NEAN, AMHS, PENS.
1.1.2	Describe the characteristics of the current networks.	2	Surveillance data, flight plan data and AIS networks e.g. CIDIN, quality of service, architecture, AMHS.

TOPIC 2: GLOBAL NETWORKS

SUB-TOPIC 2.1: Networks and standards

2.1.1	List the global networks and the standards on which they are based.	1	e.g. ICAO for AFTN/CIDIN/AMHS, ICAO for ATN, FANS 1 and FANS A for ACARS applications (SITA and ARINC).

SUB-TOPIC 2.2: Description

2.2.1	Describe the characteristics of the AFTN networks.	2	Users and data, architectures, quality of service.

SUB-TOPIC 2.3: Global architecture

2.3.1	Describe the architecture of the ATN.	2	Air-ground subnetworks, ground-ground subnetworks, airborne networks.

SUB-TOPIC 2.4: Air-ground subnetworks

2.4.1	Describe air-ground subnetworks.	2	VDL (Mode 2), HFDL, AMSS, SATCOM.

SUB-TOPIC 2.5: Ground-ground subnetworks

2.5.1	Describe the composition of ground-ground subnetworks.	2	PTT, commercial telecom providers, ARINC, SITA.

SUB-TOPIC 2.6: Air-ground applications

2.6.1	State the main communication applications using data link systems.	1	e.g. CPDLC, DLIC/AFN, ATIS, DCL.

SUBJECT 3: COMMUNICATION RECORDERS

TOPIC 1: LEGAL RECORDERS

SUB-TOPIC 1.1: Regulations

1.1.1	Explain international regulations.	2	ICAO (recording and reproducing).
1.1.2	Explain national regulations.	2	Appropriate national regulations.
1.1.3	Explain how the service provider complies with the regulations.	2	e.g. Storage media, access to recording and reproducing room, time to store information (overwrite/erase voice or data), procedure to reproduce information.

SUB-TOPIC 1.2: Principles

1.2.1	Explain the principles of recording and reproducing.	2	e.g. Storage media (tape, optical and magnetic disc), A/D-D/A converters, frequency range (300 to 3 400 Hz), channel capacity, time synchronization, connection to a network, synchronization of radar and voice recording, replay limitations.

SUBJECT 4: NAVIGATION — PBN

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: NOTAM

1.1.1	Explain the need for NOTAMs.	2	—

SUBJECT 5: NAVIGATION — GROUND-BASED SYSTEMS–NDB

TOPIC 1: NDB LOCATOR

SUB-TOPIC 1.1: Use of the system

1.1.1	Appreciate the principles of NDB.	3	Relative bearing, measuring method.
1.1.2	Describe the overall performance.	2	Coverage, accuracy, availability of the system, integrity, continuity.
1.1.3	Explain the technical limitations of NDB.	2	Lack of accuracy, lack of integrity, sensitivity to interference.
1.1.4	Describe the current situation.	2	e.g. Number, type, users, user groups, regional context.

SUBJECT 6: NAVIGATION — GROUND-BASED SYSTEMS–DF

TOPIC 1: DF

SUB-TOPIC 1.1: Use of the system

1.1.1	State the different types of DF.	1	VDF, DDF, IDF.
1.1.2	Describe the user HMI.	2	Indication on radar picture, DF indicator.
1.1.3	Appreciate the principles of DF.	3	Bearing, measuring method (standard, Doppler, interferometry).
1.1.4	Describe the overall performance.	2	Coverage, accuracy, availability of the system, integrity, continuity.
1.1.5	Explain the technical limitations of DF.	2	Sensitivity to interference.
1.1.6	Describe the current situation.	2	e.g. Number, type, users, national context.

SUBJECT 7: NAVIGATION — GROUND-BASED SYSTEMS–VOR

TOPIC 1 VOR

SUB-TOPIC 1.1: Use of the system

1.1.1	State the types of VOR systems.	1	Conventional, Doppler.
1.1.2	Describe the overall performance.	2	Coverage, accuracy, availability of the system, integrity, continuity.

1.1.3	Explain the technical limitations of CVOR.	2	Type of information (azimuth), accuracy, integrity, suitable for a network of fixed routes.
1.1.4	Appreciate the differences between CVOR and DVOR.	3	Signal broadcast differences, bearing information robustness.
1.1.5	Describe the current situation.	2	e.g. Number, type, users, user groups, national context, regional context.

SUBJECT 8: NAVIGATION — GROUND-BASED SYSTEMS–DME

TOPIC 1: DME

SUB-TOPIC 1.1: Use of the system

1.1.1	Describe the overall performances for DME.	2	Coverage, accuracy, availability of the system, integrity, continuity, number of users.
1.1.2	Explain the limitations of DME.	2	Accuracy, integrity, capacity.
1.1.3	Describe the current situation.	2	e.g. Number, types, users, user groups, national context, regional context.
1.1.4	State the role of the DME infrastructure in the future navigation applications.	1	PBN.
1.1.5	Explain the differences between DME and TACAN for civilian use.	2	e.g. Azimuth and range.

SUBJECT 9: NAVIGATION — GROUND-BASED SYSTEMS–ILS

TOPIC 1: ILS

SUB-TOPIC 1.1: Use of the system

1.1.1	Describe the overall performances for ILS.	2	ICAO Annexes 10 and 14 Coverage, accuracy, availability of the system, integrity, continuity, number of users.
1.1.2	Explain the technical limitations of ILS.	2	ICAO Annexes 10 and 14 Only 40 channels, no segmented paths of approach, beam corruption due to multi-path.
1.1.3	Interpret ILS Facility Performance Categories.	5	ICAO Annexes 10 and 14 CAT I, CAT II, CAT III Different operational category depending on operational minima, equipment and airport facilities.

1.1.4	Define obstacle free zones for ILS components.	1	ICAO Annexes 10 and 14 Dimensions e.g. National regulations.
1.1.5	Explain the importance and need for ILS obstacle free zones.	2	ILS beam protection, increased significance during LVP conditions.
1.1.6	Explain the current situation.	2	e.g. Number, type, users, national context.
1.1.7	Consider the need for ATC ILS status indications.	2	No continuous monitoring by ATSEP.

SUBJECT 10: SURVEILLANCE — PRIMARY

TOPIC 1: ATC SURVEILLANCE

SUB-TOPIC 1.1: Use of PSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach PSR.	2	Range, resolution, coverage, availability.

SUBJECT 11: SECONDARY SURVEILLANCE

TOPIC 1: SSR AND MSSR

SUB-TOPIC 1.1: Use of SSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach SSR.	2	Range, coverage, resolution, performance, update rate ICAO Doc 9924.

TOPIC 2: MODE S

SUB-TOPIC 2.1: Introduction to Mode S

2.1.1	Explain the need for and benefits of Mode S.	2	Classical SSR limitations, resolution, accuracy, integrity, enhanced data (e.g. 25 ft resolution, aircraft ID, BDS information).
2.1.2	Explain the working principles of Mode S.	2	Mode S interrogation, Mode S reply, Mode S uplink and downlink capability, Mode S formats/protocols, ELS, EHS.
2.1.3	Explain the complementary use of Mode S and conventional SSR.	2	Mode interlace pattern, operational use of all-call, roll-call.
2.1.4	Explain Mode S implementation.	2	Elementary and enhanced surveillance, II and SI codes, use of BDS.

TOPIC 3: MULTILATERATION

SUB-TOPIC 3.1: MLAT principles

3.1.1	Explain the MLAT system architecture.	2	Standards, transmitters and receivers, data processing/fusion, redundancy, performance, costs, timing solutions, etc.
3.1.2	Appreciate the principles of the MLAT system.	3	Triangulation, coverage, position calculation e.g. SCAS.
3.1.3	Describe how to operate the system.	2	Tracking, map creation and blanking.
3.1.4	Describe testing possibilities for MLAT.	2	e.g. SASS-C.

SUBJECT 12: SURVEILLANCE — HMI

TOPIC 1: HMI

SUB-TOPIC 1.1: ATCO HMI

1.1.1	Describe the display types available.	2	Video, synthetic, mixed.
1.1.2	State the type of selections available.	1	Source, range, maps, filters.
1.1.3	Describe the advantages of different display types.	2	Clarity, configurability, fallback, data integration.

SUBJECT 13: SURVEILLANCE — DATA TRANSMISSION

TOPIC 1: SURVEILLANCE DATA TRANSMISSION

SUB-TOPIC 1.1: Technology and protocols

1.1.1	Describe the implementation of formats and protocols.	2	Network protocols, surveillance data networks e.g. RADNET, messages CAT 1+.
1.1.2	Decode ASTERIX messages.	3	e.g. Categories 1, 2, 20, 21, 34, 48, and 62.
1.1.3	Identify the data transmission architecture in a multisensor environment.	3	Fault tolerance, redundancy of line equipment e.g. Software fallback capability, contingency of service, RADNET.
1.1.4	Characterize the degradations of the surveillance transmission network.	2	e.g. Saturation, excess latency.

SUBJECT 14: DATA PROCESSING — DPS SYSTEMS

TOPIC 1: USER REQUIREMENTS

SUB-TOPIC 1.1: Controller requirements

1.1.1	Explain ATCO missions and services needed in an area control centre.	2	Operational requirements e.g. Separation, flight progress monitoring and coordination, trajectory prediction, coordination with adjacent centres.
1.1.2	Explain ATCO missions and services needed in an approach control unit.	2	Operational requirements e.g. Vectoring, sequencing, AMAN, CDM.
1.1.3	Explain ATCO missions and services needed in an aerodrome control tower.	2	Operational requirements e.g. Runway management, DMAN.

SUB-TOPIC 1.2: Trajectories, prediction and calculation

1.2.1	State different types of trajectories.	1	e.g. FPL-based, surveillance data-based, FMS-based.
1.2.2	Explain the main processes for trajectory prediction.	2	SDP trajectory, FPL trajectory, merged trajectory, predicted trajectory.

SUB-TOPIC 1.3: Ground safety nets

1.3.1	Describe the function of safety nets and their legal status.	2	STCA, APW, MSAW, ASMGCS-based safety nets.

SUB-TOPIC 1.4: Decision support

1.4.1	Explain the major steps in the air traffic planning process.	2	ATFCM with strategic, pre-tactical and tactical, ATC sector planning, tactical control.
1.4.2	Explain the principles of trajectory prediction, conformance monitoring and medium term conflict detection processes.	2	Route adherence monitoring e.g. CORA, MTCD, CLAM, level adherence monitoring.
1.4.3	Explain the benefit of these tools for safety and efficiency.	2	—

SUBJECT 15: DATA PROCESSING — DATA PROCESS

TOPIC 1: HARDWARE PLATFORM

SUB-TOPIC 1.1: Equipment upgrade

1.1.1	Explain the key factors that have to be considered when data processing equipment is upgraded or changed.	2	Specification, compatibility, “proven” or “state-of-the art” technology, maintenance and operating consequence (e.g. personnel, training, spares, procedures), environmental requirements (e.g. size, power requirements, temperature, interfaces), testing.

SUB-TOPIC 1.2: COTS

1.2.1	Explain the advantages and disadvantages of commercial off-the-shelf equipment.	2	Cost, multiplicity of suppliers, quality, maintainability, life cycle, liability.

SUB-TOPIC 1.3: Interdependence

1.3.1	Describe the technical issues regarding the interdependence of various equipment and systems.	2	Interface requirements, common point of failure, data conditioning, response time.

SUBJECT 16: DATA PROCESSING — DATA

TOPIC 1: DATA ESSENTIALS FEATURES

SUB-TOPIC 1.1: Data significance

1.1.1	Explain the significance of data.	2	Criticality (critical/non critical), legality (ICAO, CAA, organizations), use (advisory, control).

SUB-TOPIC 1.2: Data configuration control

1.2.1	Explain the control procedures for changes to operational data.	2	Designated roles/persons for authorizing changes and verifying/checking changes.

SUB-TOPIC 1.3: Data standards

1.3.1	Name the authority responsible for standards.	1	
1.3.2	State the standards related to ATM data, their sources and their status.	1	e.g. ASTERIX, WGS84, OLDI, FMTP, AMHS, ADEX-P, FPL.
1.3.3	Decode a typical OLDI message.	3	e.g. ACT, PAC.
1.3.4	State the nature of ATM processing requirements.	1	Data volatility (e.g. radar), system integrity consequence of failure.

SUBJECT 17: SMC — ANS STRUCTURE

TOPIC 1: ANSP ORGANIZATION AND OPERATION

SUB-TOPIC 1.1: ANSP organization and operation

1.1.1	Describe the SMC function within the organization.	2	What the SMC does, interfaces with other functions, similarities and major differences between SMC function at different sites.
1.1.2	Describe the structure, roles and responsibilities of the SMC team and any direct interfaces.	2	—
1.1.3	Explain the duties of the ATC supervisor.	2	—

TOPIC 2: ANSP MAINTENANCE PROGRAMME

SUB-TOPIC 2.1: Policy

2.1.1	Describe, in general terms, the ANSP maintenance policy.	2	—
2.1.2	Describe the aspects of the maintenance policy that apply specifically to SMC.	2	—

TOPIC 3: ATM CONTEXT

SUB-TOPIC 3.1: ATM Context

3.1.1	Describe the ATM requirements and the related services provided by the SMC.	2	Service level agreements, working arrangements e.g. ASM, ATFCM.

TOPIC 4: ANSP ADMINISTRATIVE PRACTICES

SUB-TOPIC 4.1: Administration

4.1.1	Describe any ANSP administrative procedures, specifically applicable to SMC.	2	Any non-technical practices e.g. Security, access control (building and platform), safety, fire.

SUBJECT 18: SMC — ANS SYSTEM/EQUIPMENT

TOPIC 1: OPERATIONAL IMPACTS

SUB-TOPIC 1.1: Degradation or loss of system/equipment services

1.1.1	Describe the importance of monitoring system performance.	2	—
1.1.2	Describe possible ways in which the SMC may become aware of degradation of services and/or systems.	2	e.g. Monitoring systems, telephone calls, aural alerts, user complaint.
1.1.3	Take account of the end users/customers affected.	2	e.g. ATC units, airports, airlines.
1.1.4	Appreciate the implications for end users/customers.	3	—
1.1.5	Appreciate the appropriate actions to restore service.	3	e.g. Switching, replacing, reconfiguration, calling external service provider.
1.1.6	Appreciate the need for appropriate communication before and after restoring service.	3	e.g. Users, customers, external and internal providers.

TOPIC 2: USER POSITION FUNCTIONALITY AND OPERATION

SUB-TOPIC 2.1: User working position

2.1.1	Appreciate working position performance to agreed parameters.	3	e.g. ATCO, Met, ATSEP, airport positions.

SUB-TOPIC 2.2: SMC working position

2.2.1	Appreciate SMC working position performance to agreed parameters.	3	—

SUBJECT 19: SMC — TOOLS, PROCESSES AND PROCEDURES

TOPIC 1: REQUIREMENTS

SUB-TOPIC 1.1: SMS

1.1.1	Describe the ICAO and regional requirements and the national and ATSP SMS.	2	ICAO Annex 19, regional requirements.

SUB-TOPIC 1.2: QMS

1.2.1	Describe the quality management system requirements.	2	e.g. ISO, EFQM.

SUB-TOPIC 1.3: SMS application in the working environment

1.3.1	Describe the relationship between the SMS and the application of SMC.	2	Reporting procedures.
1.3.2	Explain which occurrences require incident reporting and follow-up action(s).	2	e.g. National categories for reporting, safety event processing.
1.3.3	Apply incident reporting procedures to example occurrence(s).	3	e.g. Safety event procedure.

TOPIC 2: MAINTENANCE AGREEMENTS WITH OUTSIDE AGENCIES REQUIREMENTS

SUB-TOPIC 2.1: Principles of agreements

2.1.1	Describe the principles and need for maintenance agreements.	2	e.g. Types of service level provided.
2.1.2	Describe within which functional areas maintenance agreements will occur.	2	e.g. Network providers, facilities management, communications.
2.1.3	Describe where in the SMS manual these agreements are included or referenced.	2	—

TOPIC 3: SMC GENERAL PROCESSES

SUB-TOPIC 3.1: Roles and responsibilities

3.1.1	Describe the role and general method of operations of the SMC.	2	—

3.1.2	Describe the need to monitor service conditions and the way to take appropriate action to ensure service performance.	2	e.g. Process to interrupt services for planned maintenance purposes, management of service provision during corrective maintenance, continuity of service, availability.
3.1.3	Describe the coordination role of the SMC.	2	e.g. ATSEP, ATCOs, external service providers, ATM stakeholders.
3.1.4	Describe how risk analysis can contribute towards decision-making.	2	e.g. Assessing risk, handling of service interventions.

TOPIC 4: MAINTENANCE MANAGEMENT SYSTEMS

SUB-TOPIC 4.1: Reporting

4.1.1	Describe how maintenance activities and SMC events/actions are recorded.	2	e.g. Procedures to follow, terminology to use, record-keeping for traceability.
4.1.2	Explain the importance of accurate record keeping and dissemination for handover and quality management purposes.	2	e.g. Information is logged in database or report is generated and distributed according to defined procedures.

SUBJECT 20: SMC — TECHNOLOGY

TOPIC 1: TECHNOLOGIES AND PRINCIPLES

SUB-TOPIC 1.1: General

1.1.1	Describe the principles of control and monitoring systems used.	2	e.g. National basis, colour codes, ergonomics.

SUB-TOPIC 1.2: Communication

1.2.1	Describe the key aspects of control and monitoring system capability.	2	e.g. Parameters presented to the SMC and types of actions that can be taken.
1.2.2	Appreciate the impact of the replacement of components in a communication chain.	3	Continuity of service, communication chain integrity.

SUB-TOPIC 1.3: Navigation

1.3.1	Describe the key aspects of control and monitoring system capability.	2	e.g. Parameters presented to the SMC and types of actions that can be taken.

1.3.2	Appreciate the impact of the replacement of components in navigation equipment.	3	Continuity of service, navigation aid integrity.

SUB-TOPIC 1.4 Surveillance

1.4.1	Describe the key aspects of control and monitoring system capability.	2	e.g. Parameters presented to the SMC and types of actions that can be taken.
1.4.2	Appreciate the impact of the replacement of components in a surveillance chain.	3	Continuity of service, surveillance chain integrity.

SUB-TOPIC 1.5: Data processing

1.5.1	Describe the key aspects of control and monitoring system capability.	2	e.g. Parameters presented to the SMC and types of actions that can be taken.
1.5.2	Appreciate the impact of the replacement of components in data processing chain.	3	Continuity of service, data processing, chain integrity.

SUB-TOPIC 1.6: Facilities

1.6.1	Describe the key aspects of system management capability.	2	e.g. Parameters presented to the SMC and types of actions that can be taken.
1.6.2	Appreciate the impact of the loss of supply and/or replacement of components in facility equipment.	3	Continuity of service, integrity.

B.7 — RECOMMENDED TRAINING OBJECTIVES FOR A QUALIFICATION TRAINING COURSE ON INFRASTRUCTURE

SUBJECT 1: POWER SUPPLY

TOPIC 1: POWER DISTRIBUTION

SUB-TOPIC 1.1: Introduction

1.1.1	Describe the power distribution system at a typical site.	2	Commercial net, UPS, engine generator set, battery stations, redundancy, solar systems.
1.1.2	Design the block diagram of the power distribution system at a typical site.	4	Components.

SUB-TOPIC 1.2: Safety

1.2.1	Explain any appropriate local and ICAO regulation in force.	2	Company rules.
1.2.2	Discuss the precautions to be taken when working on power equipment.	5	High voltage, earthling techniques, personal safety, precaution to take to handle batteries.

TOPIC 2: Uninterruptible Power Supply (UPS)

SUB-TOPIC 2.1: Design and operational requirements

2.1.1	Explain the importance and use of UPS systems.	2	Operational and technical point of view (CNS/ATM equipment demands) and ICAO Standards table, organization of maintenance.
2.1.2	Design a block diagram of a UPS.	4	Inputs/outputs, rectifier, inverter, converter, static switch, control panel, filters, bypass, batteries.
2.1.3	Analyse and interpret the components and performances of a UPS.	4	Inputs/outputs, rectifier, inverter, converter, static switch, control panel, filters, bypass, batteries.
2.1.4	Check and troubleshoot an existing UPS.	3	Monitoring, maintenance, periodic testing.

TOPIC 3: ENGINE GENERATOR SET (GenSet)

SUB-TOPIC 3.1: Design and operational requirements

3.1.1	Explain the importance and use of GenSet systems.	2	Operational and technical point of view (CNS/ATM equipment demands) and ICAO Standards table, organization of maintenance.
3.1.2	Design a block diagram of a GenSet system.	4	Engines, generator, control panel, power transfer switch, bypass, fuel system, air supply system and filters.
3.1.3	Analyse and interpret the components and performances of GenSet.	4	Engines, generator, control panel, power transfer switch, bypass, fuel system, air supply system and filters.
3.1.4	Check and troubleshoot an existing GenSet.	3	Monitoring, maintenance, periodic testing.

TOPIC 4: BATTERIES AND BATTERY STATIONS

SUB-TOPIC 4.1: Design and operational requirements

4.1.1	Explain the importance and use of batteries and battery stations.	2	Operational and technical point of view (CNS/ATM equipment demands) and ICAO Standards table, organization of maintenance.
4.1.2	Design a block diagram of a battery station.	4	Batteries, connections (parallel, serial), chargers, types, characteristics.
4.1.3	Explain and analyse the main components and performances of batteries and battery stations.	2	Batteries, connections (parallel, serial), chargers, types, characteristics.
4.1.4	Check and troubleshoot an existing battery station.	3	Monitoring, maintenance, periodic testing.

TOPIC 5: POWER SUPPLY NETWORK

SUB-TOPIC 5.1: Design and operational requirements

5.1.1	Explain the importance of a power supply network for a CNS/ATM system.	2	Operational and technical point of view (CNS/ATM equipment demands) network types and circuits (HV, LV, primary, secondary, power lines/cables), redundancy.
5.1.2	Design a block diagram of a power supply network for a CNS/ATM system.	4	Fuses, circuit breakers, contactors, relays, measuring and protection devices, distribution boards.
5.1.3	Check and troubleshoot a power supply network.	3	Monitoring, maintenance, periodic testing.

TOPIC 6: SAFETY ATTITUDE AND FUNCTIONAL SAFETY

SUB-TOPIC 6.1: Safety attitude

6.1.1	State the role of ATSEP in safety management routines and in reporting processes.	1	Safety assessment documentation related to power supply system, safety reports and occurrences, safety monitoring.

SUB-TOPIC 6.2: Functional safety

6.2.1	Describe the implications of functional failures in terms of exposure time, environment, effect on controller and pilot.	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output, safety policy, safety policy and implementation, other national and international policy.

TOPIC 7: HEALTH AND SAFETY

SUB-TOPIC 7.1: Hazard awareness

7.1.1	Be aware of potential hazards to health and safety generated by power supply equipment.	0	Mechanical hazards, electrical hazards (HV/LV, EMI), chemical hazards.

SUB-TOPIC 7.2: Rules and procedures

7.2.1	State applicable international requirement.	1	Relevant international documents.
7.2.2	State any applicable legal national requirement.	1	Relevant national documents.
7.2.3	State safety procedure for the persons working on or near power supply equipment.	1	Isolation (clothing, tools), fire extinction types, safety manual presence, safety interlocks, isolating switches, security of the site, climbing procedures.

SUB-TOPIC 7.3: Practical situation

7.3.1	In a practical situation, apply and demonstrate the procedures and techniques to be followed.	2	e.g. Replacing fuses or boards, start-up/shut down a station, climbing procedures.

SUB-TOPIC 7.4: Resuscitation techniques

7.4.1	Apply and demonstrate resuscitation techniques.	2	First aid, rescue procedures, resuscitation.

TOPIC 8: Air Conditioning

SUB-TOPIC 8.1: Cooling

8.1.1	Explain the importance of cooling for CNS/ATM system.	1	Operational and technical point of view.
8.1.2	Check and troubleshoot a cooling system.	3	Monitoring, maintenance, periodic testing.

SUB-TOPIC 8.2: Heating

8.2.1	Explain the importance of heating for air conditioning systems.	1	Operational and technical point of view.
8.2.2	Check and troubleshoot a heating system.	3	Monitoring, maintenance, periodic testing.

SUB-TOPIC 8.3: Fresh Air Supply

8.3.1	Explain the importance of fresh air supply for air conditioning systems.	1	Operational and technical point of view.
8.3.2	Check and troubleshoot a cooling system.	3	Monitoring, maintenance, periodic testing.

B.8 — RECOMMENDED TRAINING OBJECTIVES FOR A QUALIFICATION TRAINING COURSE ON ENGINEERING

SUBJECT 1: ENGINEERING

TOPIC 1: INTRODUCTION

SUB-TOPIC 1.1: Needs for Engineering

1.1.1	Define the role of engineering in an ANSP.	1	—

SUB-TOPIC 1.2: Engineering basics

1.2.1	Describe the importance of engineering standards and procedures.	2	—
1.2.2	Describe Engineering Quality Management.	2	—
1.2.3	Describe Engineering Standards.	2	—
1.2.4	Describe the Equipment Life Cycle.	2	—

TOPIC 2: SAFETY

SUB-TOPIC 2.1: Lab Safety Procedures

2.1.1	Describe Safety procedures.	2	—

SUB-TOPIC 2.2: Personnel/Equipment Safety Procedures

2.2.1	Describe personnel safety.	2	—

SUB-TOPIC 2.3: Electrostatic Discharge Precautions

2.3.1	Describe safety equipment.	2	—
2.3.2	Describe fire and emergency procedures.	2	—

SUB-TOPIC 2.4: Fire and Emergency Procedures

2.4.1	Describe electrostatic discharge.	2	—
2.4.2	Describe fire and emergency procedures.	2	—

TOPIC 3: RESILIENCE

SUB-TOPIC 3.1: Resilience and safety

3.1.1	Take account of modelling state-of-the-art approaches.	2	—

SUB-TOPIC 3.2: Applicable models

3.2.1	Take account of modelling state-of-the-art approaches.	2	—

SUB-TOPIC 3.3: STAMP – Accident causation model

3.3.1	Take account of design and implement state-of-the-art approaches.	2	—

SUB-TOPIC 3.4: Audit resilience in risk control and safety management systems

3.4.1	Take account of following resilient engineering concepts; Take account of modelling state-of-the-art approaches of design and implement.	2	—
3.4.2	Take account of following resilient engineering concepts.	2	—

SUBJECT 2: REQUIREMENTS AND SPECIFICATIONS

TOPIC 1: DEFINING

SUB-TOPIC 1.1: Regulations

1.1.1	Describe the purpose of regulations.	2	—
1.1.2	Define regulations.	1	—

SUB-TOPIC 1.2: Performance

1.2.1	Define specifications.	1	—
1.2.2	Balance / assess technical solutions.	5	—
1.2.3	Analyse requirements and project the utilization into operational environment.	4	—
1.2.4	Interpret needs and translate into specifications.	5	—

SUB-TOPIC 1.3: Maintenance

1.3.1	Define maintenance objectives.	1	—
1.3.2	Define maintenance requirement.	1	—
1.3.3	Define maintenance procedures.	1	—

SUB-TOPIC 1.4: Training

1.4.1	Define training requirement.	1	—
1.4.2	Organize training programmes.	4	—
1.4.3	Organize training courses.	4	—
1.4.4	Assess training results.	5	—

TOPIC 2: INSTALLATION REQUIREMENTS

SUB-TOPIC 2.1: Human resources

2.1.1	Manage teams.	4	—

TOPIC 3: TRACE

SUB-TOPIC 3.1: Monitor legislation evolution

3.1.1	Take into account all legislation and recommendations impacting engineering design and installation.	2	—

SUBJECT 3: DESIGN

TOPIC 1: PROJECT MANAGEMENT

SUB-TOPIC 1.1: Design and planning

1.1.1	Demonstrate performing project management and estimate cost.	2	—
1.1.2	Describe design and planning.	2	—
1.1.3	Describe implementation phase.	2	—
1.1.4	State the various phases of an installation project.	1	—
1.1.5	Describe the Project Brief.	2	—

SUB-TOPIC 1.2: Problem reporting and change request

1.2.1	Describe problem reporting and change request.	2	—

SUB-TOPIC 1.3: Cost

1.3.1	Describe budgetary concerns.	2	—

SUB-TOPIC 1.4: Conception

1.4.1	Apply project management approaches.	3	Agile project management, Critical chain project management (CCPM), Event chain methodology, Extreme project management (XPM), Lean project management, PRINCE2, Process-based management.

SUB-TOPIC 1.5: Risk analysis

1.5.1	Identify risks.	3	—
1.5.2	Analyse risks.	4	—
1.5.3	Prevent and manage risks.	4	—

SUBJECT 4: VALIDATION AND TESTING

TOPIC 1: PERFORMANCE VALIDATION

SUB-TOPIC 1.1: Testing standards and frameworks

1.1.1	Apply standards and adapt frameworks.	3	—

SUB-TOPIC 1.2: Unit testing

1.2.1	Apply unit test plan.	3	—

SUB-TOPIC 1.3: Integration testing

1.3.1	Apply integration test plan.	3	—

SUB-TOPIC 1.4: System testing

1.4.1	Apply system test plan.	3	—

TOPIC 2: OPERATIONAL VALIDATION

SUB-TOPIC 2.1: Requirements compliance

2.1.1	Comply user requirements/system requirements/test results traceability.	4	—
2.1.2	Appreciate results.	3	—
2.1.3	Solve in line with state-of-the-art approaches.	5	—

SUBJECT 5: INSTALLATION

TOPIC 1: PLANIFICATION

SUB-TOPIC 1.1: Describe Installation Preparation Activities

1.1.1	Describe how to configure installation items.	2	—
1.1.2	Describe installation instructions.	2	—
1.1.3	Describe installation standards and practices.	2	—
1.1.4	Describe spares and special tools.	2	—
1.1.5	Describe NOTAM.	2	—
1.1.6	Describe impact assessment	2	—

SUB-TOPIC 1.2: Explain the procurement process

1.2.1	Describe the requisition on supply.	2	—
1.2.2	Describe purchasing methods.	2	—
1.2.3	Describe budgetary concerns.	2	—

TOPIC 2: PHYSICAL INSTALLATION

SUB-TOPIC 2.1: Explain panel assembly

2.1.1	Describe AC power distribution.	2	—
2.1.2	Describe DC power distribution.	2	—
2.1.3	Describe AC ground.	2	—
2.1.4	Describe signal grounding.	2	—
2.1.5	Describe protective devices.	2	—
2.1.6	Describe RF cables and systems.	2	—
2.1.7	Describe antennas and structures.	2	—
2.1.8	Describe Control cables.	2	—
2.1.9	Describe Cross connections.	2	—

SUB-TOPIC 2.2: Explain Rack Mechanical Assembly

2.2.1	Describe AC power distribution.	2	—
2.2.2	Describe DC power distribution.	2	—
2.2.3	Describe AC ground.	2	—
2.2.4	Describe signal grounding.	2	—
2.2.5	Describe protective devices.	2	—
2.2.6	Describe RF cables and systems.	2	—
2.2.7	Describe antennas and structures.	2	—
2.2.8	Describe Control cables.	2	—
2.2.9	Describe Cross connections.	2	—

SUB-TOPIC 2.3: Explain Rack Electrical Assembly

2.3.1	Describe AC power distribution.	2	—
2.3.2	Describe DC power distribution.	2	—
2.3.3	Describe AC ground.	2	—
2.3.4	Describe signal grounding.	2	—
2.3.5	Describe protective devices.	2	—
2.3.6	Describe RF cables and systems.	2	—
2.3.7	Describe antennas and structures.	2	—
2.3.8	Describe Control cables.	2	—
2.3.9	Describe Cross connections.	2	—

Appendix C

TRAINING OBJECTIVES TAXONOMY

Definition of verbs for each level of accomplishment

Definition of verbs — Level 0

Level 0: Requires from the trainee a simple level of awareness.

Verb	*Definition*	*Example*	*Level*
Demonstrate familiarization	To become acquainted with a subject	To demonstrate familiarization with technical and operational ATM facilities.	0
To demonstrate general awareness of	Condition of being conscious, level of awareness	To demonstrate general awareness of potential hazards to health and safety generated by navigation equipment.	0

Definition of verbs — Level 1

Level 1: Requires a basic knowledge of the subject. It is the ability to remember essential points; the trainee is expected to memorize and retrieve data.

Verb	*Definition*	*Example*	*Level*
Define	State what it is and what its limits are; state the definition	Define the global performances for CVOR and DVOR.	1
Draw	Produce a picture, pattern or diagram	Draw the block diagram of the transmitter.	1
List	Say one after the other	List the main SW development processes used in industries.	1
Name	Give name of objects or procedures	Name who is designated to authorize changes in operational data.	1
Quote	Repeat what is written or said to underline	Quote the ICAO definition of ATC service.	1

Verb	*Definition*	*Example*	*Level*
Recognize	To know what it is because you have seen it before	Recognize on a diagram all the elements of the ADS.	1
State	Say or write in a formal or definite way	State who are the local telecom providers and the service characteristics.	1

Definition of verbs — Level 2

Level 2: Requires an understanding of the subject sufficient to enable the student to discuss intelligently. The individual is able to represent for himself certain objects and events in order to act upon these objects and events.

Verb	*Definition*	*Example*	*Level*
Characterize	To describe the quality of features in something	Characterize consequences of an OS upgrade.	2
Consider	To think carefully about it	Consider institutional issues and service provider responsibilities.	2
Demonstrate	Describe and explain; logically or mathematically proves the truth of a statement	Demonstrate the possible use of GBAS for approach and landing.	2
Describe	Say what it is like or what happened	Describe the architecture of the ATN network.	2
Differentiate	Show the differences between things	Differentiate on a diagram all the possible elements of the ADS-C system.	2
Explain	Give details about something or describe so that it can be understood	Explain the principles of non-blocking switches.	2
Take account of	Take into consideration before deciding	Take wind influence into account when calculating a ground speed.	2

Definition of verbs — Level 3

Level 3: Requires a thorough knowledge of the subject and the ability to apply it with accuracy. The student should be able to make use of his repertoire of knowledge to develop plans and activate them.

Verb	*Definition*	*Example*	*Level*
Act	Carry out, execute	Act in accordance with the rules.	3
Apply	Use something in a situation or activity	Apply the appropriate model to the analysis of a relevant aviation system.	3
Appreciate	To understand a situation and know what is involved in a problem-solving situation, to state a plan without applying it	Appreciate criticality of the conditions.	3
Assist	Help somebody to do a job by doing part of it	Handle the operational HMI and assist in the tuning of the screens.	3
Calculate	To discover from information you already have by arithmetic; to think about a possible cause of action in order to form an opinion or decide what to do	Calculate the values of the elements of a simple generic antenna system.	3
Check	Make sure the information is correct (satisfactory)	Check the operational status of the monitor system.	3
Choose	Select out of number, decide to do one thing rather than another	Choose the appropriate type of line for a given specific application.	3
Collect	Assemble, accumulate, bring or come together	Collect remote data.	3
Conduct	Lead, guide	Conduct coordination.	3
Confirm	Establish more firmly, corroborate	Confirm sequence order.	3
Decode	Turn into ordinary writing, decipher	Decode a transponder message.	3
Encode	Put into code or cipher	Encode a typical ATC data item.	3
Estimate	Form an approximate judgment of a number; form an opinion	Being given an aircraft route, estimate thanks to a software package or/and GPS receiver the availability of the constellation.	3
Execute	Perform action	Execute an arrival sequence.	3
Extract	Copy out, make extracts from, find, deduce	Extract data from a flight plan.	3

Verb	*Definition*	*Example*	*Level*
Identify	Associate oneself inseparably with, establish the identity	Identify and locate data transmission problems.	3
Inform	Inspire, tell	Inform the planning controller.	3
Initiate	Begin, set going, originate	Initiate a coordination procedure.	3
Input	Enter in the system	Input data.	3
Issue	Send forth, publish	Issue ATC clearance.	3
Maintain	Carry on, keep up, refresh	Maintain flight data display.	3
Measure	Ascertain extent or quality of (thing) by comparison with fixed unit or with object of known size	Measure the typical parameters of lines.	3
Monitor	Keep under observation	Monitor traffic.	3
Notify	Make known, announce, report	Notify runway in use.	3
Obtain	Acquire easily, without research	Obtain aeronautical information.	3
Operate	Conduct work on equipment	Operate test tools to analyse the system.	3
Pass	Move, cause to go, transmit	Pass essential traffic information without delay.	3
Perform	Carry into effect, go through, execute	Perform typical measurements on a receiver.	3
Record	Register, set down for remembrance or reference	Record information by writing effectively.	3
Relay	Arrange in, provide with, replace by	Relay pilot message.	3
Respond	Make answer, perform answering or corresponding action	Respond to the loss of aircraft radar identification.	3
Scan	Look intently at all parts successively	Scan data display.	3
Transfer	Hand over	Transfer information to receiving controller.	3
Update	Refresh, make up to date	Update professional knowledge and skills.	3
Use	Employ for a purpose, handle as instrument, put into operation	Use the ICAO documentation to explain the principles related to signals in space.	3

Verb	*Definition*	*Example*	*Level*
Verify	Establish truth of	Verify the impact of the requirements on the location and the type of ground station.	3

Definition of verbs — Level 4

Level 4: Ability to establish a line, within a unit of known applications, following the correct chronology, and the adequate methods to resolve a problem situation. This involves the integration of known applications in a familiar situation.

Verb	*Definition*	*Example*	*Level*
Acquire	Gain by oneself and for oneself; obtain after research	Acquire relevant aeronautical information.	4
Adjust	Change to a new position, value or setting	Adjust antenna system.	4
Allocate	Assign, devote	Allocate the responsibility of separation during transfer.	4
Analyse	Examine minutely the constitution of	Analyse the coverage of the radio system.	4
Assign	Allot as a share, make over	Assign take off number.	4
Coordinate	Bring part into proper relation	Coordinate with RCC.	4
Comply	Act in accordance with	Comply with rules.	4
Delegate	Commit authority to somebody	Delegate separation in case of aircraft continuing visually.	4
Design	Conceive mental plans for	Design a NDB station according to operational requirements.	4
Detect	Discover existence of	Detect disturbances.	4
Ensure	Make safe, make certain	Ensure the agreed course of action is carried out.	4
Expedite	Assist the progress of, do speedily	Expedite the traffic.	4
Integrate	Combine into a whole, complete by addition of parts	Integrate adequately components into a LAN.	4
Justify	Show the rightness of a choice or of an option	Justify and theorize the DME/N versus the DME/P.	4

Verb	*Definition*	*Example*	*Level*
Manage	Handle, wield, conduct	Manage aerodrome surface movements.	4
Organize	Give orderly structure to, frame and put into working order	Organize arrival sequence.	4
Predict	Forecast	Predict evolution of a conflict situation.	4
Provide	Supply, furnish	Provide separation.	4
Relate	Establish link with	Relate a pressure setting to an altitude.	4

Definition of verbs — Level 5

Level 5: Ability to analyse new situation, in order to elaborate and apply one or other relevant strategy, to solve a complex problem. The defining feature is that the situation is qualitatively different from those previously met, requiring judgment and evaluation of options.

Verb	*Definition*	*Example*	*Level*
Appraise	Estimate, determine the benefit	Appraise the interest of a traffic management option.	5
Assess	Estimate value or difficulty, evaluate	Assess flight inspection results.	5
Balance	Weigh (a question, two arguments, etc., against each other)	Balance two control actions.	5
Calibrate	Correct and adjust to enable the provision of accurate data	Calibrate the NDB system according to flight inspection.	5
Discuss	Investigate by reasoning or argument	Discuss the distribution of integrity information through GALILEO.	5
Evaluate	Ascertain amount of, find numerical expression for	Evaluate workload.	5
Extemporize	Produce without preparation, improvise	Extemporize phraseology in abnormal situations.	5
Imagine	Form mental image of, conceive	Imagine possible actions to cope with unusual situations.	5
Interpret	To decide on something’s meaning or significance when there is a choice	Interpret fault report based on various test tool measures.	5

Verb	*Definition*	*Example*	*Level*
Resolve	Solve, clear up, settle	Resolve conflict.	5
Review	Survey, look back on	Review previous clearance according to the latest aircraft relative positions.	5
Select	Pick out as best or most suitable	Select the runway in use.	5
Solve	Find answer to	Solve separation problems.	5
Theorize	Extract general principles from a particular experience	Theorize the principles of ILS.	5
Troubleshoot	Trace and correct faults	Troubleshoot wrong bearing indications of a VOR.	5
Validate	Make valid, ratify, confirm	Validate one radar vectoring option to expedite the traffic.	5

Classes of skills

Skill	*Examples*
Intellectual skills	
Classifying	Distinguishes between average flight distance and average stage length.
Rule-using	Identifies different classes of aircraft.
Discriminating	Defines the concept of insurance.
Problem-solving	Determines expected approach times for aircraft in an approach sequence. Generates a weather forecast. Decides whether or not a fire is completely extinguished. Judges whether an aircraft cabin has been adequately cleaned. Diagnoses an equipment fault.
Physical (motor) skills	Manipulates a fire hose. Operates a computer keyboard.

Appendix D

DEVELOPMENT TRAINING SCENARIOS

1. TECHNICAL FLIGHT INSPECTOR

1.1 Paragraph 2.7 of ICAO Annex 10 — *Aeronautical Telecommunications*, Volume I — *Radio Navigation Aids*, requires States or ANSPs to perform flight tests on aeronautical telecommunications systems. Flight tests are carried out following guidance provided in ICAO's *Manual on Testing of Radio Navigation Aids* (Doc 8071). States or ANSPs involved in flight tests have developed documents, standards and procedures which meet the requirements of Doc 8071. Electronic test equipment such as high precision navigation receivers, sensors, data recorders, computers and signal analysers are installed on an aircraft for the calibration of radio navigation aids. In most cases the aircraft is used for the sole purpose of flight calibration. The personnel required to maintain and operate the flight calibration equipment are identified as technical flight inspectors, and they may come from the ATSEP environment.

1.2 The functions of the ATSEP as a technical flight inspector (TFI) are generally related to the operation of the airborne recording and positioning equipment which include:

a) calibration of radio navigational receivers;

b) operation of computer and data recording equipment;

c) real-time data analysis and decision-making;

d) preparation and operation of aircraft positioning equipment (e.g. theodolite, laser tracker, differential GPS);

e) communications with ground personnel as required; and

f) preparation of inspection report.

1.3 Trainees should perform flight test activities in accordance with standards and procedures approved by the State or ANSP. The ATSEP TFI should be able to:

a) operate all airborne and ground systems and equipment to be used during the flight calibration;

b) analyse and evaluate technical problems related to the radio navigational aid under inspection;

c) provide advice and recommendations to ground personnel with a view to achieving compliance with the applicable standards;

d) understand instrument procedures used in all phases of a flight; and

e) describe relative standards and procedures.

1.4 Standard of accomplishment:

a) all the descriptions should include the essential points of the given situation; and

b) all work should be performed as per the approved standards and procedures.

2. ATSEP INSTRUCTOR TRAINING

2.1 ATSEP training is specialized. Therefore, ATSEP trained as instructors should have the ability to teach in a classroom setting, to provide OJT and to coach on equipment.

2.2 *Classroom instructional techniques*

2.2.1 This course is designed for ATSEP who are, or will be, involved in classroom instruction. At the end of this course, ATSEP should have basic instructional skills.

2.2.2 Instructors have to follow specific guidelines to plan, prepare and deliver presentations and lessons. During the course, the student will play alternatively the role of instructor and class participant. Performance as an instructor is subsequently assessed.

2.2.3 The course should address:

a) qualities of a good instructor;

b) principles of adult learning;

c) use and structure of a lecture;

d) how to design and structure a lesson and lesson plan, including design of instructional events, selection of training techniques and selection of media options;

e) questioning techniques;

f) elements and formulation of training objectives;

g) use of teaching aids;

h) principles of student motivation;

i) qualities and types of written tests;

j) how to administer practical exercises (written, small group discussion, group discussion, lab, role play, simulator); and

k) practical exercises presenting one lecture and one lesson.

2.3 *On-the-job training instructor and coaching*

2.3.1 The course is designed for ATSEP who will carry out OJT or coaching in an operational unit. The OJT phase and practical exercises on equipment (standby or real equipment or special equipment for development and

training purpose) are critical in training ATSEP. The OJT instructor and coach should apply best practices in teaching techniques and coaching which will increase the quality and the efficiency of the OJT, increase safety, and decrease risk when dealing with equipment. The course should also advocate a code of practice for the instructor.

2.3.2 The programme should address:

a) safety precautions to take before teaching practical training on equipment;

b) learning processes, cognitive aspects and motivation theories;

c) effective verbal communication, non-verbal communication and effective listening skills;

d) personal interaction, personal styles and attitudes, building positive relationships, the influence of recognition, interpersonal conflict;

e) training practices such as briefing a student, monitoring the student's progress, intervention methods, feedback and debriefing;

f) task training, how to build practical exercises and sessions dealing directly with equipment, measurement technique, etc.;

g) progressive application of coaching theory with feedback; and

h) stress recognition and stress management.

2.4 *Assessment training*

2.4.1 This course is designed for an experienced engineer, technician or OJT instructor who will be conducting assessments. It focuses on procedures for evaluating the initial and continued operational competency of ATSEP.

2.4.2 Assessors ensure that competency standards and safety are maintained. They may have to comment and take action on the competency of colleagues and friends. This is challenging and requires professional and personal integrity.

2.4.3 Through this course, trainees will learn the rationale, initial knowledge, skills and techniques for the role of competency assessor as well as how to use practical and oral assessments to determine if a trainee achieved competence. Such a course should help the assessors fulfil their jobs, but also help the administration to establish the required infrastructure in order to meet the regulatory requirements.

2.4.4 Programme outline:

a) role and task of assessor;

b) international, regional and local safety regulatory requirement;

c) concept of assessment;

d) human factors affecting assessment;

e) the oral part of the assessment and the interview scenario;

f) the practical part of the assessment process and work on equipment;

g) assessment for competency;

h) maintenance of competency;

i) competency assessment debriefing; and

j) exercises in practical and oral assessment.

3. ENGINEERING ATSEP – INSTALLATION

Most States have regulatory requirements for ensuring that CNS/ATM systems and equipment are analysed and installed by qualified ATSEP. Generally, ANSPs create a distinct group of specialized ATSEP who are responsible for the engineering and the installation of all CNS/ATM systems and equipment.

3.1 Installation engineering

3.1.1 The training objectives of this module are generic and target ATSEP involved in the first part of the life cycle (Chapter 1, 1.2.2). This module should be developed, implemented and delivered in compliance with ATSEP activities and profile, and in accordance with approved local and/or national standards and procedures.

3.1.2 In a given situation, the engineering ATSEP shall be able to:

a) demonstrate the ability to identify operational needs;

b) interpret the needs and translate them into specifications;

c) use results to discuss with industry representatives;

d) discuss appropriate solutions; and

e) appraise commercial off-the-shelf products provided by industry.

3.1.3 Standard of accomplishment:

a) should include all the main points of the given situation; and

b) should be performed in accordance with approved standards and procedures.

3.2 Installation design

3.2.1 The training objectives of this module are generic and target ATSEP involved in installation design. This module should be developed, implemented and delivered in compliance with ATSEP activities and profile, and in accordance with approved standards and requirements.

3.2.2 In a given situation, the engineering or installation ATSEP shall be able to:

a) demonstrate the ability to manage a project;

b) comply with performance requirements;

c) comply with an integrated management system (safety and quality);

d) use competencies in system engineering;

e) design new electronics systems, equipment or parts of them;

f) respect delays and costs;

g) comply with development requirements and regulations; and

h) take into account sustainable development.

3.2.3 Standard of accomplishment:

a) should include all the main points of the given situation; and

b) should be performed in accordance with approved standards and procedures.

3.3 Installation validation and testing

3.3.1 The training objectives of this module are generic and target those ATSEP involved in testing of the system or equipment at the final stage of the life cycle. This module should be developed, implemented and delivered in compliance with ATSEP activities and profile, and in accordance with approved local and/or national standards and procedures.

3.3.2 ANSPs are responsible for on-site testing activities since they are also responsible for the operations of their CNS/ATM systems and equipment. The ATSEP responsible for testing must have in-depth knowledge of technical systems and strong system engineering skills.

3.3.3 These ATSEP should:

a) develop testing strategies tailored to the system and to its future use in the operational environment, including the development of testing objectives, the verification against technical, safety and regulatory requirements, and the plan and resources required for testing (i.e. steps, staff, and technical means). Note that this activity should take into account the distribution of responsibilities between the supplier(s) and the ANSP;

b) develop detailed test documents in line with the testing strategy, including a clear link between the tests and the requirements. These test documents list the technical actions to be done and the resulting observations. These documents must be developed in such a manner as to collect evidence against the requirements to be met;

c) implement a dedicated testing management plan to manage the testing process;

d) conduct the testing programme;

e) carry out tests;

f) report results and conclusions to management, the engineering services, the supplier(s) and the operational and technical services; and

g) design a testing strategy dedicated to the transition phase, in order to demonstrate the capability of the ANSP to put the future system into operation safely, and execute this strategy in close cooperation with the operational staff.

3.3.4 For a given testing situation, the ATSEP shall be able to:

a) describe clearly the system to be tested: what part of the system is under testing, what are the external interfaces;

b) identify the relevant technical, safety and regulatory requirements pertaining to the system to be tested;

c) develop a relevant testing strategy;

d) propose the technical and organizational processes to ensure a sound cooperation of all stakeholders involved into the testing activities; and

e) demonstrate the ability to manage a project.

3.3.5 Standard of accomplishment:

a) should include all the main points of the given situation; and

b) should be performed in accordance with approved standards and procedures.

3.4 Installation — deployment

3.4.1 The training objectives of this module are generic and target those ATSEP involved in the final stage of the life cycle (See Chapter 1, 1.2.2). This module should be developed, implemented and delivered in compliance with ATSEP activities and profile, and in accordance with approved local and national standards and procedures.

3.4.2 The deployment phase must be managed as a specific project, with its own constraints and goals. ATSEP should manage deployment bearing in mind the safety and operations of the target environment. The goal of deployment is to deliver a “ready for tests” system to teams responsible for its verification in the operational environment.

3.4.3 ATSEP should:

a) define the location of the system;

b) produce blue-prints, plans, and drawings of the future system in its operational environment;

c) develop the deployment plan including a description of the technical tasks (energy, air conditioning, supply, wiring, etc.), staff and resources required;

d) conduct the deployment programme;

e) carry out technical activities;

f) check installation; and

g) report results and conclusions.

3.4.4 For a given deployment situation, the ATSEP shall be able to:

a) describe clearly the system to be deployed;

b) identify all the constraints to be taken into account in the course of the deployment (including operational constraints);

c) identify all the activities and the overall rationale, milestones, dependencies;

d) develop a relevant deployment plan;

e) propose the technical and organizational processes to ensure a sound cooperation of all stakeholders involved in the deployment activities (i.e. progress meetings…); and

f) demonstrate the ability to manage a project.

3.4.5 Standard of accomplishment:

a) all the descriptions should include the essential points of the given situation; and

b) all work should be performed as per the approved standards and procedures.

4 QUALITY, SAFETY AND SECURITY ATSEP MANAGER

Installation, operation and maintenance activities are related to the management of quality (customer-oriented), safety (goods and person-oriented) and security (integrity and protection against attacks).

4.1 Generic training objective

4.1.1 This module provides generic objectives for training of quality, safety and/or security management. This module should be developed, implemented and delivered in compliance with the ATSEP activities and profile, and in accordance with the local environment and duties. ATSEP should:

a) in a technical service, apply and manage the ANSP’s policies on quality, safety and/or security; or

b) apply quality, safety and/or security policies in installation, operation and maintenance activities.

4.1.2 In a local context and environment, the quality, safety and/or security ATSEP manager shall be able to:

a) demonstrate communication abilities;

b) design quality, safety and/or security procedures related to ATSEP activities;

c) apply quality, safety and/or security policies deployed by the ANSP; and

d) promote quality, safety and/or security.

4.1.3 Standard of accomplishment:

a) all the descriptions should include the essential points of the given situation; and

b) all work should be performed in accordance with approved standards and procedures.

4.1.4 All training objectives below assume that trainees have access to the relevant reference material.

4.2 Training objective for safety ATSEP manager

4.2.1 The trainee will describe the functions in ANSP operations and responsibilities, as follows:

a) explain the purpose of safety management;

b) explain the purpose of ICAO documents Annex 19 — *Safety Management* and the *Safety Management Manual (SMM)* (Doc 9859);

c) describe the relationship between the ANSP and the Civil Aviation Authority;

d) describe the purpose of the regulations;

e) describe the importance of safety procedures;

f) describe CNS/ATM services; and

g) relate technical activities to operation activities.

4.2.2 The trainee will prepare audit activities, as follows:

a) explain safety standards;

b) interpret local, national and international documentation; and

c) explain audit reference.

4.2.3 The trainee will describe CNS/ATM systems environment, as follows:

a) describe local technical environment;

b) explain CNS/ATM services to ATCOs and pilots;

c) explain the importance of the availability and integrity of the information delivered to the ATCO and pilot in the safety chain;

d) explain the potential risks to safety due to installation, operation and/or maintenance activities on CNS/ATM systems; and

e) explain the impact on safety in consequence of a lack of availability or integrity of information delivered to the ATCO and pilot.

4.2.4 The trainee will apply safety regulation, as follows:

a) appraise the safety impact from installation, operation and/or maintenance activity on a CNS/ATM system and/or equipment;

b) measure the risk and the impact on the safety aspect of any action undertaken on a CNS/ATM system and/or equipment;

c) propose organizational action in order to mitigate the risk during installation, operation and/or maintenance action on a CNS/ATM system and/or equipment;

d) apply appropriate mitigation tools and/or procedure during installation, operation and/or maintenance actions;

e) report appropriate results and comments after installation, operation and/or maintenance actions; and

f) promote safety.

4.3 Training objective for quality ATSEP manager

4.3.1 The trainee will describe the functions in ANSP operations and responsibilities, as follows:

a) explain the purpose of quality management;

b) describe the relationship between the ANSP and its customers (operators, stakeholders, passengers);

c) describe the relationship between the technical service and its customers (ATCO, pilots, ANS provider, airport authority, other stakeholders);

d) describe the importance of quality, safety and/or security procedures; and

e) describe CNS/ATM services.

4.3.2 The trainee will prepare audit activities, as follows:

a) describe quality, safety and/or security standards;

b) interpret documentation; and

c) apply audit referential.

4.3.3 The trainee will describe CNS/ATM systems environment:

a) describe the local technical environment.

4.3.4 The trainee will apply safety regulations, as follows:

a) appraise the safety impact concerning installation, operation and/or maintenance activity on CNS/ATM system and/or equipment;

b) measure the risk and the impact on safety aspect of any action undertaken on a CNS/ATM system and/or equipment;

c) propose organizational action in order to mitigate the risk during installation, operation and/or maintenance action on a CNS/ATM system and/or equipment;

d) apply appropriate mitigation tools and/or procedure during installation, operation and/or maintenance actions;

e) report appropriate results and comments after installation, operation and/or maintenance actions; and

f) promote safety.

4.4 Training objectives for security ATSEP manager

4.4.1 This module addresses the activities of an ATSEP manager dealing with security. These ATSEP are concerned with network security and measures to protect the integrity of data-processing systems against cyber-attacks.

4.4.2 Trainees will describe the functions in ANSP operations and responsibilities, as follows:

a) describe the relationship between the ANSP and the airport authority;

b) describe the relationship between the ANSP and security forces authorities (police, customs);

c) describe the purpose of the local and/or national regulations;

d) describe the importance of security procedures;

e) explain local information security system policy; and

f) describe CNS/ATM services.

4.4.3 Trainees will take into account external providers:

a) describe the relationship between the ANSP and external providers such as telecom providers, sub-contractors;

b) describe the relationship between the ANSP and security forces authorities (police, customs);

c) describe the purpose of the local and/or national regulations;

d) describe the importance of security procedures;

e) explain local information security system policy; and

f) describe CNS/ATM services.

4.4.4 Trainees will prepare audit activities:

a) describe security standards;

b) interpret documentation; and

c) apply audit referential.

4.4.5 Trainees will describe CNS/ATM systems environment:

a) describe the local technical environment; and

b) explain the risks of security breach using any type of connection on CNS/ATM system and/or equipment.

4.4.6 Trainees will apply security regulation, as follows:

a) appraise the security impact from installation, operation and/or maintenance activity on a CNS/ATM system and/or equipment;

b) measure the risk and impact on security aspect of any action undertaken on a CNS/ATM system and/or equipment;

c) propose organizational action in order to mitigate the risk during installation, operation and/or maintenance action on a CNS/ATM system and/or equipment;

d) apply appropriate mitigation tools and/or procedure during installation, operation and/or maintenance actions;

e) report appropriate results and comments after installation, operation and/or maintenance actions; and

f) promote security.

4.5 ATSEP team manager

4.5.1 ATSEP teams involved in installation, operation and maintenance activities are usually managed by one member who has been promoted out of their ranks. This module provides generic objectives for training of team managers. This module should be developed, implemented and delivered in compliance with the ATSEP activities and profile and in accordance with the local environment and duties. The ATSEP should manage people and a team in accordance with their status, job description, activities, profile and certifications. The manager should:

a) comply with local, national and/or international regulations;

b) take into account quality, safety and security policies and/or regulation on installation, operation and maintenance activities; and

c) take into account human factors.

4.5.2 In a local context and environment, the ATSEP team manager shall be able to:

a) demonstrate communication abilities;

b) organize ATSEP activities according to the staff's qualifications and certifications;

c) organize ATSEP team activities according to operational needs and applicable regulations;

d) communicate and report to stakeholders; and

e) solve personal conflicts.

4.5.3 Standard of accomplishment:

a) all the descriptions should include the essential points of the given situation; and

b) all work should be performed as per the approved standards and procedures.

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