ICAO

Doc 10057

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

Second Edition, 2020

Approved by and published under the authority of the Secretary General

INTERNATIONAL CIVIL AVIATION ORGANIZATION

ICAO

Doc 10057

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

Second Edition, 2020

Approved by and published under the authority of the Secretary General

INTERNATIONAL CIVIL AVIATION ORGANIZATION

Published in separate English, Arabic, Chinese, French, Russian
and Spanish editions by the
INTERNATIONAL CIVIL AVIATION ORGANIZATION
999 Robert-Bourassa Boulevard, Montréal, Quebec, Canada H3C 5H7

For ordering information and for a complete listing of sales agents
and booksellers, please go to the ICAO website at www.icao.int

Second edition, 2020

Doc 10057, ***Manual on Air Traffic Safety Electronics Personnel (ATSEP) Competency-based Training and Assessment***
Order Number: 10057
ISBN 978-92-9258-942-4

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

TABLE OF CONTENTS

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
International Civil Aviation Organization
999 Robert-Bourassa Boulevard
Montréal, Québec Canada H3C 5H7

GLOSSARY

DEFINITIONS

Activities. A group of related tasks.

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 standard. A level of performance that is defined as acceptable when assessing whether or not competency has been achieved.

Conditions. Anything that may qualify a specific environment in which performance will be demonstrated.

Observable behaviour (OB). A single role-related behaviour that can be observed and may or may not be measurable.

Performance criteria. Statements used to assess whether the required levels of performance have been achieved for a competency. A performance criterion consists of an observable behaviour, condition(s) and a competency standard.

Task. Any action that is performed with a particular objective, in support of a defined activity.

Unit training. Training that addresses theoretical and practical issues from equipment-specific and/or site-specific perspectives. It includes on-the-job training.

ACRONYMS

The following abbreviations are used in this document:

ACC	area control centre
ADDIE	analyse, design, develop, implement and evaluate
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
ASR	airport surveillance radar
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
OB	observable behaviour
OJT	on-the-job training
PO	position operation
PSR	primary surveillance radar
QMS	quality management system
RF	radio frequency
RR	release and restoration
R/T	receiver/transmitter
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
SUR	surveillance
TFI	technical flight inspector
TRM	team resource management
UAC	upper area control centre
UAT	universal access transceiver
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)

———————

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 Scope of ATSEP activities

1.2.2.1 ATSEP may perform activities on a wide variety of CNS/ATM systems and equipment requiring a wide range of competencies, expertise, knowledge and skills in disciplines such as electronics, computer sciences and networks.

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.

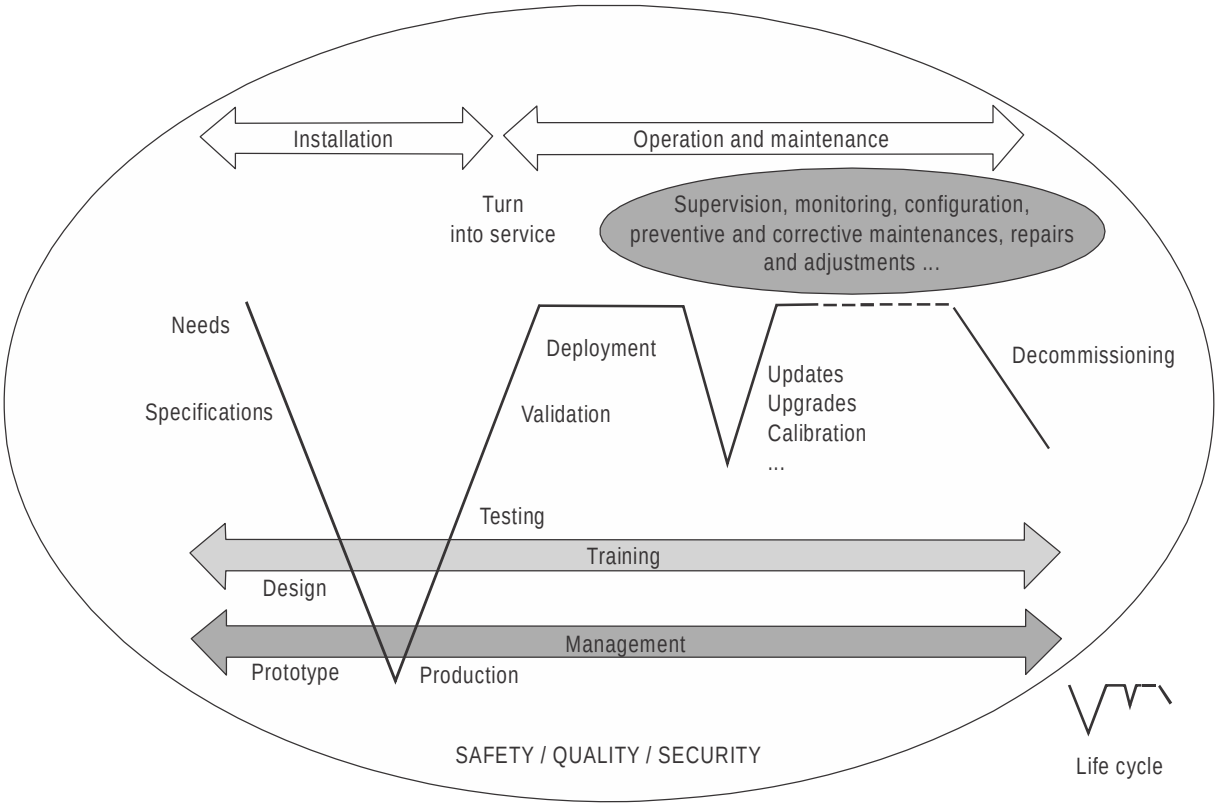

Figure 1-1. Scope of ATSEP activities

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 profiles 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 tasks and with an eye to future tasks. Training programmes should be focused on the specific tasks assigned to ATSEP within an ANSP.

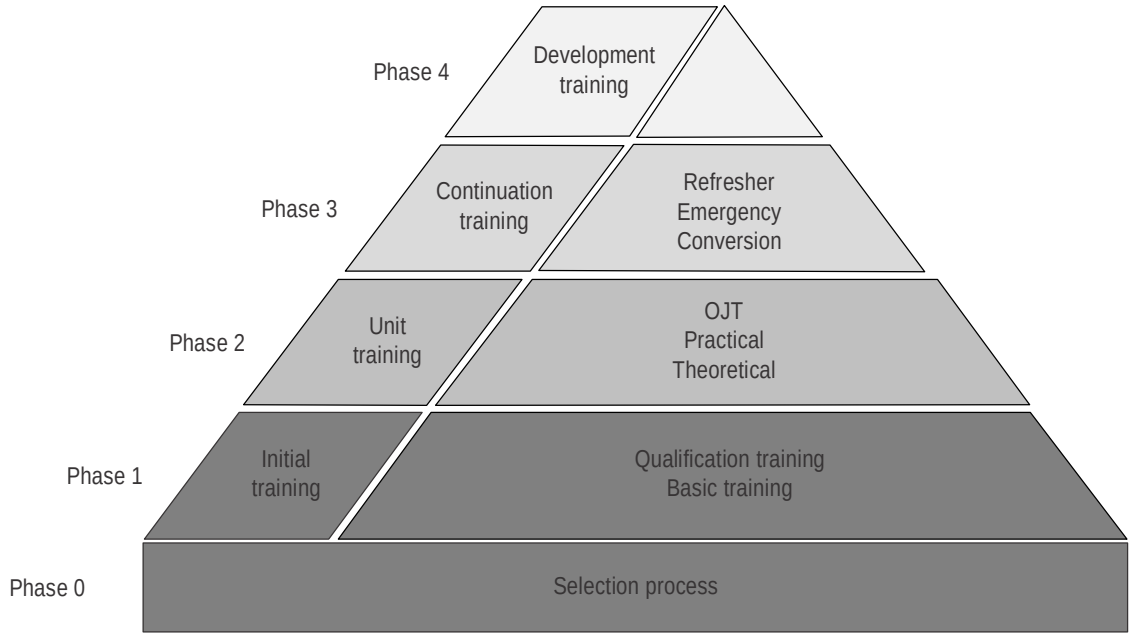

Figure 1-2. ATSEP training phases

1.3 ATSEP TRAINING PHASES

1.3.1 It is recommended that ATSEP training be organized in the phases illustrated in Figure 1-2, which will also facilitate global standardization for ATSEP training. The phases are outlined as follows:

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 tasks 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.

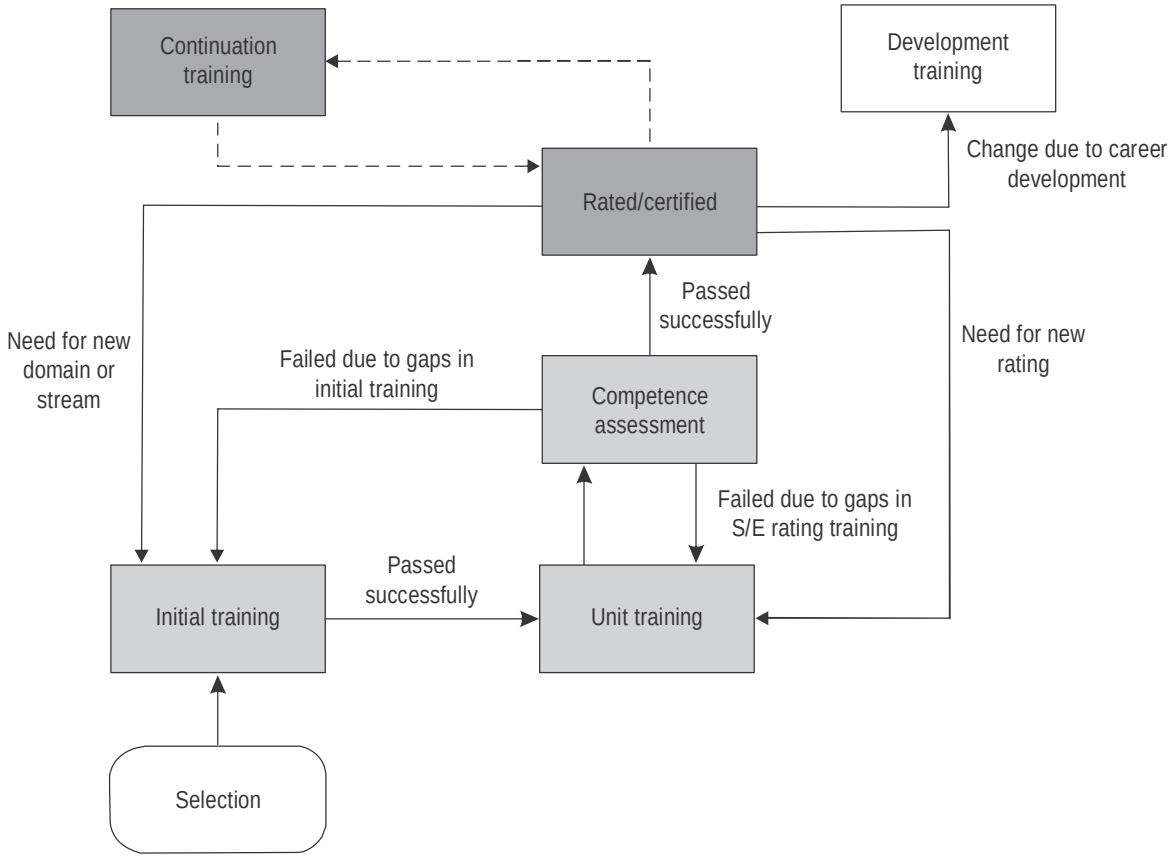

Figure 1-3. ATSEP training progression

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. It makes use of the ICAO competency framework and the analyse, design, develop, implement and evaluate (ADDIE) model.

2.1.2 The aim of competency-based training and assessment is to provide a competent workforce for the provision of safe and efficient CNS/ATM engineering ATSEP services. To achieve this, various components are necessary. They are listed in Table 2-1:

Table 2-1. Components of a competency-based training and assessment programme

Component	*Description*
Training specification	The document that describes the purpose of the training, the task list and the requirements that must be fulfilled when designing the training.
Adapted competency model	A group of competencies with their associated descriptions, and performance criteria adapted from an ICAO competency framework that an organization uses to develop competency-based training and assessment for a given role. The components of an adapted competency model are: • competencies: the competencies that are required to be achieved by the end of training; • performance criteria: statements used to assess whether the required levels of performance have been achieved for a competency. A performance criterion consists of an observable behaviour (OB), condition(s) and a competency standard.
Assessment plan	The document that details the assessment events and tools (evidence guide, competency checklist, competency assessment form) that will be used to determine if competence has been achieved.
Training plan	The document used for structuring, developing and delivering the training.
Training and assessment materials	All the materials used to deliver the training in accordance with the training plan. These may include the course programme, training notes, manuals, presentations and simulated exercises.

2.2 PREREQUISITES: ATSEP SCOPE, PROFILES AND TASKS IN AN ORGANIZATION

2.2.1 A prerequisite for developing a competency-based training and assessment programme for ATSEP is to deconstruct the ATSEP scope and tasks as described in section 1.2. In this process, an ANSP should:

a) define the scope of ATSEP in its organization (paragraph 1.2.2.3 refers);

b) create job profiles (1.2.2.6 (optional) refers); and

c) identify ATSEP tasks (1.2.2.6 refers).

2.2.2 Scoping ATSEP in the organization is described in section 1.2. Scoping needs to be documented as a starting point for establishing a competency-based training and assessment programme.

2.2.3 The nature and distribution of job profiles are determined by the needs and requirements of the ANSPs. In small ANSPs,[1] there may be a single ATSEP profile, while in large ANSPs there may be several ATSEP profiles. An ANSP may also choose not to create job profiles and identify ATSEP tasks directly.

2.2.4 Tasks can be derived from operations manuals, equipment manuals and/or manufacturers' documentation, if available. Also, best practices and other sources may serve for the identification of ATSEP tasks.

2.2.5 The deconstruction of the scope of ATSEP in the organization by means of job profiles and/or tasks depends on the organizational structure and processes of the individual ANSP (e.g. the size of the ANSP, work distribution, and work organization within the ANSP or relevant national rules and regulations). Thus, it is the ANSP that must define these structures. In this process, the ANSP must ensure that the combination of all job profiles and/or tasks fully defines the scope of ATSEP in its organization.

2.2.6 An example of an ATSEP job profile, including tasks, is given in Table 2.2.

Table 2-2. Example of an ATSEP job profile, including tasks

Job profile	
Item	*Description*
Job title	System monitoring and control (SMC) ATSEP at regional airport ABC
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 a bachelor's degree in engineering with initial job experience
General nature of the job	Responsible execution of activities for the supervision, monitoring and configuration of the related equipment
Key responsibilities	• Operational availability of the related equipment • Compliance with regulatory requirements • Compliance with internal procedures

1. See Appendix A, Example 1.

Job profile	
Item	*Description*
List of tasks	a) Monitors, operates, controls and checks relevant equipment b) Releases from and returns into operations ATS/CNS systems c) Documents activities in electronic log d) Reconfigures equipment e) Triggers external support (e.g. from the manufacturer), if needed f) Supports maintenance activities carried out by third parties g) Takes care of own qualification and currency

2.3 ADDIE MODEL WORKFLOWS

2.3.1 This section builds on the prerequisites detailed in section 2.2 and focuses on the application of the ADDIE model. The remainder of this chapter provides guidance to ANSPs and training organizations on five steps, or "workflows", that serve as the basis for developing an ATSEP competency-based training and assessment programme. The five workflows are as follows:

a) Workflow 1 — *Analyse* training needs;

b) Workflow 2 — *Design* local competency-based training and assessment;

c) Workflow 3 — *Develop* the training and assessment materials;

d) Workflow 4 — *Implement* the course in accordance with the training and assessment plans; and

e) Workflow 5 — *Evaluate* the course, including the training and assessment plans.

2.3.2 Appendix A provides detailed examples of these workflows for two different fictitious ANSPs.

2.3.3 The first two workflows, *analyse* (analyse training needs) and *design* (design local competency-based training and assessment), establish the training specification, adapted competency model, assessment plan and training plan used to *develop* and *implement* the training course (Workflows 3 and 4). The *evaluate* workflow (evaluate the course, including the training and assessment plans) reviews the effectiveness of the training and assessment conducted and recommends improvements, as appropriate.

2.3.4 This chapter focuses primarily on the *analyse* and *design* workflows. An overview of the remaining workflows is also provided (see sections 2.6, 2.7 and 2.8) to highlight important issues directly related to competency-based training and assessment.

2.3.5 A stepped approach is used for the *analyse* and *design* workflows and details:

a) the inputs required;

b) the process to be worked through; and

c) the outputs achieved on completion of each process.

It should be noted that the output of the *analyse* workflow becomes one of the inputs for the *design* workflow.

2.4 WORKFLOW 1 — ANALYSE TRAINING NEEDS

2.4.1 The need to develop training may be established in various ways; however, the training designer typically receives some form of training request that provides details on what should be trained and why it is necessary.

2.4.2 The first step in developing a competency-based training and assessment programme is to conduct a training needs analysis in which the purpose of the training is considered in relation to the operational, technical, regulatory and organizational requirements of the ATSEP training course that will eventually be delivered. This must be based on the identified tasks of the individuals who will undergo the training (see section 2.2). The outcome of Workflow 1 is a training specification that details the requirements that need to be fulfilled when designing the course.

2.4.3 The training specification should provide sufficient detail to answer the questions listed in Table 2-3.

Table 2-3. Information to be included in the training specification

Purpose	
What is the purpose of the training?	This is taken directly from the training request. There is considerable variation in the amount of detail that is provided in a training request, but typically it will indicate the purpose of the training as a minimum.
State the phase(s) of training.	Initial, unit, continuation and development training.
What qualification, if any, will the trainee achieve on successful completion of the training?	In some instances, a formal qualification will be achieved at the end of the training (e.g. in-depth or second-level maintenance on system ABC). In other instances, this may not be the case (e.g. after routine refresher or conversion training).
Tasks	
Describe the tasks associated with the purpose of the training.	For the purposes of defining the training specification, only a task list is required. This task list may be extracted from a completed job and task analysis, or may be taken from the operations manual that has listed the various roles and responsibilities in the operations environment. In some instances, this task list may need to be developed (see section 2.2 for more information).
Operational requirements	
Which operational procedures will be applied?	In the case of unit training, this refers to the local operating documentation (e.g. manual of engineering, local operating procedures, letters of agreement). In the case of initial training, the local operating documentation may not apply at this stage, but will be introduced later during the unit training phase. For the purposes of the training specification, the source documents that will be used for developing these procedures should be listed (e.g. ICAO Annex 10 — *Aeronautical Telecommunications*).
Describe the operational environment in which the training will take place.	Training may take place in a simulated environment, for example a training laboratory or facility. This environment must be properly designed and documented to ensure that it sufficiently re-creates the real-world environment and serves the purpose of the training. If the training is to take place in a real operational environment, it is sufficient to reference the operational

	documentation that describes the environment.
Which non-routine situations are necessary for successful completion of the training?	These could include emergency or unusual situations or degraded modes of operation.
Technical requirements	
List any specific operational (or simulated operation) systems and/or equipment that are necessary to achieve the purpose of the training.	These could include primary and secondary systems, peripheral systems and interface with the primary system.
Regulatory requirements	
Which rules and regulations are applicable?	These may include international, regional or national regulations. This information is recorded in the training specification to ensure that rules and regulations are taken into consideration during the training design. Typical regulatory requirements may include the minimum number of hours of experience in the operational environment under supervision, the minimum list of knowledge subjects to be covered, etc. Consideration should be given to whether any regulatory requirements affect the following aspects of the training design: a) duration; b) content; c) assessment procedures; d) course approval; or e) other (equipment, qualifications of instructors, trainee-to-instructor ratios, etc.).
Organizational requirements	
Describe any organizational requirements that may impact the training.	In some instances, an organization may wish to achieve additional objectives that are required to be included or emphasized in the training (e.g. strategic objectives such as reducing delays or increasing customer focus).
Other requirements	
Describe any other requirements that may impact the training.	This question captures any other requirements that may not have been covered in the previous questions (e.g. two languages to be used).

2.5 WORKFLOW 2 — DESIGN LOCAL COMPETENCY-BASED TRAINING AND ASSESSMENT

2.5.1 The objectives of Workflow 2 are: to establish an adapted competency model that addresses the training specification identified in Workflow 1; design an assessment plan that will be used to assess the competence of trainees; and design a training plan that will enable the development and delivery of the training course. It can be considered in two parts:

Part 1: Designing the adapted competency model

2.5.2 To design an adapted competency model, ICAO's ATSEP competency framework is adapted to meet the organizational competency requirements using the information contained in the training specification developed in Workflow 1.

2.5.3 ANSPs and training organizations can find ICAO's ATSEP competency framework in the PANS-TRG and should use it as a starting point and reference for this workflow. ICAO's competency framework should be adapted to the ATSEP tasks identified by the ANSP. These are structured in terms of competencies, competency descriptions and observable behaviours. See Appendix A for detailed examples. Adaptation may comprise of using, enhancing, changing or omitting elements of ICAO's competency framework at all levels, and should relate clearly to the local environment of the ANSP. For every ATSEP task, the competencies necessary to perform the task should be specified.

2.5.4 The competency standards must then be determined. Competency standards apply to all observable behaviours and relate to the standards, procedures, rules and regulations contained in national regulations, operations manuals, policies, procedures manuals and other documents.

2.5.5 Finally, the training specification developed in Workflow 1 is used to identify conditions specific to the environment in which performance will be demonstrated. These conditions relate to the nature and complexity of the operational and environmental context, tools, systems or equipment, and the amount of support or assistance a trainee can expect from the instructor/assessor. Conditions include:

a) whether the performance takes place in an offline/simulated or live operational environment;

b) the complexity of the system used for the training;

c) the use of artificially generated distractions;

d) the intentional use of erroneous data;

e) more active coaching or teaching provided by instructors to trainees at early stages of training; and

f) an approach whereby instructors adopt a more passive role, giving occasional advice on how to improve efficiency or intervening in instances where safety may be compromised, if trainees are progressing towards the final competency standard and are gaining confidence in performing independently.

2.5.6 Most of the conditions will apply generally to all of the observable behaviours that have been identified as part of the adapted competency model. However, in very few instances, specific conditions may be associated with some observable behaviours. As part of the progression towards the final competency standard, it may be necessary to establish interim competency standards. The way in which the conditions are modified to establish interim competency standards is covered in Appendix A.

2.5.7 Once part 1 of Workflow 2 is completed, ANSPs and training organizations will have identified and adapted the relevant competencies and observable behaviours required for the ATSEP to perform their tasks, and established the performance criteria used to assess whether the required levels of performance have been achieved. With all of these elements, the ANSPs will have a clear view of what competencies the ATSEP should demonstrate in the operational environment.

Part 2: Designing the assessment and training plans

Issues to consider before developing assessment and training plans

2.5.8 Part 2 of Workflow 2 includes the design of the assessment and training plans. When developing the assessment and training plans, it is important to consider the principles of competency-based training, typical assessment methods, the concept of milestones and final and interim competency standards. The relationship between the adapted competency model and the training and assessment plans should also be understood (see section 4.3). At the completion of this step, ANSPs and training organizations will have developed a training plan based on the tasks as well as an assessment plan based on the performance criteria identified previously.

2.5.9 An assessment and training plan for each ATSEP job profile should be developed.

2.5.10 Table 2-4 describes the principles that should drive competency-based assessments.

Table 2-4. Principles of competency-based assessments

Clear performance criteria are used to assess competence.	The adapted competency model establishes these performance criteria.
An integrated performance of the competencies is observed.	The trainee undergoing assessment must demonstrate all competencies and their seamless interaction with each other.
Multiple observations are undertaken.	To determine whether or not a trainee has achieved the interim and/or final competency standard, multiple observations must be carried out.
Assessments are valid.	All of the components that comprise the adapted competency model must be assessed. There must be sufficient evidence to ensure that the trainee meets the competency specified by the interim and/or final competency standard. The trainee must not be asked to provide evidence for, or be assessed against, activities that are outside the scope of the adapted competency model.
Assessments are reliable.	All assessors should reach the same conclusion when performing an assessment. All assessors should be trained and monitored to achieve and maintain an acceptable level of inter-rater reliability.

Assessment methods

2.5.11 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.

2.5.12 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.

2.5.13 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 knowledge, skills or 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.

2.5.14 A checklist may be 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. The assessment outcome is *competent* or *not competent* for the assessment undertaken.

2.5.15 An evidence guide provides practical examples of what can be observed for a given competency and performance criteria in certain conditions. The evidence guide also provides the criteria for assessment for the interim or final competency standard. It ensures that instructors and assessors interpret performance criteria consistently and that valid and reliable evidence is gathered. In addition, the evidence guide can be used as a checklist to document the training progression. Appendix A provides an example of an evidence guide.

2.5.16 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. Each assessment method can be applied using a formative or summative approach. Possible assessment methods are:

a) multiple choice questionnaire;

b) written and/or oral examination;

c) practical examination (demonstration);

d) examination on position; and

e) examination in simulation.

2.5.17 This list of methods is not intended to be restrictive. Any suitable supplemental method for assessing competence may be used. Other methods may include projects and group assignments.

2.5.18 The assessment method should take into account the taxonomy level related to the training objective. The taxonomy levels are described in Appendix C.

Assessment plan

2.5.19 The purpose of the assessment plan is to detail how competence is going to be determined. 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 (if applicable);

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

c) the list of assessments (formative and summative assessments, examinations, oral assessments, etc.) required for each defined milestone;

d) the timing of the assessments;

e) the tools to be used to collect evidence during practical assessment;

f) the pass marks for projects, examinations or oral assessments;

g) if required, the minimum number of formative assessments to be undertaken prior to starting summative assessments; and

h) the number of observations required to assess performance for the interim and final competency standard.

2.5.20 For ATSEP, competency-based assessment does not fully apply to initial training modules, which usually provide training for knowledge and skills only. Therefore, a competency cannot be assessed until the training is conducted at a unit level, where competencies can be observed. When assessing knowledge and skills during initial training, the relevant parts of the assessment plan must be documented.

2.5.21 ANSPs or training organizations should have 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 competency standard(s) of the assessment.

Training plan

2.5.22 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) the composition and structure of the training course;

b) the syllabus;

c) the milestones (if required);

d) the modules, training events and their delivery sequence; and

e) the course schedule.

Note.— Comparable terminology may be used in practice; for example, "lesson" can be used for a training event, "subject" can be used for a module, and a number of subjects can constitute a "training course".

2.5.23 Depending on the number, type and complexity of the training objectives, it may be helpful to further subdivide the training plan into modules (within an entire course or within all or some milestones, if milestones are required).

2.5.24 Whichever substructure is determined as appropriate (course, milestones or modules), training events are developed to support the substructure. Training events are the smallest units of learning and may include classroom-based lessons, simulator exercises, web-based training exercises, case studies, etc. Training events should contain the following information:

a) which objectives are grouped and taught together;

b) the number of periods needed to teach each group of objectives;

c) which method(s) should be used (lessons, case studies, individual simulation, briefing, self-study, etc.);

d) which media are used (e.g. simulators, visual aids or textbook);

e) the learning rate (e.g. self-paced, time-restricted or real-time); and

f) whether the training is delivered to individuals or in groups.

2.5.25 The course schedule indicates how the training events and assessments fit together into the total duration of the course.

2.5.26 Recommended basic and qualification training modules are detailed in Appendix B. An ANSP or training organization should use the ATSEP job profile as a starting point and identify which training modules in Appendix B apply (see Chapter 3 for more details). The knowledge and skills acquired through the initial training modules should be clearly linked with the tasks the ATSEP will perform and the competencies they will need to demonstrate on the job.

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

2.5.28 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.

2.5.29 When the duration or the complexity of unit training is such that it makes 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.

2.5.30 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.

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

2.5.32 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). Depending on the nature of the continuation training (e.g. contingency simulations or practical exercises), the structure and elements of the continuation

training plan may vary significantly when compared to a training plan developed for classroom-based continuation training. Chapter 5 contains more information about continuation training.

2.5.33 Regardless of the type of training plan established (basic, qualification, unit, continuation), a process to benchmark, maintain and improve the efficiency and quality of training is required as part of a safety and/or quality management system. 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.

2.6 WORKFLOW 3 — DEVELOP THE TRAINING AND ASSESSMENT MATERIALS

2.6.1 During this workflow, all the training and assessment materials are developed based on the adapted competency model and the training and assessment plans. Training and assessment materials include, but are not limited to, training notes, exercise briefings, practical exercises, case studies, presentations, video clips, self-test quizzes, examinations, assessments and assessment tools. On completion of Workflow 3, the outputs should include all training and assessment materials, schedules and any other applicable training resources.

2.7 WORKFLOW 4 — IMPLEMENT THE COURSE IN ACCORDANCE WITH THE TRAINING AND ASSESSMENT PLANS

2.7.1 Workflow 4 consists of the process of conducting the course in accordance with the training and assessment plans developed in previous workflows.

2.8 WORKFLOW 5 — EVALUATE THE COURSE, INCLUDING THE TRAINING AND ASSESSMENT PLANS

2.8.1 At the end of a training period, feedback regarding on-the-job performance from trainees, instructors, assessors and employers is collected to determine the effectiveness of the course in supporting the progression of learning towards competence in the workplace. This should culminate in a course report. Evaluation of the training and assessment plans may lead to improvements being made to the course.

———————

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 focuses on the components of the qualification training modules. Proposed training objectives for these modules can be found in Appendix B.

3.1.4 The training organization should ensure that ATSEP successfully achieve all basic training objectives before proceeding to the qualification training modules. The training organization should also ensure that ATSEP successfully achieve all relevant qualification training objectives before proceeding to the unit training modules. This can be achieved by:

a) establishing a set of assessment questions associated with each training objective;

b) defining a mechanism to select assessment questions for an individual assessment; and

c) defining a pass mark for the assessment.

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.

International and national organizations and standards

3.2.2 CNS/ATM systems operations are regulated by international organizations that provide rules and standards to ensure the safe operation and interoperability of air navigation services (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 Electronics 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

3.2.3 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

3.2.4 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

3.2.5 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. The training plan should include, 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 Finally, on completion of the qualification training modules, ATSEP should understand the impact of their work on the users and on the overall ANS system.

Communication module

3.3.5 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

3.3.6 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

3.3.7 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.

Data processing/automation module

3.3.8 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

3.3.9 The implementation of CNS/ATM systems and equipment has led to new ways of providing SMC. Most ANSPs have centralized the SMC functions within a geographical area, typically the flight information region (FIR) or the area of responsibility. Many ACCs/upper area control centres (UACs) 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 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.

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.

Engineering module

3.3.12 States may 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 engineers or ATSEP who are responsible for the engineering and the installation of all CNS/ATM systems and equipment.

3.3.13 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 Workflow 2, Part 2, described in Chapter 2, section 2.5, 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 in Workflow 2, Part 1 (Chapter 2, section 2.5).

4.1.3 Unit training addresses theoretical and practical issues specific to the equipment and site of an operations unit. Unit training includes 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 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. The taxonomy levels are described in Appendix C.

4.2.8 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 Workflow 2, Part 1. 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 2-4 in 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 local operational environment that 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 address only 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.

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

4.4.5 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 functionalities 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

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

4.4.7 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.

4.4.8 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.

4.4.9 At the end of this module and in accordance with the ATSEP tasks, the trainee will be able to perform relevant tasks from the following list, depending on the job profile:

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.

4.4.10 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. An 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 2-4 (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 that 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 "management of non-routine situations" competency and the subsequent observable behaviours.

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, cyberattack, 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) roundtable 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 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 competencies.

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 of 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 workflows for developing 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. The purpose of the examples 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.

Prerequisites: ATSEP scope, profiles and tasks in ANSP ABC

Within ANSP ABC, the ATSEP activities are scoped as supervision, monitoring and configuration. Specifically, the ATSEP is designated to work at the regional airport SMALLAIRPORT, servicing a VOR, a DF, an R/T system and an ASR.

Creating the job profile

ANSP ABC creates a job profile containing the key responsibilities and related tasks of the ATSEP, as indicated in Table A-1:

Table A-1. Job profile for ATSEP within ANSP ABC (example)

Job profile	
Item	*Description*
Job title	SMC ATSEP at regional airport ABC
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's degree in engineering with initial job experience

Job profile	
Item	*Description*
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 with regulatory requirements • Compliance with 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

The related job profile for the ATSEP at ANSP ABC can be depicted in the ATSEP scope diagram provided in section 1.2, which is presented here in Figure A-1 (see dotted rectangle):

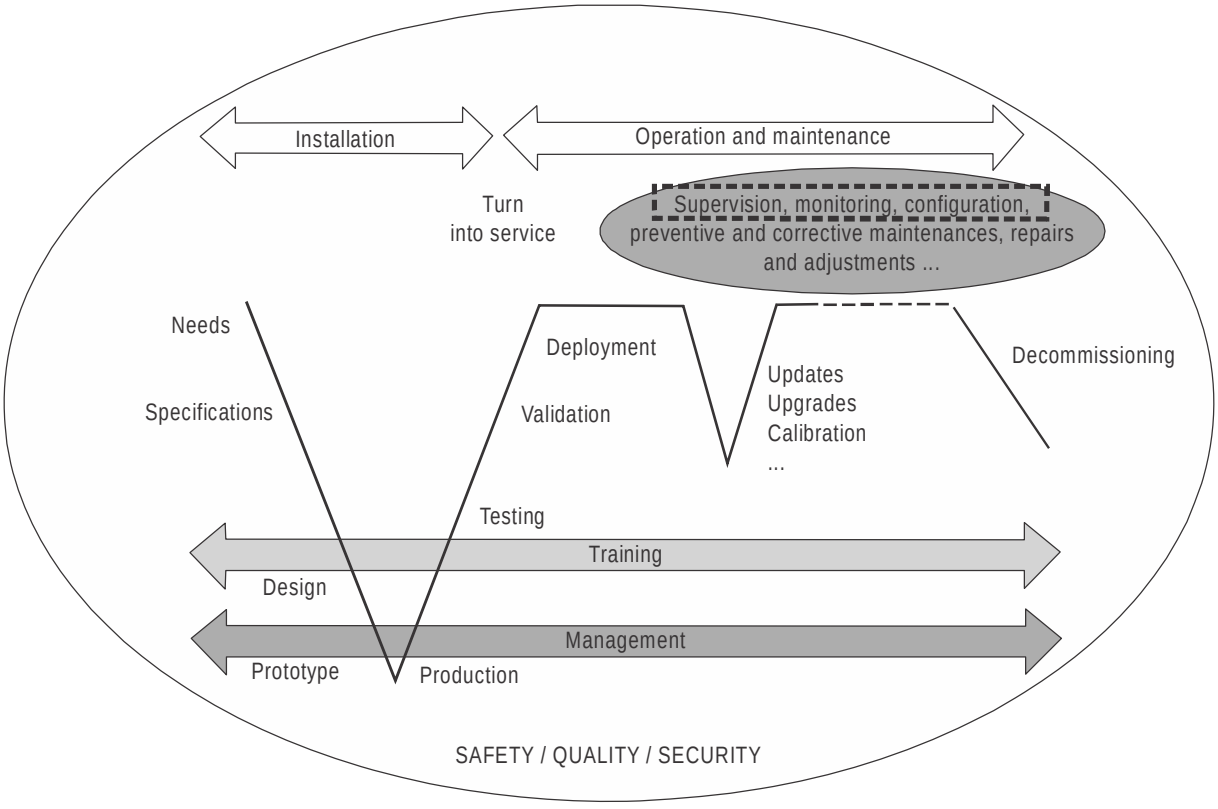

Figure A-1. ATSEP scope within ANSP ABC (example)

Workflow 1 — Analyse training needs

Developing the training specification

Based on the job profile for ATSEP at ANSP ABC, a training request or recognition of required training prompts the development of the training specification presented in Table A-2. This training specification provides the basis for designing the adapted competency model.

Table A-2. Training specification for ATSEP within ANSP ABC (example)

Item	*Description*
Purpose	To ensure a satisfactory level of competence among SMC ATSEP personnel at regional SMALLAIRPORT; to supervise, monitor and configure the related equipment (VOR, DF, R/T system, ASR). Individuals are technicians with four years of previous job experience (minimum) or a bachelor's degree in engineering with initial job experience.
Phases of training	Initial, unit, refresher
End qualification	Current as SMC ATSEP at SMALLAIRPORT
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
Operational requirements	ANSP ABC manuals
Technical requirements	VOR, DF, R/T system, ASR
Regulatory requirements	National regulations ABC/2017 on the provision of ATSEP personnel. ICAO documentation, for example: Annex 10 — *Aeronautical Telecommunications*; *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444); and the *Manual on Testing of Radio Navigation Aids* (Doc 8071).
Organizational requirements	Familiarity with general operations at SMALLAIRPORT
Other requirements	None

Workflow 2, Part 1 — Design the adapted competency model

Identifying the observable behaviours

ANSP ABC associates the ATSEP tasks identified in the training specification (Workflow 1) with the competencies and observable behaviours defined in the PANS-TRG, as indicated in Table A-3:

Table A-3. Observable behaviours for each ATSEP task within ANSP ABC (example)

ATSEP tasks (from the Workflow 1 training specification)	*Competencies and observable behaviours (See Appendix 2 to Chapter 3 of the PANS-TRG [Doc 9868] for the full descriptions of each competency and observable behaviour)*									
	Engineering	*Situational 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 VOR, DF, R/T, ASR systems		2.1 2.2 2.3 2.4 2.5	3.1				7.2 7.7	8.4		
Receive and forward error messages		2.2 2.3	3.2	4.1	5.3 5.4		7.2 7.7			10.2 10.3
Initiate maintenance activities based on error messages received				4.1 4.2	5.3 5.4		7.2 7.7	8.4		
Relate to manufacturer for maintenance activities				4.2	5.3 5.4		7.2 7.7	8.4		10.2 10.3
Inform customers (airport) on status of troubleshooting process				4.2			7.2 7.7			10.2 10.3
Document and report			3.2				7.2 7.7	8.4		

ATSEP tasks (from the Workflow 1 training specification)	*Competencies and observable behaviours (See Appendix 2 to Chapter 3 of the PANS-TRG [Doc 9868] for the full descriptions of each competency and observable behaviour)*									
	Engineering	*Situational awareness*	*Service provision*	*Coordination*	*Management of non-routine situations*	*Problem-solving and decision-making*	*Self-management and continuous learning*	*Workload management*	*Teamwork*	*Communication*
Summary of observable behaviours		*2.1* *2.2* *2.3* *2.4* *2.5*	*3.1* *3.2*	*4.1* *4.2*	*5.3* *5.4*		*7.2* *7.7*	*8.4*		*10.2* *10.3*

Creating the adapted competency model

ANSP ABC adapts the ICAO competency framework for ATSEP as defined in Appendix 2 to Chapter 3, Part IV, of the PANS-TRG, second edition. This is reflected in Table A-4:

Table A-4. Adapted competency model for ATSEP within ANSP ABC (example)

Adapted competency	*Description*	*Performance criteria*			
		OB no.	*Observable behaviour (OB)*	*Competency assessment*	
				Final competency standard	*Condition*
Situational awareness	Comprehends the current status of the ATM system and anticipates future events.	2.1	Monitors the CNS/ATM systems in own area of responsibility and contributing areas as well.	Consistently monitors all systems (VOR, DF, R/T, ASR) and responds in a timely manner with appropriate actions.	In times of low and high alarm rates, and under normal 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.	Independently monitors environmental conditions (weather) and responds with the appropriate actions in own and adjacent areas of responsibility.	In all situations
		2.3	Monitors the relevant elements of the ATC operational situation.	Able to execute the most appropriate action taking into account the operational situation with respect to traffic levels, equipment availability, open sectors and staffing levels.	Independently without oversight
		2.4	Maintains awareness of the people involved in or affected by the operation.	Demonstrates awareness of the people involved in or affected by the operation.	In all activities
		2.5	Obtains information from all available monitoring sources.	Demonstrates awareness of different information sources and obtains information.	From all (relevant) monitoring sources
Service provision	Ensures availability and reliability of CNS/ATM systems and capabilities.	3.1	Uses systems monitoring and diagnostic capabilities effectively.	Demonstrates the ability to interact with all system management tools, using all the features in a safe and consistent manner.	In all situations
		3.2	Evaluates the operational consequences of CNS/ATM system anomalies or failures.	Independently takes appropriate action in response to system anomalies and failures.	In all workload conditions

Adapted competency	*Description*	*Performance criteria*			
		OB no.	*Observable behaviour (OB)*	*Competency assessment*	
				Final competency standard	*Condition*
Coordination	Manages coordination with operational stakeholders and with other affected stakeholders.	4.1	Coordinates effectively with internal stakeholders.	Demonstrates the ability to coordinate effectively with all relevant internal stakeholders in a timely manner.	In all situations
		4.2	Coordinates effectively with external stakeholders.	Demonstrates the ability to coordinate effectively with all relevant external stakeholders in a timely manner.	In all situations
Management of non-routine situations	Detects and responds to emergency and unusual situations related to the ATC operation and/or CNS/ATM systems and capabilities.	5.3	Prioritizes actions based on the urgency of the situation.	Demonstrates adequate prioritization of actions taking into account the urgency of the situation and all relevant options.	In all situations
		5.4	Follows prescribed procedures for responding to non-routine situations.	Demonstrates adherence to prescribed procedures in response to non-routine situations.	In non-routine situations
Self-management and continuous learning	Demonstrates personal attributes that improve performance and maintains an active involvement in self-learning and self-development.	7.2	Improves performance through self-evaluation of the effectiveness of actions.	Demonstrates continuous improvement of performance by always self-evaluating the effectiveness of own activities.	In all activities
		7.7	Participates in learning activities.	Demonstrates organization and continuous participation.	In all planned learning activities
Workload management	Uses available resources to prioritize and perform tasks in an efficient and timely manner.	8.4	Selects appropriate tools, equipment and resources to support the efficient achievement of tasks.	Independently selects appropriate tools, equipment and resources to support the efficient achievement of activities.	In all workload conditions
Communication	Communicates effectively in all situations.	10.2	Speaks clearly, accurately and concisely.	Speaks clearly, accurately and concisely.	In any situation
		10.3	Uses appropriate vocabulary and expressions for communications with stakeholders.	Demonstrates the use of appropriate vocabulary and expressions for communications with stakeholders.	In all workload conditions

Note.— In situations where it is difficult to identify the final competency standard (FCS) directly from the OBs, it may be beneficial to develop an evidence guide, including possible interim competency standards (ICSs), in parallel. An example of an evidence guide for ANSP ABC is provided in the following section.

Workflow 2, Part 2 — Design the assessment and training plans

Assessment plan

Note.— This example is not intended 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.

The assessment plan for unit training is designed based on the performance criteria identified in Table A-4. It details assessment events and tools that will be used to determine if an ATSEP achieves competence during and at the end of unit training.

As part of the progression towards the FCS, it may be necessary to establish ICSs. This is presented in the evidence guide in Table A-5. In this example, no more than two ICSs were identified before achievement of the FCS for each OB. However, there may be situations where an identified OB requires more or less ICSs in the progression towards the FCS. This may be due to specific details of the task, environment, assessment capability or many other reasons determined by the training designer.

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 profile.

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.

Table A-5. Evidence guide for ATSEP within ANSP ABC (example)

C 2 — Situational awareness				
OB		*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.

C 2 — Situational awareness				
OB		*ICS 1*	*ICS 2*	*FCS*
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.
C — Competency OB — Observable behaviour		ICS — Interim competency standard FCS — Final competency standard		

C 3 — Service provision				
OB		*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.
C — Competency OB — Observable behaviour		ICS — Interim competency standard FCS — Final competency standard		

C 4 — Coordination				
OB		*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.
C — Competency OB — Observable behaviour		ICS — Interim competency standard FCS — Final competency standard		

C 5 — Management of non-routine situations				
OB		*ICS 1*	*ICS 2*	*FCS*
5.3	Prioritizes actions based on the urgency of the situation.	Demonstrates prioritization of actions in a mentored session.	Demonstrates prioritization of actions taking into account the urgency of the situation in a 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 a mentored session.	Demonstrates adherence to prescribed procedures in response to non-routine situations.
C — Competency OB — Observable behaviour		ICS — Interim competency standard FCS — Final competency standard		

C 7 — Self-management and continuous learning				
OB		*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.
C — Competency OB — Observable behaviour		ICS — Interim competency standard FCS — Final competency standard		

C 8 — Workload management				
OB		*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.
C — Competency OB — Observable behaviour		ICS — Interim competency standard FCS — Final competency standard		

C 10 — Communication				
OB		*ICS 1*	*ICS 2*	*FCS*
10.2	Speaks clearly, accurately and concisely.	On request, speaks clearly, accurately and concisely.	In standard situations, 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.
C — Competency OB — Observable behaviour		ICS — Interim competency standard FCS — Final competency standard		

Training plan

ANSP ABC associates the ATSEP job objective (defined in Table A-1) with predefined training modules (see Chapter 3), as demonstrated in Table A-6:

Table A-6. Identification of training modules for ATSEP within ANSP ABC (example)

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	

Table A-7 provides an indication of the possible content of the unit training programme based on the ANSP ABC ATSEP job profile (Table A-1 refers). 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.

Table A-7. Training content for ATSEP within ANSP ABC (example)

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 of procedures	Internal	1	Classroom	
Overview of documentation tools	Internal	½	Classroom	

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

Workflow 3 — Develop the training and assessment materials

As indicated in Chapter 2, 2.6.1, the training plan is used to develop the training materials. This example is not intended to provide a comprehensive set of training materials (e.g. 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 or training organization.

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.

Prerequisites*: *ATSEP scope, profiles and tasks in ANSP XYZ

In ANSP XYZ, ATSEP operate alone with full responsibility for their maintenance tasks. They are trained to perform comprehensive tasks in the maintenance of complex surveillance systems and have ultimate responsibility for results. 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.

Creating the job profile

ANSP XYZ creates a job profile containing the key responsibilities and related tasks of the ATSEP, as indicated in Table A-8:

Table A-8. Job profile for ATSEP within ANSP XYZ (example)

Job profile	
Item	*Description*
Job title	In-depth maintenance ATSEP for surveillance systems
Job objective	Perform comprehensive tasks in the maintenance of complex surveillance systems with ultimate responsibility for results
Entry level	Bachelor's degree in engineering with six years of previous job experience (minimum) or master's degree in engineering with initial job experience
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 with regulatory requirements • Compliance with internal procedures

Job profile	
Item	*Description*
List of tasks	a) Troubleshoot the system b) Inspect and conduct in-depth maintenance according to system handbook (manufacturer) c) Maintain hardware and repair fixed components d) Install new software/firmware versions e) Exchange faulty hardware f) Adjust local adaptation data g) Cooperate with relevant partners in the investigation of cross-device errors h) Manage hardware configuration i) Conduct initial turning of systems into service after validation j) Conduct consultation with customers

The related job profile for the ATSEP at ANSP XYZ can be depicted in the ATSEP scope diagram provided in section 1.2. Here, it is presented in Figure A-2 (see dotted rectangle):

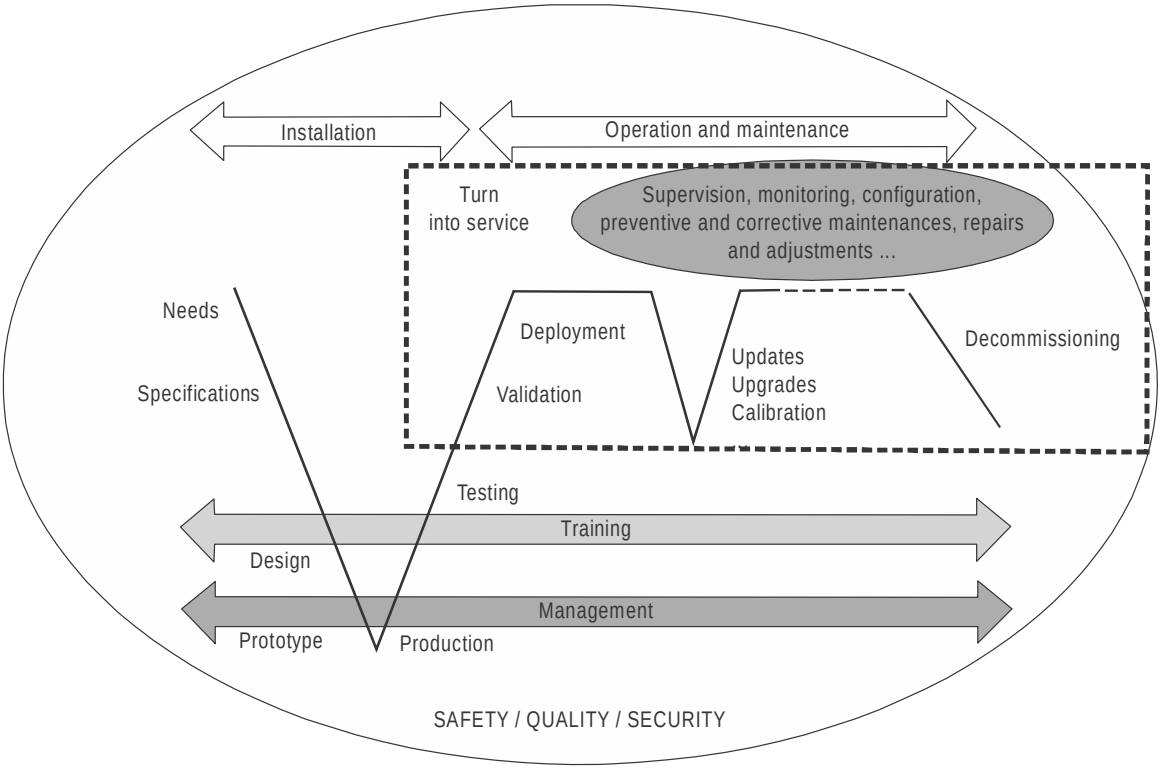

Figure A-2. ATSEP scope within ANSP XYZ (example)

Workflow 1 — Analyse training needs

Developing the training specification

Based on the job profile for ATSEP at ANSP XYZ, a training request or recognition of required training prompts the development of the training specification outlined in Table A-9. This training specification provides the basis for designing the adapted competency model.

Table A-9. Training specification for ATSEP within ANSP XYZ (example)

Item	*Description*
Purpose	To ensure a satisfactory level of competence among in-depth maintenance ATSEP required to perform comprehensive tasks in the maintenance of complex surveillance systems with ultimate responsibility for results. Their role includes self-responsible execution of in-depth maintenance tasks of all levels in the field on Raytheon long range radar, primary and secondary. Individuals will hold a bachelor's degree in engineering with six years of previous job experience (minimum), or a master's degree in engineering with initial job experience.
Phases of training	Initial, unit, refresher
End qualification	Current as ATSEP XYZ
Tasks	a) Monitor the surveillance system b) Reduce primary radar false target rate due to weather conditions c) Conduct fault analysis d) Troubleshoot the system e) Inspect and conduct in-depth maintenance according to system handbook (manufacturer) f) Maintain hardware and repair fixed components g) Install new software/firmware versions h) Exchange faulty hardware i) Adjust local adaptation data j) Cooperate with relevant partners in the investigation of cross-device errors k) Manage hardware configuration l) Conduct initial turning of systems into service after validation m) Conduct consultation with customers
Operational requirements	ANSP XYZ manuals
Technical requirements	Raytheon long range radar, primary and secondary
Regulatory requirements	National regulations ABC/2017 on the provision of ATSEP personnel. ICAO PANS-ATM (Doc 4444) and ICAO Annex 10, Volume II — *Communication Procedures including those with PANS Status*, for standard words and radiotelephony phraseology.
Organizational requirements	Familiarity with general operations of ANSP XYZ
Other requirements	None

Workflow 2, Part 1 — Design the adapted competency model

Identifying the observable behaviours

ANSP XYZ associates the ATSEP tasks identified in the training specification (Workflow 1) with the competencies and observable behaviours defined in Appendix 2 to Chapter 3 in Part IV of the PANS-TRG, second edition, as indicated in Table A-10:

Table A-10. Observable behaviours for each ATSEP task within ANSP XYZ (example)

ATSEP tasks (from the Workflow 1 training specification)	*Competencies and observable behaviours (See Appendix 2 to Chapter 3 of the PANS-TRG [Doc 9868] for the full descriptions of each competency and observable behaviour)*									
	Engineering	*Situational 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 2.4	3.1				7.2 7.6 7.7			
Reduce primary radar false target rate due to weather conditions			3.3				7.2 7.6 7.7	8.4		
Conduct fault analysis	1.10 1.12	2.1 2.2	3.3	4.2	5.6		7.2 7.6 7.7	8.1		
Troubleshoot the system	1.10	2.1 2.2	3.3	4.1 4.2	5.6	6.1 6.2 6.3	7.2 7.6 7.7	8.4		10.2 10.3
Inspect and conduct in-depth maintenance according to system handbook (manufacturer)	1.10	2.1	3.3	4.2	5.6	6.1 6.2 6.3	7.2 7.6 7.7	8.4		

ATSEP tasks (from the Workflow 1 training specification)	*Competencies and observable behaviours (See Appendix 2 to Chapter 3 of the PANS-TRG [Doc 9868] for the full descriptions of each competency and observable behaviour)*									
	Engineering	*Situational awareness*	*Service provision*	*Coordination*	*Management of non-routine situations*	*Problem-solving and decision-making*	*Self-management and continuous learning*	*Workload management*	*Teamwork*	*Communication*
Maintain hardware and repair fixed components		2.1	3.3	4.2	5.6		7.2 7.6 7.7	8.4		
Install new software/firmware versions		2.1	3.3	4.2	5.6		7.2 7.6 7.7	8.4		
Exchange faulty hardware		2.1	3.3	4.2	5.6		7.2 7.6 7.7	8.4		
Adjust local adaptation data				4.2		6.1 6.2	7.2 7.6 7.7	8.4		
Cooperate with relevant partners in the investigation of cross-device errors	1.10 1.12					6.1 6.2 6.3	7.2 7.6 7.7		9.2	10.2 10.3
Manage hardware configuration			3.2				7.2 7.6 7.7	8.4		
Conduct initial turning of systems into service after validation	1.8 1.11	2.1				6.5	7.2 7.6 7.7	8.4	9.2	10.2 10.3
Conduct consultation with customers	1.1 1.4					6.1 6.2				10.1 10.2 10.3

ATSEP tasks (from the Workflow 1 training specification)	Competencies and observable behaviours (See Appendix 2 to Chapter 3 of the PANS-TRG [Doc 9868] for the full descriptions of each competency and observable behaviour)									
	Engineering	Situational awareness	Service provision	Coordination	Management of non-routine situations	Problem-solving and decision-making	Self-management and continuous learning	Workload management	Teamwork	Communication
Summary of observable behaviours	1.1 1.4 1.8 1.10 1.11 1.12	2.1 2.2 2.4	3.1 3.2 3.3	4.1 4.2	5.6	6.1 6.2 6.3 6.5	7.2 7.6 7.7	8.1 8.4	9.2	10.1 10.2 10.3

Creating the adapted competency model

ANSP XYZ adapts the ICAO competency framework for ATSEP as defined in Appendix 2 to Chapter 3 in Part IV of the PANS-TRG, second edition. This is reflected in Table A-11:

Table A-11. Adapted competency model for ATSEP within ANSP XYZ (example)

Adapted competency	*Description*	*Performance criteria*			
		OB no.	*Observable behaviour (OB)*	*Competency assessment*	
				Final competency standard	*Condition*
Engineering	Collaborates in developing, modifying and integrating systems, networks and equipment.	1.1	Demonstrates technical knowledge and reasoning.	Demonstrates consistently technical knowledge and reasoning.	In all situations
		1.4	Demonstrates ability to set system requirements.	Demonstrates the ability to comprehensively set system requirements.	In all situations
		1.8	Tests, verifies, validates and certifies new systems, equipment or installations.	Responsibly manages testing, verification, validation and/or certification of new systems, equipment or installations.	In all situations
		1.10	Optimizes systems and network elements.	Routinely optimizes all systems and/or network elements.	In the area of responsibility
		1.11	Supports system life cycle.	Supports the life cycle of all relevant systems.	In an integrated manner
		1.12	Anticipates and organizes system and equipment decommissioning.	Demonstrates the ability to anticipate, organize and conduct a system or equipment decommissioning process.	In all situations
Situational awareness	Comprehends the current status of the ATM system and anticipates future events.	2.1	Monitors the CNS/ATM systems in own area of responsibility and contributing areas as well.	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.	Independently monitors environmental conditions (weather) and responds with the appropriate actions in own and adjacent area of responsibility.	In all situations
		2.4	Maintains awareness of the people involved in or affected by the operation.	Demonstrates awareness of the people involved in or affected by the operation.	In all activities

Adapted competency	*Description*	*Performance criteria*			
		OB no.	*Observable behaviour (OB)*	*Competency assessment*	
				Final competency standard	*Condition*
Service provision	Ensures availability and reliability of CNS/ATM systems and capabilities.	3.1	Uses systems monitoring and diagnostic capabilities effectively.	Demonstrates the ability to interact with all system management tools, using all the features in a safe and consistent manner.	In all situations
		3.2	Evaluates the operational consequences of CNS/ATM system anomalies or failures.	Demonstrates an understanding of the consequences of system anomalies and failures online.	In all workload conditions
		3.3	Switches from monitoring to intervention in a timely manner.	Independently takes appropriate action in response to system anomalies and failures.	In all workload conditions
Coordination	Manages coordination with operational stakeholders and with other affected stakeholders.	4.1	Coordinates effectively with internal stakeholders.	Demonstrates the ability to coordinate effectively with all relevant internal stakeholders in a timely manner.	In all situations
		4.2	Coordinates effectively with external stakeholders.	Demonstrates the ability to coordinate effectively with all relevant external stakeholders in a timely manner.	In all situations
Management of non-routine situations	Detects and responds to emergency and unusual situations related to the ATC operation and/or CNS/ATM systems and capabilities.	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, to create a solution for that situation and to implement it successfully.	In non-routine situations
Problem-solving and decision-making	Finds and implements solutions for identified hazards and associated risks.	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 considered for determining possible solutions to a problem.	In all workload conditions
		6.2	Implements a chosen solution to a problem.	Demonstrates that a chosen solution to a problem is implemented.	In all workload conditions
		6.3	Organizes tasks in accordance with determined priorities.	Demonstrates that activities are properly prioritized.	In all workload conditions
		6.5	Works through problems without reducing safety.	Independently works through problems without reducing safety.	In all workload conditions

Adapted competency	*Description*	*Performance criteria*			
		OB no.	*Observable behaviour (OB)*	*Competency assessment*	
				Final competency standard	*Condition*
Self-management and continuous learning	Demonstrates personal attributes that improve performance and maintains an active involvement in self-learning and self-development.	7.2	Improves performance through self-evaluation of the effectiveness of actions.	Demonstrates continuous improvement of performance by always self-evaluating the effectiveness of own activities.	In all activities
		7.6	Maintains awareness of developments in aviation and technological evolution.	Continuously demonstrates maintenance of knowledge of aviation and technological evolution by contributing to relevant discussions.	In all situations
		7.7	Participates in learning activities.	Demonstrates organization and continuous participation.	In all planned learning activities
Workload management	Uses available resources to prioritize and perform tasks in an efficient and timely manner.	8.4	Selects appropriate tools, equipment and resources to support the efficient achievement of tasks.	Independently selects appropriate tools, equipment and resources to support the efficient achievement of activities.	In all workload conditions
Teamwork	Operates as a team member.	9.2	Shows respect and tolerance for other people.	Demonstrates respect and tolerance for other people (within team/outside team).	In all situations within the professional environment
Communication	Communicates effectively in all situations.	10.1	Selects communication methods that take into account the requirements of the situation.	Independently selects communication methods appropriate to the situation.	In all workload conditions
		10.2	Speaks clearly, accurately and concisely.	Speaks clearly, accurately and concisely.	In any situation
		10.3	Uses appropriate vocabulary and expressions for communications with stakeholders.	Demonstrates the use of appropriate vocabulary and expressions for communications with stakeholders.	In all workload conditions

Note.— In situations where it is difficult to identify the FCS directly from the OBs, it may be beneficial to develop an evidence guide, including possible ICSs, in parallel. An example of an evidence guide for ANSP XYZ is provided in the following section.

Workflow 2, Part 2 — Design the assessment and training plans

Assessment plan

Note.— This example is not intended 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.

The assessment plan for unit training is designed based on the performance criteria identified in Table A-11. It details assessment events and tools that will be used to determine if an ATSEP achieves competence during and at the end of unit training.

As part of the progression towards the FCS, it may be necessary to establish ICSs. This is presented in the evidence guide in Table A-12. In this example, no more than two ICSs were identified before achievement of the FCS for each OB. However, there may be situations where an identified OB requires more or less ICSs in the progression towards the FCS. This may be due to specific details of the task, environment, assessment capability or many other reasons determined by the training designer.

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 profile.

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 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.

Table A-12. Evidence guide for ATSEP within ANSP XYZ (example)

C 1 — Engineering				
OB		*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 testing, 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 testing, verification, validation and/or certification of new systems, equipment or installations.

C 1 — Engineering				
OB		*ICS 1*	*ICS 2*	*FCS*
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.
C — Competency OB — Observable behaviour		ICS — Interim competency standard FCS — Final competency standard		

C 2 — Situational awareness				
OB		*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 areas of responsibility.	Independently monitors environmental conditions (weather) and responds with the appropriate actions in own and adjacent areas of responsibility.

C 2 — Situational awareness				
OB		*ICS 1*	*ICS 2*	*FCS*
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.
C — Competency OB — Observable behaviour		ICS — Interim competency standard FCS — Final competency standard		

C 3 — Service provision				
OB		*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.
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 a mentor during periods of high workload.	Independently takes appropriate action in response to system anomalies and failures in all workload conditions.
C — Competency OB — Observable behaviour		ICS — Interim competency standard FCS — Final competency standard		

C 4 — Coordination				
OB		*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.
C — Competency OB — Observable behaviour		ICS — Interim competency standard FCS — Final competency standard		

C 5 — Management of non-routine situations				
OB		*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.
C — Competency OB — Observable behaviour		ICS — Interim competency standard FCS — Final competency standard		

C 6 — Problem-solving and decision-making				
OB		*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 a 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 a mentored session that priorities are considered to prioritize activities.	Demonstrates that activities are properly prioritized in low workload conditions.	Demonstrates that activities are properly prioritized in 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.
C — Competency OB — Observable behaviour		ICS — Interim competency standard FCS — Final competency standard		

C 7 — Self-management and continuous learning				
OB		*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.
C — Competency OB — Observable behaviour		ICS — Interim competency standard FCS — Final competency standard		

C 8 — Workload management				
OB		*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.
C — Competency OB — Observable behaviour		ICS — Interim competency standard FCS — Final competency standard		

C 9 — Teamwork				
OB		*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.
C — Competency OB — Observable behaviour		ICS — Interim competency standard FCS — Final competency standard		

C 10 — Communication				
OB		*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 situations, 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.
C — Competency OB — Observable behaviour		ICS — Interim competency standard FCS — Final competency standard		

Training plan

ANSP XYZ associates the ATSEP job objective (defined in Table A-8) with predefined training modules (see Chapter 3), as demonstrated in Table A-13:

Table A-13. Identification of training modules for ATSEP within ANSP XYZ (example)

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	

Table A-14 provides an indication of the possible content of the unit training programme based on the ANSP XYZ ATSEP job profile (Table A-8 refers). 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.

Table A-14. Training content for ATSEP within ANSP XYZ (example)

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	
Overview of procedures	Internal	2	Classroom	
Overview of documentation tools	Internal	1	Classroom	

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

Workflow 3 — Develop the training and assessment materials

As indicated in Chapter 2, 2.6.1, the training plan is used to develop the training materials. This example is not intended to provide a comprehensive set of training materials (e.g. 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 or training organization.

———————————

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.

Each training objective is preceded by a unique training objective identifier. It consists of the following elements:

<training group identifier>.< course identifier>.<subject>_<training objective number>
Example: *ATSEP.DPR.DPS_1.2.1*

The training objective identifier serves a number of purposes:

a) it enables a quick, unique and unambiguous designation of a training objective without using the complete text of the training objective;

b) it can be used to reference training objectives in any documentation related to the training and across different documents;

c) by including the training group identifier (e.g. ATSEP), the discipline to which a training objective applies is immediately identifiable;

d) it facilitates the use of a training objective across different disciplines, e.g. aircraft maintenance personnel utilizing an ATSEP training objective; and

e) it establishes transparency on the re-use of training objectives in different courses. The proportion of training objectives used more than once within the scope of this appendix resides at a level of 13.3 per cent.

The following acronyms are used in this context:

<training group identifier>
ATSEP

<course identifier>

BAS	Basic
COM	Communication
NAV	Navigation
SUR	Surveillance
DPR	Data processing and automation
SMC	System monitoring and control

INF Infrastructure
ENG Engineering

<subject>

IND Induction
ATF Air traffic familiarization
AIS Aeronautical information service
MET Meteorology
Continued… (see tables in sections B-1 to B-8)

<training objective number>

x.y.z

Note.— In some courses, the topics and sub-topics for some subjects may be inherited from other courses, where the topic and associated training objectives originate. For consistency, the numbering of those topics and objectives have been maintained between courses. This may result in some subjects containing topics that do not run in sequential number order and are preceded by an explanatory note.

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

The following column headers apply to all the training objective tables in the remainder of this appendix:

Training objective identifier	*Corpus* (description of the required performance)	*Taxonomy level number* (see Appendix C)	*Content*[1]

SUBJECT 1. INDUCTION

TOPIC 1: INDUCTION

SUB-TOPIC 1.1: Training and assessment overview

ATSEP.BAS.IND_1.1.1	Describe the training scheme and progression towards ATSEP competence.	2	Initial (basic and qualification), S/E rating and continuation training. Course aims, objectives and topics.
ATSEP.BAS.IND_1.1.2	State the assessment requirements, procedures and methods.	1	—

1. The content illustrates and provides details on performance. When the items are listed, each of them is to be addressed as a minimum. The expression "e.g." is used to indicate optional content. All content following "e.g." is provided to illustrate the type of content that could be used to meet the objective. When no content is given, the objective has to be performed according to the action verb in the Corpus.

SUB-TOPIC 1.2: National organization

ATSEP.BAS.IND_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.
ATSEP.BAS.IND_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).
ATSEP.BAS.IND_1.2.3	State appropriate accountabilities and responsibilities of the service provider(s) and competent authority.	1	—

SUB-TOPIC 1.3: Workplace

ATSEP.BAS.IND_1.3.1	State the role of trade unions and professional organizations.	1	e.g. International, regional, national.
ATSEP.BAS.IND_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.
ATSEP.BAS.IND_1.3.3	Describe actions when suspecting a security breach.	2	e.g. Inform police, security agencies and managers, follow the security manual and/or contingency plan.

SUB-TOPIC 1.4: ATSEP role

ATSEP.BAS.IND_1.4.1	Describe the key responsibilities of an ATSEP.	2	—

SUB-TOPIC 1.5: National/regional/worldwide dimension

ATSEP.BAS.IND_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.
ATSEP.BAS.IND_1.5.2	Define the regulatory framework of international and national ATM.	1	e.g. ICAO, regional and national concepts, responsibilities.
ATSEP.BAS.IND_1.5.3	State the purpose of a range of international and regional bodies.	1	e.g. ICAO, EASA, RTCA, EUROCAE.

SUB-TOPIC 1.6: International Standards and Recommended Practices

ATSEP.BAS.IND_1.6.1	Explain how the regulatory environment of ICAO notifies and implements legislation.	2	ICAO Annexes
ATSEP.BAS.IND_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: Quality management

ATSEP.BAS.IND_1.7.1	Explain quality management and the need for it.	2	e.g. ISO, EFQM (European Foundation for Quality Management).
ATSEP.BAS.IND_1.7.2	Explain the need for configuration management.	2	Importance for safe operations, e.g. S/E build state, software adaption/version.

SUB-TOPIC 1.8: Safety management system

ATSEP.BAS.IND_1.8.1	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 1.9: Health and safety

ATSEP.BAS.IND_1.9.1	Explain personal safety responsibilities in the work environment.	2	Safety statement, first aid, rules about climbing.
ATSEP.BAS.IND_1.9.2	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.
ATSEP.BAS.IND_1.9.3	Describe fire safety and first aid regulations and practices.	2	Requirements and rules, e.g. Standards.
ATSEP.BAS.IND_1.9.4	State any applicable legal requirements and safety rules.	1	National, regional, international regulations, e.g. for working on power supply and/or air conditioning.
ATSEP.BAS.IND_1.9.5	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

ATSEP.BAS.ATF_1.1.1	Define air traffic management.	1	ICAO, regional regulations.
ATSEP.BAS.ATF_1.1.2	Describe operational ATM functions.	2	ATFCM, ATS, ASM.
ATSEP.BAS.ATF_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).
ATSEP.BAS.ATF_1.1.4	Explain the operational importance of technical services required for ATM.	2	e.g. Interoperability.
ATSEP.BAS.ATF_1.1.5	State future developments in systems and/or ATM/ANS practices that may have an 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.
ATSEP.BAS.ATF_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

ATSEP.BAS.ATF_1.2.1	Define airspace organization.	1	ICAO Annex 11, e.g. additional regional regulations, FIR, UTA, TMA, CTR, ATS routes.
ATSEP.BAS.ATF_1.2.2	Describe commonly used airspace terminologies and concepts.	2	e.g. Sectorization, identification of ATS routes, restricted airspace, significant points.
ATSEP.BAS.ATF_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.
ATSEP.BAS.ATF_1.2.4	State the purpose of ATC.	1	ICAO Doc 4444.
ATSEP.BAS.ATF_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

ATSEP.BAS.ATF_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

ATSEP.BAS.ATF_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

ATSEP.BAS.ATF_1.5.1	Take account of ATC tasks.	2	e.g. Simulation, role play, PC, Part Task Trainer, observations in the operational environment.
ATSEP.BAS.ATF_1.5.2	Explain the need for good communication, coordination and cooperation between operational staff.	2	e.g. Handovers, MIL/CIV, planner/tactical, SV Tech (SMC) and SV ATCO, site visit(s) to ATC units.
ATSEP.BAS.ATF_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, meteorological providers, remote sites, airport operations.
ATSEP.BAS.ATF_1.5.4	Define the phases of flight.	1	Take-off, climb, cruise, descent and initial approach, final approach and landing.
ATSEP.BAS.ATF_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.
ATSEP.BAS.ATF_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

ATSEP.BAS.AIS_1.1.1	State the organization of the AIS.	1	—
ATSEP.BAS.AIS_1.1.2	Define an AIP.	1	e.g. Data contents of AIPs, supplementary, AIC and types of publication: AIRAC, non-AIRAC, data collection and preparation, data format, distribution channels, supporting systems and tools.
ATSEP.BAS.AIS_1.1.3	Define the aeronautical charting service.	1	Types of aeronautical charts, operational use of charts, supporting systems and tools.
ATSEP.BAS.AIS_1.1.4	Define the NOTAM services.	1	—
ATSEP.BAS.AIS_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.
ATSEP.BAS.AIS_1.1.6	Define the regional/national AIS database.	1	e.g. Paper/data, central single source, validated, redundancy.
ATSEP.BAS.AIS_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

ATSEP.BAS.MET_1.1.1	State the relevance of meteorology in aviation.	1	Influence on the operation of aircraft, flying conditions, aerodrome conditions.
ATSEP.BAS.MET_1.1.2	State the weather prediction and measurement systems available.	1	Wind, visibility, temperature, pressure, humidity, cloud base.

SUB-TOPIC 1.2: Impact on aircraft and ATS operations

ATSEP.BAS.MET_1.2.1	State the meteorological conditions and their impact on aircraft operations.	1	e.g. Wind, visibility, temperature/humidity, clouds, precipitation, pressure, density.
ATSEP.BAS.MET_1.2.2	State the meteorological conditions hazardous to aircraft operations.	1	e.g. Turbulence, thunderstorms, icing, squall, macro bursts, wind shear, contaminated runway.
ATSEP.BAS.MET_1.2.3	Explain the impact of meteorological conditions and hazards on ATS operations.	2	Increased vertical and horizontal separation, low visibility procedures, anticipation of flights not adhering to tracks, diversions, missed approaches. e.g. effects on equipment performance.
ATSEP.BAS.MET_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

ATSEP.BAS.MET_1.3.1	List the main meteorological parameters.	1	Wind, visibility, temperature, pressure, humidity.
ATSEP.BAS.MET_1.3.2	List the most common weather messages and broadcasts used in aviation.	1	Meteorology messages: TAF, METAR, SNOWTAM, SIGMET Broadcasts: ATIS/VOLMET

SUB-TOPIC 1.4: Meteorological systems

ATSEP.BAS.MET_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

ATSEP.BAS.COM_1.1.1	State the structure of the communication domain.	1	Voice communication, data communication.
ATSEP.BAS.COM_1.1.2	State major substructures of the communication domain.	1	Air-ground, ground-ground, air-air communications.
ATSEP.BAS.COM_1.1.3	State ATS requirements for safe communications.	1	Safety, reliability, availability, coverage, QoS, latency.
ATSEP.BAS.COM_1.1.4	State the aeronautical communication services.	1	Mobile, fixed.

TOPIC 2: VOICE COMMUNICATION

SUB-TOPIC 2.1: Introduction to voice communications

ATSEP.BAS.COM_2.1.1	Describe system architecture.	2	—
ATSEP.BAS.COM_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.
ATSEP.BAS.COM_2.1.3	Describe the way in which voice communication systems function.	2	VoIP VCS, analogue/digital comparisons, distortion, harmonics.
ATSEP.BAS.COM_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.
ATSEP.BAS.COM_2.1.5	State how systems interface to produce an integrated service to ATS.	1	—
ATSEP.BAS.COM_2.1.6	State radio spectrum and frequency allocation constraints and procedures.	1	Spectrum, interference sources, commercial allocations, world radio conference, ITU efficient utilization of frequency bands, channel spacing.
ATSEP.BAS.COM_2.1.7	State voice recording systems in use.	1	e.g. Digital recording equipment.
ATSEP.BAS.COM_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.

ATSEP.BAS.COM_2.1.9	State the purpose of ATIS and VOLMET.	1	—

SUB-TOPIC 2.2: Air-ground communication

ATSEP.BAS.COM_2.2.1	State the functions and basic operation of routing and switching equipment in use in the ATS environment.	1	Voice switching.
ATSEP.BAS.COM_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.
ATSEP.BAS.COM_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 versus element redundancy.
ATSEP.BAS.COM_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, push-to-talk.
ATSEP.BAS.COM_2.2.5	List techniques and future developments that have or may have an impact on ATS voice communications.	1	e.g. CPDLC, VDL Mode 2.

SUB-TOPIC 2.3: Ground-ground communication

ATSEP.BAS.COM_2.3.1	State the functions and the basic operations of routing and switching equipment in use in the ATS environment.	1	General architecture.
ATSEP.BAS.COM_2.3.2	Describe how ground-ground systems interface to provide an integrated service to the ATS environment.	2	International/national links, ACC interoperability, voice and data integration.
ATSEP.BAS.COM_2.3.3	Describe the functionality of the elements of ground-ground communication.	2	Main and emergency systems, interfaces to telecom providers e.g. MFC and ATS-Qsig, switching, local PABX equipment.
ATSEP.BAS.COM_2.3.4	Recognize the elements of the CWP used for ground-ground communication.	1	Selection, emergency, loudspeaker, headset, microphone.
ATSEP.BAS.COM_2.3.5	Describe developments in ground-ground technologies that may impact on ATS voice communication.	2	TCP/IP, VoIP. e.g. Future development of protocols.

TOPIC 3: DATA COMMUNICATIONS

SUB-TOPIC 3.1: Introduction to data communications

ATSEP.BAS.COM_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.
ATSEP.BAS.COM_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.
ATSEP.BAS.COM_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.
ATSEP.BAS.COM_3.1.4	Define protocols in current use.	1	e.g. TCP/IP, frame relay, asynchronous transfer mode.

SUB-TOPIC 3.2: Networks

ATSEP.BAS.COM_3.2.1	State ATS requirements for safe data communications.	1	Reliability, availability.
ATSEP.BAS.COM_3.2.2	Describe the different types of networks.	2	LAN, WAN, ATN, national network for ATM e.g. satellite-dedicated networks, AFTN.
ATSEP.BAS.COM_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

ATSEP.BAS.COM_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.
ATSEP.BAS.COM_3.3.2	Name a range of ground-ground aviation-related network concepts.	1	ATN, PENS e.g. Physical networks: PENS, AFTN, RAPNET. Communication protocols: IP, ASTERIX, FMTP. Communication service providers: SITA, ARINC, national carriers, ANSPs.

			Applications: AMHS, AIDC, OLDI.
ATSEP.BAS.COM_3.3.3	Define SWIM.	1	SWIM institutional framework and applications. e.g SWIM providers and users.

SUBJECT 6: NAVIGATION

TOPIC 1: INTRODUCTION

SUB-TOPIC 1.1: Purpose and use of navigation

ATSEP.BAS.NAV_1.1.1	Explain the need for navigation in aviation.	2	Positioning, guidance, planning.
ATSEP.BAS.NAV_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

ATSEP.BAS.NAV_2.1.1	State the shape of the Earth and its parameters.	1	Oblate spheroid. e.g. Diameter, gravity, rotation, axis, magnetic field.
ATSEP.BAS.NAV_2.1.2	Explain the Earth's properties and their effects.	2	Polar axis, direction of rotation.
ATSEP.BAS.NAV_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

ATSEP.BAS.NAV_2.2.1	State the general principles of reference systems.	1	Geoid, reference ellipsoids, WGS 84. Latitude and longitude, undulation.
ATSEP.BAS.NAV_2.2.2	Explain why a global reference system is required for aviation.	2	—

SUB-TOPIC 2.3: Earth's magnetism

ATSEP.BAS.NAV_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

ATSEP.BAS.NAV_3.1.1	State how radio waves propagate.	1	Ground, sky, line of sight.
ATSEP.BAS.NAV_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

ATSEP.BAS.NAV_3.2.1	State the performance of navigation systems.	1	Coverage, accuracy, integrity, continuity of service, availability.
ATSEP.BAS.NAV_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

ATSEP.BAS.NAV_3.3.1	State the different means of navigation.	1	Sole, primary, supplementary.

TOPIC 4: NAVIGATION SYSTEMS

SUB-TOPIC 4.1: Terrestrial navigation aids

ATSEP.BAS.NAV_4.1.1	Explain the basic working principles of electronic positioning.	2	Distance measurements (time and phase), angular measurements.
ATSEP.BAS.NAV_4.1.2	Describe ground-based navigation systems.	2	NDB, VOR, DME, ILS, DF. e.g. TACAN, marker beacons.
ATSEP.BAS.NAV_4.1.3	Recognize how the navigation information is displayed on the relevant pilot HMI.	1	—
ATSEP.BAS.NAV_4.1.4	Explain the operational use of ground-based navigation systems in the different phases of flight.	2	NDB, VOR, DME, ILS, DF.

ATSEP.BAS.NAV_4.1.5	Recognize the frequency bands used by the ground-based navigation systems.	1	—
ATSEP.BAS.NAV_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

ATSEP.BAS.NAV_4.2.1	State the use of on-board navigation systems.	1	e.g. Barometric altimetry, radio altimetry, INS/IRS, compass.
ATSEP.BAS.NAV_4.2.2	State the use of an FMS.	1	Sensors, navigation database.

SUB-TOPIC 4.3: Space-based navigation systems

ATSEP.BAS.NAV_4.3.1	Explain the basic working principles of satellite positioning.	2	GNSS e.g. Galileo, GPS.
ATSEP.BAS.NAV_4.3.2	Recognize the basic architecture of a core satellite positioning system.	1	GNSS e.g. Galileo, GPS.
ATSEP.BAS.NAV_4.3.3	Recognize the frequency bands used by the space-based navigational systems.	1	—
ATSEP.BAS.NAV_4.3.4	State the benefits of satellite-based navigation.	1	Global coverage, accuracy, time dissemination. e.g. Redundancy, interoperability, single set of avionics.
ATSEP.BAS.NAV_4.3.5	State the current limitations of space-based navigation systems.	1	e.g. Single frequency, weak signal, ionospheric delay, institutional, military, multipath.
ATSEP.BAS.NAV_4.3.6	Describe the basic working principles of satellite augmentation.	2	ABAS (RAIM, AAIM), SBAS (WAAS, EGNOS), GBAS.
ATSEP.BAS.NAV_4.3.7	State the current implementations of satellite-based navigation systems.	1	Core systems: GPS, GLONASS, Galileo, BeiDou. Augmentation systems: RAIM, AAIM, EGNOS, WAAS, GBAS.

TOPIC 5: PERFORMANCE-BASED NAVIGATION (PBN)

SUB-TOPIC 5.1: PBN

ATSEP.BAS.NAV_5.1.1	Describe the performance-based navigation (PBN) concept.	2	ICAO Doc 9613.
ATSEP.BAS.NAV_5.1.2	List the navigation applications in use in the region.	1	e.g. RNAV-5 (B-RNAV), RNAV-1 (P-RNAV), RNP approaches.

SUB-TOPIC 5.2: Future developments

ATSEP.BAS.NAV_5.2.1	State current navigation developments.	1	e.g. 4D-RNAV, free routes, rationalization plans, advanced RNP.

SUBJECT 7: SURVEILLANCE

TOPIC 1: INTRODUCTION TO SURVEILLANCE

SUB-TOPIC 1.1: Introduction to surveillance

ATSEP.BAS.SUR_1.1.1	Define surveillance in the context of ATM.	1	What (positioning/identification) and why (maintain separation).
ATSEP.BAS.SUR_1.1.2	Define the various surveillance domains.	1	Air-air, ground-air, ground-ground.
ATSEP.BAS.SUR_1.1.3	List the surveillance techniques.	1	Non-cooperative, cooperative, dependent, independent techniques.
ATSEP.BAS.SUR_1.1.4	Define the current and emerging surveillance systems in use in ATM.	1	Radar technology, ADS technology, multilateration, e.g. TIS.
ATSEP.BAS.SUR_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.
ATSEP.BAS.SUR_1.1.6	State ICAO and any local legal requirements.	1	e.g. ICAO SARPS, Annex 10 Vol. IV.
ATSEP.BAS.SUR_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

ATSEP.BAS.SUR_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.
ATSEP.BAS.SUR_1.2.2	Define the role of TCAS as a safety net.	1	e.g. FMS.

SUB-TOPIC 1.3: Primary radar

ATSEP.BAS.SUR_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).
ATSEP.BAS.SUR_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.
ATSEP.BAS.SUR_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

ATSEP.BAS.SUR_1.4.1	Describe the need for and 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.
ATSEP.BAS.SUR_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.
ATSEP.BAS.SUR_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

ATSEP.BAS.SUR_1.5.1	State the need for harmonization.	1	Surveillance data sharing, interoperability.
ATSEP.BAS.SUR_1.5.2	State the techniques used for transmission of surveillance data.	1	e.g. Point-to-point, network, microwave, satellite.
ATSEP.BAS.SUR_1.5.3	State the main formats in use.	1	e.g. ASTERIX.

SUB-TOPIC 1.6: Automatic dependent surveillance (ADS)

ATSEP.BAS.SUR_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.
ATSEP.BAS.SUR_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.
ATSEP.BAS.SUR_1.6.3	State the data link technologies proposed and the current situation of deployment.	1	Extended squitter 1090 MHz, e.g. VDL 4, HFDL, UAT, AMSS.

SUB-TOPIC 1.7: Weather radar

ATSEP.BAS.SUR_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

ATSEP.BAS.SUR_1.8.1	Describe the complementary use of different sensors.	2	—

SUB-TOPIC 1.9: Multilateration (MLAT)

ATSEP.BAS.SUR_1.9.1	State the use of MLAT in ATC.	1	LAM and WAM.
ATSEP.BAS.SUR_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

ATSEP.BAS.SUR_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.
ATSEP.BAS.SUR_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

ATSEP.BAS.SUR_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

ATSEP.BAS.SUR_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

ATSEP.BAS.DPR_1.1.1	Describe the functions and generic architecture of the systems.	2	Generic FDP and SDP overall functional block diagrams.
ATSEP.BAS.DPR_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.
ATSEP.BAS.DPR_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).
ATSEP.BAS.DPR_1.1.4	State the legal aspects of data	1	Traceability and recording of data and

	processing in ATM.		actions, configuration control.
ATSEP.BAS.DPR_1.1.5	State current developments and future possibilities.	1	e.g. Coflight, iTEC, SESAR, NextGen, multisensor tracking. SWIM, flight object.

SUB-TOPIC 1.2: System software and hardware principles

ATSEP.BAS.DPR_1.2.1	Describe the current hardware configurations used in ATM.	2	Redundancy and backup. e.g. Driver, interfaces, hardware platforms, fault tolerant systems.
ATSEP.BAS.DPR_1.2.2	Describe the current software platforms used in ATM.	2	Operating systems.
ATSEP.BAS.DPR_1.2.3	Describe concepts of virtualization in ATM.	2	Virtual centre (remote CWP – SESAR). e.g. Display virtualization (remote display unit (RDU)), server virtualization (server consolidation).

SUB-TOPIC 1.3: Surveillance data processing (SDP)

ATSEP.BAS.DPR_1.3.1	State ATC requirements.	1	QoS, mandatory data recording, dependability.
ATSEP.BAS.DPR_1.3.2	Explain the principles of SDP.	2	e.g. Single, multi, plot, track.
ATSEP.BAS.DPR_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.
ATSEP.BAS.DPR_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.
ATSEP.BAS.DPR_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)

ATSEP.BAS.DPR_1.4.1	State ATC requirements.	1	QoS, unambiguous, accurate, error free, timely.
ATSEP.BAS.DPR_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.
ATSEP.BAS.DPR_1.4.3	Define inputs and outputs.	1	Flow control flight strips/data displays, MRT, environmental data, static data, airspace adaptation.
ATSEP.BAS.DPR_1.4.4	Describe the basic software functions/applications.	2	FDP (route processing, code/call sign correlation, code allocation, strip distribution, track labelling).
ATSEP.BAS.DPR_1.4.5	Describe the FPL data update process.	2	Automatic and manual update.

SUB-TOPIC 1.5: Human-machine interface systems

ATSEP.BAS.DPR_1.5.1	Describe the different display technologies and interfaces.	2	Common graphic display interface, LCD, TFT, touch input device, video interfaces, extenders. DVI, HDMI, DisplayPort, Thunderbolt, video and USB signal extenders, video splitters and video frame rate encoders.
ATSEP.BAS.DPR_1.5.2	Recognize what information is normally displayed on the ATCO and ATSEP HMI.	1	—

SUB-TOPIC 1.6: Miscellaneous information

ATSEP.BAS.DPR_1.6.1	State the additional data used by the ATM system.	1	e.g. MET, AIM (NOTAMs), CDM, aircraft data.

SUBJECT 9: SYSTEM MONITORING AND CONTROL

TOPIC 1: SYSTEM MONITORING AND CONTROL (SMC)

SUB-TOPIC 1.1: Overview of the SMC function

ATSEP.BAS.SMC_1.1.1	Describe the principles and purpose of the operational management of the technical	2	Service requirements, interfaces, boundaries of tactical responsibility.

	services.		e.g. Hierarchy of authority for the technical and ATC structures.
ATSEP.BAS.SMC_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. Communication: 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.
ATSEP.BAS.SMC_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

ATSEP.BAS.SMC_1.2.1	Describe the range of configurations that can be used.	2	Equipment or channel switching, parameter settings.
ATSEP.BAS.SMC_1.2.2	Describe the general techniques that are employed to make configuration changes.	2	e.g. Physical switching.
ATSEP.BAS.SMC_1.2.3	State the 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

ATSEP.BAS.SMC_1.3.1	State the monitoring functions that are available.	1	e.g. BITE, status, parameters, software and hardware watchdogs.
ATSEP.BAS.SMC_1.3.2	State the control functions that are available.	1	e.g. Switching, parameters, set configurations.
ATSEP.BAS.SMC_1.3.3	Explain the importance of SMC management and coordination of maintenance activities.	2	—
ATSEP.BAS.SMC_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

ATSEP.BAS.SMC_1.4.1	State why coordination and reporting are required and how they are 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

ATSEP.BAS.SMC_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.
ATSEP.BAS.SMC_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.
ATSEP.BAS.SMC_1.5.3	Explain the responsibilities and/or duties of SMC members during an emergency situation by using an example scenario.	2	—
ATSEP.BAS.SMC_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

ATSEP.BAS.SMC_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).
ATSEP.BAS.SMC_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

ATSEP.BAS.MTN_1.1.1	Explain the handling precautions to be taken to ensure equipment protection.	2	Isolation, protection devices, electrostatic sensitive devices, power supplies, heavy loads, high voltage.
ATSEP.BAS.MTN_1.1.2	Explain the classifications of maintenance.	2	e.g. Preventative, corrective, service configuration.
ATSEP.BAS.MTN_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.
ATSEP.BAS.MTN_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

ATSEP.BAS.INF_1.1.1	Define the performance of power supply systems in the operational environment.	1	Availability, quality, continuity of service.
ATSEP.BAS.INF_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).
ATSEP.BAS.INF_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

ATSEP.BAS.INF_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.
ATSEP.BAS.INF_1.2.2	State the importance and criticality of	1	Short- and long-term effect on people

	maintaining a controlled environment.		and equipment.

SUBJECT 12: SAFETY

TOPIC 1: SAFETY MANAGEMENT

SUB-TOPIC 1.1: Policy and principles

ATSEP.BAS.SAF_1.1.1	Explain the underlying need for safety management policies and principles.	2	ICAO Annex 19, lessons learned from events, evolving environment, requirements.
ATSEP.BAS.SAF_1.1.2	State the safety management policy.	1	ICAO Annex 19, priority of safety, the safety objective of ATM, roles and responsibilities.
ATSEP.BAS.SAF_1.1.3	Explain safety management principles.	2	ICAO Annex 19, safety achievement, safety assurance, safety promotion.
ATSEP.BAS.SAF_1.1.4	Appreciate the reactive and proactive nature of safety management policy and principles.	3	e.g. ICAO Annex 19. Nature of events, Swiss cheese model (J. Reason), events investigation, safety assessment.
ATSEP.BAS.SAF_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.
ATSEP.BAS.SAF_1.1.6	Appreciate the ATSEP role and responsibilities in safety management.	3	Competency, occurrence reporting e.g. “Just culture (ref.: EAM2 GUI6), risk assessment.
ATSEP.BAS.SAF_1.1.7	State the role and content of a typical SMS within an ANSP.	1	ICAO Annex 19.
ATSEP.BAS.SAF_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

ATSEP.BAS.SAF_1.2.1	Describe the concept of risk.	2	Types of risk, components of risk, risk contributors (people, procedures, organizations and equipment).
ATSEP.BAS.SAF_1.2.2	State ways of assessing risk.	1	Risk comparisons, risk analysis.
ATSEP.BAS.SAF_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

ATSEP.BAS.SAF_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.
ATSEP.BAS.SAF_1.3.2	Appreciate the importance of adopting a total system approach covering human, procedure, organization and equipment elements.	2	ATM system description (including scope definition and limitation), end-to-end integrity of safety assessment. e.g. Concept of TRM.
ATSEP.BAS.SAF_1.3.3	Describe the overall safety assessment process and its relationships with risk assessment during the total life cycle of the 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

ATSEP.BAS.SAF_1.4.1	Describe the ATM system risk classification scheme.	2	e.g. Scenario of failure of air navigation system (incident chain), components of a risk classification scheme, severity classes, probability classes (qualitative and quantitative).

SUB-TOPIC 1.5: Safety regulation

ATSEP.BAS.SAF_1.5.1	Describe the role of safety regulation.	2	The purpose of national regulations and international standards, objective of the national regulator.

ATSEP.BAS.SAF_1.5.2	Explain the relationship between the safety regulation documents.	2	ICAO SARPs, regional regulations, national regulations.
ATSEP.BAS.SAF_1.5.3	Explain how the safety regulation documents affect ATM service provision.	2	ICAO documentation (SARPs), regional regulations, AMCs and GM, national regulations.
ATSEP.BAS.SAF_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

ATSEP.BAS.HAS_1.1.1	Consider potential hazards to health and safety generated by equipment used in CNS/ATM.	2	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

ATSEP.BAS.HAS_1.2.1	State applicable international requirements.	1	—
ATSEP.BAS.HAS_1.2.2	State any applicable national requirements.	1	—
ATSEP.BAS.HAS_1.2.3	Describe the safety procedure or measures for persons working on or near relevant equipment and in the general working environment.	1	e.g. COM/NAV/SUR/SMC: protection and 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

ATSEP.BAS.HAS_1.3.1	State regional and local regulations for electronic device disposal.	1	Protection of the environment e.g. Recycling

SUBJECT 14: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

ATSEP.BAS.FST_1.1.1	State the role of ATSEP in safety management routines and in reporting processes.	1	Safety assessment documentation related to navigation, communication and surveillance systems; safety reports and occurrences; safety monitoring.

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

ATSEP.BAS.FST_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).
ATSEP.BAS.FST_2.1.2	Explain the need for NOTAMs.	2	e.g. for PBN and GNSS status.

SUBJECT 15: HUMAN FACTORS

TOPIC 1: INTRODUCTION TO HUMAN FACTORS

SUB-TOPIC 1.1: Introduction

ATSEP.BAS.HUF_1.1.1	Explain why human factors are particularly important in the ATM environment.	2	Historical background, safety impact on ATM, incidents.
ATSEP.BAS.HUF_1.1.2	Define human factors.	1	e.g. ICAO Human Factors Training Manual.
ATSEP.BAS.HUF_1.1.3	Explain the concept of systems and its relevance in the ATM environment.	2	People, procedures, equipment.
ATSEP.BAS.HUF_1.1.4	Explain the use of the SHELL model.	2	e.g. ICAO Doc 9683, visits to OPS and technical rooms.
ATSEP.BAS.HUF_1.1.5	State the factors that 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

ATSEP.BAS.HUF_2.1.1	Explain the importance of maintaining and updating professional knowledge and skills.	2	Ensuring safety.
ATSEP.BAS.HUF_2.1.2	Explain the importance of maintaining non-technical skills and professional competence.	2	e.g. Communication, human relationships, knowledge of environment, human limit awareness.
ATSEP.BAS.HUF_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

ATSEP.BAS.HUF_3.1.1	Describe major aspects of human information processing.	2	Attention, memory, situational awareness (perception, comprehension, projection), decision-making, action, feedback, environment.
ATSEP.BAS.HUF_3.1.2	Describe the factors that influence information processing.	2	e.g. Stress and strain, experience, knowledge, distraction, interpersonal relations, working environment, risk perception, attitude, workload, fatigue, confidence, job security.
ATSEP.BAS.HUF_3.1.3	Appreciate factors that influence information processing.	3	e.g. Case study, simulation, role playing.

TOPIC 4: MEDICAL

SUB-TOPIC 4.1: Fatigue

ATSEP.BAS.HUF_4.1.1	Describe the effect of fatigue on human performance.	2	Physiological, cognitive and relational effects. e.g. Lack of concentration, irritability, frustration.
ATSEP.BAS.HUF_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.

ATSEP.BAS.HUF_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

ATSEP.BAS.HUF_4.2.1	Describe signs of lack of personal fitness.	2	—
ATSEP.BAS.HUF_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.
ATSEP.BAS.HUF_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

ATSEP.BAS.HUF_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

ATSEP.BAS.HUF_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.
ATSEP.BAS.HUF_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)

ATSEP.BAS.HUF_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

ATSEP.BAS.HUF_5.3.1	Describe the differences between social	2	—

	human relations and professional interactions.		
ATSEP.BAS.HUF_5.3.2	Take account of reasons for loss of team effectiveness and actions to prevent it and prevent repetition.	2	e.g. Roles poorly defined, goals poorly identified, bad planning, too many leaders or not enough, respect for others, divergence in values, misunderstandings.
ATSEP.BAS.HUF_5.3.3	Describe the principles of teamwork.	2	e.g. Team membership, group dynamics, advantages/disadvantages of teamwork.
ATSEP.BAS.HUF_5.3.4	Appreciate reasons for conflict.	3	—
ATSEP.BAS.HUF_5.3.5	Describe actions to prevent human conflicts.	2	—
ATSEP.BAS.HUF_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

ATSEP.BAS.HUF_6.1.1	Appreciate the importance of recording information by writing effectively.	2	ATSEP technical report, logs, system degradation reports, specification, system manager report.
ATSEP.BAS.HUF_6.1.2	Use appropriate terminology to communicate effectively in writing.	3	Be concise and clear; use common technical terms; convey key points.

SUB-TOPIC 6.2: Verbal and non-verbal communication

ATSEP.BAS.HUF_6.2.1	Describe the human communication process.	2	—
ATSEP.BAS.HUF_6.2.2	Characterize the factors that affect verbal communication.	2	e.g. Cognitive: lack of knowledge of procedures or 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.
ATSEP.BAS.HUF_6.2.3	Describe factors that affect non-verbal communication.	2	e.g. Touch, noise, interruption, body language.
ATSEP.BAS.HUF_6.2.4	Use appropriate vocabulary to	3	Technical jargon, language differences,

	communicate effectively on technical matters.		standard words/phrases.
ATSEP.BAS.HUF_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

ATSEP.BAS.HUF_7.1.1	Explain the process of stress.	2	Causes, stress mechanism, consequences in different work situations (e.g. online intervention, maintenance, training).
ATSEP.BAS.HUF_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

ATSEP.BAS.HUF_7.2.1	Explain how to relieve or minimize stress in oneself and/or others.	2	The effect of personality in coping with stress, benefits of active stress management.
ATSEP.BAS.HUF_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.
ATSEP.BAS.HUF_7.2.3	Recognize the effects of shocking and stressful situations.	1	For oneself and for others, in abnormal situations.
ATSEP.BAS.HUF_7.2.4	Consider the benefits of critical incident stress management.	2	—

TOPIC 8: HUMAN ERROR

SUB-TOPIC 8.1: Human error

ATSEP.BAS.HUF_8.1.1	Describe human error.	2	—
ATSEP.BAS.HUF_8.1.2	Explain the relationship between human error and safety.	2	Mechanism, error-prone conditions, consequences. e.g. Swiss cheese model, feedback.

ATSEP.BAS.HUF_8.1.3	State different types of errors using an appropriate model.	1	e.g. Rasmussen model, Gagne model.
ATSEP.BAS.HUF_8.1.4	Differentiate between errors and violations.	2	—
ATSEP.BAS.HUF_8.1.5	Explain how to detect errors.	2	e.g. Individual and collective strategy, event report, procedure.
ATSEP.BAS.HUF_8.1.6	Explain, in general terms, how errors are mitigated.	2	—
ATSEP.BAS.HUF_8.1.7	Appreciate two significant ATM incidents/accidents involving ATSEP/engineering contributory factors.	2	—

SUBJECT 16: INFORMATION SYSTEM SECURITY

TOPIC 1: INTRODUCTION

SUB-TOPIC 1.1: Purpose and principles

ATSEP.BAS.ISS_1.1.1	Define information system security and the relevant terminology.	1	e.g. Information security, cybersecurity, network security, physical security.
ATSEP.BAS.ISS_1.1.2	Define the regulatory framework.	1	ICAO, regional regulations, NIS Directive.
ATSEP.BAS.ISS_1.1.3	List the concepts governing a security policy.	1	Security objectives, business continuity. e.g. Resilience, recovery plan.
ATSEP.BAS.ISS_1.1.4	List the relevant security managerial personnel.	1	—
ATSEP.BAS.ISS_1.1.5	Explain the importance of ATM security.	2	—
ATSEP.BAS.ISS_1.1.6	Describe the security of operational data.	2	Secure, restricted access by authorized personnel.
ATSEP.BAS.ISS_1.1.7	Appreciate the security risk management system in an ANSP's organization.	3	Risk-based approach, risk assessment, threats, vulnerabilities, residual risks, impact, likelihood, risk treatment.
ATSEP.BAS.ISS_1.1.8	Explain information security frameworks.	2	e.g. ISO, NIST.
ATSEP.BAS.ISS_1.1.9	Explain the confidentiality, integrity and availability (CIA) concept.	2	—
ATSEP.BAS.ISS_1.1.10	Appreciate the security threats faced by the functional system.	3	ATM/ANS.
ATSEP.BAS.ISS_1.1.11	Explain different network and physical	2	DoS, DDoS, port scanning, network

	attacks.		sniffing, spoofing, MITM, APT (advanced persistent threat), e.g. tailgating, cryptojacking.
ATSEP.BAS.ISS_1.1.12	Explain social engineering techniques.	2	Social networking, human flaws, phishing, spear phishing.
ATSEP.BAS.ISS_1.1.13	Explain different types of malware.	2	Viruses, worms, spyware, ransomware.
ATSEP.BAS.ISS_1.1.14	Identify the different phases of a security attack.	3	e.g. Cyber kill chain, Swiss cheese model.
ATSEP.BAS.ISS_1.1.15	Appreciate how to detect and stop security attacks.	3	e.g. Cyber kill chain.
ATSEP.BAS.ISS_1.1.16	Appreciate a holistic security architecture.	3	Application security, network security, operating systems security, role of SOC/CERT, system of systems, e.g. firewalls, proxies, routers, switches, network data flow, PKIs, DMZ, IDS/IPS.
ATSEP.BAS.ISS_1.1.17	Explain security policies and practices for information and data.	2	Backup, storing, hacking, confidentiality, copyright.
ATSEP.BAS.ISS_1.1.18	Describe the possible external interventions that may interrupt or corrupt ATM services.	2	Introduction of software viruses, illegal broadcasts, jamming, spoofing.

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

ATSEP.COM.VCE_1.1.1	Appreciate typical measurements on a transmitter.	3	Frequency (single carrier, offset carrier), modulation, output power, SWR. Adjacent channel power.
ATSEP.COM.VCE_1.1.2	Appreciate a generic radio transmitter.	3	Frequency power, modulation index, audio input level.
ATSEP.COM.VCE_1.1.3	Identify the main elements in a block diagram of a generic radio transmitter.	3	Characteristics (modulation, single carrier, channel spacing), functionalities.
ATSEP.COM.VCE_1.1.4	Perform typical measurements on a	3	Frequency, modulation, channel spacing,

	receiver.		sensitivity, selectivity.
ATSEP.COM.VCE_1.1.5	Appreciate a generic radio receiver.	3	Signal-to-noise ratio, audio input level, frequency.
ATSEP.COM.VCE_1.1.6	Identify the main elements of a block diagram of a generic radio receiver.	3	Characteristics (single carrier, channel spacing, sensitivity, selectivity).
ATSEP.COM.VCE_1.1.7	Characterize intermodulation and interference phenomena.	2	Collocation of multiple transmitters at the same radio site, external interference (jamming).

SUB-TOPIC 1.2: Radio antenna systems

ATSEP.COM.VCE_1.2.1	Explain antenna parameters.	2	Impedance, polar diagram, bandwidth, polarization, types of antennas.
ATSEP.COM.VCE_1.2.2	Characterize the coverage of the radio system.	2	Polar diagram, types of antennas, frequency bands, propagation mode.
ATSEP.COM.VCE_1.2.3	Characterize the link budget according to various conditions.	2	Output power, antennas, propagation, geographic, meteorological, day and night.
ATSEP.COM.VCE_1.2.4	Characterize the elements of a generic antenna system.	2	Filters, combiners, multi-cavity system.
ATSEP.COM.VCE_1.2.5	Consider the conformity of a system to ITU and national regulations.	2	Ref.: ICAO Annex 10 (VHF, UHF).
ATSEP.COM.VCE_1.2.6	Appreciate measurements with generic radio test equipment.	3	e.g. Spectrum analyser, scanner.

SUB-TOPIC 1.3: Voice switch

ATSEP.COM.VCE_1.3.1	Explain switching functionalities.	2	General architecture, digital, analogue, multiplex types, PCM. e.g. Cross-coupling, split headset (radio both ears, telephone single ear).
ATSEP.COM.VCE_1.3.2	Explain the principles of non-blocking switches.	2	Advantages, disadvantages, delays (digital).
ATSEP.COM.VCE_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

ATSEP.COM.VCE_1.4.1	Describe the most common features of a controller working position and the HMI.	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

ATSEP.COM.VCE_1.5.1	Describe the different types of interfaces.	2	Internal, external, phantom signalling, in-band signal.

TOPIC 2: GROUND-GROUND

SUB-TOPIC 2.1: Interfaces

ATSEP.COM.VCE_2.1.1	Describe the different types of interfaces.	2	e.g. Analogue (2, 4, 6 and 8 wires), digital (ISDN; 64 Kb, 2 Mb, IP).
ATSEP.COM.VCE_2.1.2	Explain the advantages and disadvantages of each type.	2	e.g. Analogue (2, 4, 6 and 8 wires), digital (ISDN; 64 Kb, 2 Mb, IP).
ATSEP.COM.VCE_2.1.3	Operate measuring equipment.	3	e.g. dB meters, level meters, generators, sniffer.

SUB-TOPIC 2.2: Protocols

ATSEP.COM.VCE_2.2.1	Operate standard protocol analysers.	3	e.g. MFC R2 and/or ATS QSIG (rerouting), impulse dialling and DTMF dialling, ISDN, SIP, RTP.
ATSEP.COM.VCE_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, SIP, RTP.

SUB-TOPIC 2.3: Switch

ATSEP.COM.VCE_2.3.1	State the similarities between ground-ground and air-ground switches.	1	Switching techniques.
ATSEP.COM.VCE_2.3.2	Describe the most commonly used functionality of PABX.	2	General architecture, digital, analogue, multiplex types, PCM30. e.g. IPBX.

ATSEP.COM.VCE_2.3.3	Explain conversion analogue-digital, digital-analogue.	2	General architecture, analogue-digital-analogue.

SUB-TOPIC 2.4: Communication chain

ATSEP.COM.VCE_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

ATSEP.COM.VCE_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

ATSEP.COM.DTA_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.
ATSEP.COM.DTA_1.1.2	Explain how networks meet requirements.	2	Redundancy, bandwidth, BER, time delay, network security.

SUB-TOPIC 1.2: Networks

ATSEP.COM.DTA_1.2.1	Analyse the features of a network.	4	Routing scheme, rate, internal networking, routers, gateways, switches, firewalls e.g. wireless networks, bridges, modems, IRB, VRF, EtherChannel, VLAN trunking, NFV, spanning tree, IPsec tunnels, hierarchical design mode.
ATSEP.COM.DTA_1.2.2	Describe network standards and devices.	2	Ethernet, optical fibre. e.g. LAN/MAN: CSMA/CD, Ethernet frame types, VLAN tag (802.1Q), fibre-optic cable qualities for SM and MM, connectors, SFP module types, wireless. WAN: MPLS, PDH, SDH networks.

ATSEP.COM.DTA_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

ATSEP.COM.DTA_1.3.1	Explain aspects of external network services.	2	Provided QoS e.g. SLAs.

SUB-TOPIC 1.4: Measuring tools

ATSEP.COM.DTA_1.4.1	Identify the main parameters of the network to be measured and the corresponding instruments to be used.	3	Types of measurements, typical parameters, e.g. data analyser (sniffer), NETSCOUT, Wireshark.

SUB-TOPIC 1.5: Troubleshooting

ATSEP.COM.DTA_1.5.1	Appreciate how to troubleshoot a network.	3	e.g. Broken lines, unusable network components, overload, integrity problems.
ATSEP.COM.DTA_1.5.2	Explain the principles of troubleshooting a network.	2	—

TOPIC 2: PROTOCOLS

SUB-TOPIC 2.1: Fundamental theory

ATSEP.COM.DTA_2.1.1	Appreciate the principles of layers.	3	Differences between layers, e.g. layer(s) of sniffer information.
ATSEP.COM.DTA_2.1.2	Appreciate the principles of network addressing.	3	Masks, prefixes, subnets, IP addressing (unicast, multicast), IPv4 and IPv6, MAC addressing. e.g. Same logical network computers and systems, broadcast, multicast MAC addressing, DHCPv4, DHCPv6.
ATSEP.COM.DTA_2.1.3	Appreciate the principles of an IP routing strategy.	3	Routing tables, preferences, fault tolerance, static and dynamic routing protocols for IPv4 and IPv6, HSRP/VRRP. e.g. Unicast, multicast, broadcast, OSPF, BGP, IS-IS, IDRP, multicast routing, ECMP, route summarization.

SUB-TOPIC 2.2: General protocols

ATSEP.COM.DTA_2.2.1	Describe the general protocol structure.	2	IPv4 and IPv6 (header, fragmentation), UDP and TCP headers, TCP reliable transport. e.g. MPLS, frame structure, PDH, SDH.
ATSEP.COM.DTA_2.2.2	Appreciate the general application layer protocols using the appropriate tools and documentation.	3	NTP, FTP. e.g. SIP (session initiation protocol), SMTP, HTTP.

SUB-TOPIC 2.3: Specific protocols

ATSEP.COM.DTA_2.3.1	Describe the specific protocols.	2	FMTP, e.g. BATAP – ARINC 620.

TOPIC 3: NATIONAL NETWORKS

SUB-TOPIC 3.1: National networks

ATSEP.COM.DTA_3.1.1	Name the national networks to which the organization is connected.	1	e.g. ANSP, MET, military, commercial telecom providers, airlines, national network(s).
ATSEP.COM.DTA_3.1.2	Describe the interfaces between national and global networks.	2	—

TOPIC 4: NETWORKS

SUB-TOPIC 4.1: Network technologies

ATSEP.COM.DTA_4.1.1	State current and emerging network concepts.	1	e.g. as used in AMHS, PENS.
ATSEP.COM.DTA_4.1.2	Describe the characteristics of current networks.	2	Surveillance data, flight plan data and AIS networks e.g. quality of service, architecture, FMTP, AMHS.

TOPIC 5: GLOBAL NETWORKS

SUB-TOPIC 5.1: Networks and standards

ATSEP.COM.DTA_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: Global architecture

ATSEP.COM.DTA_5.2.1	Describe the architecture of the ATN.	2	Air-ground subnetworks, ground-ground subnetworks, airborne networks.
ATSEP.COM.DTA_5.2.2	Describe the SWIM concept.	2	Main SWIM standards, SWIM profiles, standards and protocols, TCP/IP version, compatibility issues. e.g. Topology, potential development, challenges (cybersecurity), opportunities.
ATSEP.COM.DTA_5.2.3	Describe SWIM data.	2	Types of aeronautical data (dynamic, static), other data relevant for aviation, e.g. AMHS data, MET data, 4D trajectory data, aerodrome data, flight procedures.

SUB-TOPIC 5.3: Air-ground subnetworks

ATSEP.COM.DTA_5.3.1	Describe the air-ground subnetworks.	2	VDL (mode 2), AMSS.

SUB-TOPIC 5.4: Ground-ground subnetworks

ATSEP.COM.DTA_5.4.1	Describe the composition of ground-ground subnetworks.	2	PTT, commercial telecom providers, Rockwell Collins, SITA.

SUB-TOPIC 5.5: Networks on board the aircraft

ATSEP.COM.DTA_5.5.1	State the existence of subnetworks inside the aircraft relevant for ATM communications.	1	e.g. AFDX – ARINC 429.

SUB-TOPIC 5.6: Air-ground applications

ATSEP.COM.DTA_5.6.1	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

ATSEP.COM.TRP_1.1.1	Explain the parameters of a line.	2	e.g. Equation, attenuation, impedance, S-parameters, Smith chart, bandwidth, HF specifics (dipoles, multipoles), SWR.

SUB-TOPIC 1.2: Digital transmission

ATSEP.COM.TRP_1.2.1	Describe the parameters for digital transmission.	2	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

ATSEP.COM.TRP_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, crosstalk.
ATSEP.COM.TRP_1.3.2	Appreciate the appropriate type of line for a given specific application.	2	e.g. Bandwidth, noise immunity.
ATSEP.COM.TRP_1.3.3	Describe the typical parameters of lines.	2	e.g. Impedance, insulation, signal level, time delay.

TOPIC 2: SPECIFIC LINKS

SUB-TOPIC 2.1: Microwave link

ATSEP.COM.TRP_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

ATSEP.COM.TRP_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

ATSEP.COM.REC_1.1.1	Explain the international regulations.	2	ICAO (recording and reproducing).
ATSEP.COM.REC_1.1.2	Explain national regulations.	2	Appropriate national regulations.
ATSEP.COM.REC_1.1.3	Consider recording and reproducing processes.	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

ATSEP.COM.REC_1.2.1	Explain the principles of voice recording.	2	Recording interfaces, codecs, ambient recording. e.g. Analogue: A/D converters, E1, VoIP office telephony, VoIP VCS ED-137; A-law, u-law codecs; frequency range (300 to 3400 Hz).
ATSEP.COM.REC_1.2.2	Explain the principles of video recording.	2	Software recording, hardware recording, evidence.
ATSEP.COM.REC_1.2.3	Explain the security of recorded data.	2	Confidentiality, protection against tampering, access protection, access logging.
ATSEP.COM.REC_1.2.4	Explain the principles of replay.	2	Synchronisation of screen/radar and voice recording, replay limitations, e.g. inability to measure separation on screen replay.

SUBJECT 5: DATA PROCESS

TOPIC 1: SOFTWARE PROCESS

Note.— This topic and its associated objective are inherited from the course on data processing/automation, subject 8 (section B.5).

SUB-TOPIC 1.2: Operating systems (OS)

ATSEP.DPR.PRC_1.2.2	Identify relevant OS commands.	3	e.g. Linux systems.

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

SUBJECT 1: VOICE

TOPIC 1: AIR-GROUND

Note.— This topic and associated objectives are inherited from course on communication, subject 1 (section B.2).

SUB-TOPIC 1.2: Radio antenna systems

ATSEP.COM.VCE_1.2.1	Explain antenna parameters.	2	Impedance, polar diagram, bandwidth, polarization, types of antennas.
ATSEP.COM.VCE_1.2.2	Characterize the coverage of the radio system.	2	Polar diagram, types of antennas, frequency bands, propagation mode.

SUBJECT 2: TRANSMISSION PATH

TOPIC 1: LINES

Note.— This topic and its associated objective are inherited from course on communication, subject 3 (section B.2).

SUB-TOPIC 1.3: Types of lines

ATSEP.COM.TRP_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, crosstalk.

SUBJECT 3: PERFORMANCE-BASED NAVIGATION

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: Operational requirements

ATSEP.NAV.PBN_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.
ATSEP.NAV.PBN_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 (PBN)

ATSEP.NAV.PBN_1.2.1	Describe the PBN concept.	2	ICAO documents, airspace concept, application supported by navigation infrastructure and navigation specifications, functionality of the avionics.
ATSEP.NAV.PBN_1.2.2	Differentiate between an RNAV and an RNP navigation specification.	2	On-board performance monitoring and alerting.
ATSEP.NAV.PBN_1.2.3	State which navigation applications support the different phases of flight.	1	ICAO Doc 9613.
ATSEP.NAV.PBN_1.2.4	Describe the navigation infrastructure included in the PBN concept.	2	e.g. VOR/DME, DME/DME, ILS, GNSS

SUB-TOPIC 1.3 Area navigation concept (RNAV)

ATSEP.NAV.PBN_1.3.1	Differentiate between conventional navigation and area navigation.	2	Fixed route versus flexible route structure.

SUBJECT 4: GROUND-BASED SYSTEMS — NDB

TOPIC 1: NON-DIRECTIONAL BEACON (NDB)

SUB-TOPIC 1.1: Use of the system

ATSEP.NAV.NDB_1.1.1	Appreciate the principles of an NDB.	3	Relative bearing, measuring method.
ATSEP.NAV.NDB_1.1.2	Describe the overall performance.	2	Coverage, accuracy, availability of the

			system, integrity, continuity.
ATSEP.NAV.NDB_1.1.3	Explain the technical limitations of an NDB.	2	Lack of accuracy, lack of integrity, sensitivity to interference.
ATSEP.NAV.NDB_1.1.4	Describe the current situation.	2	e.g. Number, type, users, user groups, regional context.

SUB-TOPIC 1.2: Ground station architecture

ATSEP.NAV.NDB_1.2.1	Describe the main components of an NDB ground station.	2	Electronic cabinet, antennas, power supply, remote controls and monitoring.
ATSEP.NAV.NDB_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

ATSEP.NAV.NDB_1.3.1	Characterize the main NDB signal parameters.	2	Carrier and ident frequency, output power, depth of modulation.
ATSEP.NAV.NDB_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

ATSEP.NAV.NDB_1.4.1	Explain NDB antenna characteristics.	2	Impedance, polar diagram, polarization, ground reflections.
ATSEP.NAV.NDB_1.4.2	Appreciate the interface between power stage and the antenna.	3	Antenna tuning units, matching filter, SWR, radiated power.

SUB-TOPIC 1.5: Monitoring and control subsystems

ATSEP.NAV.NDB_1.5.1	Describe the purpose of monitoring.	2	Integrity, continuity of service, availability.
ATSEP.NAV.NDB_1.5.2	Describe which parameters are used for monitoring.	2	Antenna current, ID code, depth of modulation.
ATSEP.NAV.NDB_1.5.3	Appreciate how the operational status of the NDB monitoring system is checked.	3	System status.

ATSEP.NAV.NDB_1.5.4	Describe the issues associated with NDB obstacle limitations and obstacle removal.	2	Siting.

SUB-TOPIC 1.6: On-board equipment

ATSEP.NAV.NDB_1.6.1	Describe the on-board equipment (ADF).	2	Receiver, antenna, displays.
ATSEP.NAV.NDB_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

ATSEP.NAV.NDB_1.7.1	Describe the conformity to international and national regulations.	2	ITU regulations (EMC + SAR), ICAO Annex 10.
ATSEP.NAV.NDB_1.7.2	Appreciate calibration tasks and flight inspection results.	3	e.g. Maintenance and flight inspection manuals, procedures and reports.
ATSEP.NAV.NDB_1.7.3	Appreciate troubleshooting of an NDB.	3	e.g. Maintenance and flight inspection manuals, procedures and reports.
ATSEP.NAV.NDB_1.7.4	Appreciate the origins of NDB errors.	3	e.g. Multipath, EMC, interference with radio broadcast transmissions.

SUBJECT 5: GROUND-BASED SYSTEMS — DF

TOPIC 1: DIRECTION FINDER (DF)

SUB-TOPIC 1.1: Use of the system

ATSEP.NAV.DFI_1.1.1	State the different types of DFs.	1	VDF, DDF, IDF.
ATSEP.NAV.DFI_1.1.2	Describe the user HMI.	2	Indication on radar picture, DF indicator.
ATSEP.NAV.DFI_1.1.3	Appreciate the principles of DFs.	3	Bearing, measuring method (standard, Doppler, interferometry).
ATSEP.NAV.DFI_1.1.4	Describe the overall performance.	2	Coverage, accuracy, availability of the system, integrity, continuity.
ATSEP.NAV.DFI_1.1.5	Explain the technical limitations of DFs.	2	Sensitivity to interference.
ATSEP.NAV.DFI_1.1.6	Describe the current situation.	2	e.g. Number, type, users, national context.

SUB-TOPIC 1.2: VDF/DDF equipment architecture

ATSEP.NAV.DFI_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

ATSEP.NAV.DFI_1.3.1	Explain the main signal parameters.	2	Frequency band (UHF, VHF).

SUB-TOPIC 1.4: Antenna subsystem

ATSEP.NAV.DFI_1.4.1	Explain DF antenna characteristics.	2	Impedance, polar diagram, polarization, types of antennas.
ATSEP.NAV.DFI_1.4.2	Appreciate protection areas.	3	Obstacles, ICAO Annex 10. e.g. Manufacturers' manuals.

SUB-TOPIC 1.5: Monitoring and control subsystems

ATSEP.NAV.DFI_1.5.1	Describe the purpose of monitoring.	2	Integrity, continuity of service, availability.
ATSEP.NAV.DFI_1.5.2	Describe which parameters are used for monitoring.	2	Noise figure, stability of measurement.
ATSEP.NAV.DFI_1.5.3	Appreciate how the operational status of the DF monitoring system is checked.	3	System status.
ATSEP.NAV.DFI_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

ATSEP.NAV.DFI_1.6.1	Appreciate the conformity to international and national regulations.	2	ITU regulations (EMV + SAR), ICAO Annex 10.
ATSEP.NAV.DFI_1.6.2	Perform typical measurements on a DF system.	3	Frequency, channel spacing, sensitivity, selectivity, bearing accuracy.
ATSEP.NAV.DFI_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.
ATSEP.NAV.DFI_1.6.4	Appreciate troubleshooting of DF.	3	e.g. Sensitivity, local oscillator level

			maintenance and flight inspection manuals, procedures and reports.
ATSEP.NAV.DFI_1.6.5	Appreciate the origin of DF errors.	3	e.g. Multipath, EMC, interference with radio broadcast transmissions.

SUBJECT 6: GROUND-BASED SYSTEMS — VOR

TOPIC 1: VERY HIGH FREQUENCY OMNIDIRECTIONAL RADIO RANGE (VOR)

SUB-TOPIC 1.1: Use of the system

ATSEP.NAV.VOR_1.1.1	State the types of VOR systems.	1	Conventional, Doppler.
ATSEP.NAV.VOR_1.1.2	Describe the overall performance.	2	Coverage, accuracy, availability of the system, integrity, continuity.
ATSEP.NAV.VOR_1.1.3	Explain the technical limitations of CVOR.	2	Type of information (azimuth), accuracy, integrity, suitable for a network of fixed routes.
ATSEP.NAV.VOR_1.1.4	Appreciate the differences between CVOR and DVOR.	3	Signal broadcast differences, bearing information robustness.
ATSEP.NAV.VOR_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

ATSEP.NAV.VOR_1.2.1	Appreciate the mathematical signal description.	3	Declination, equations of CVOR and/or DVOR, reference and variable signals.
ATSEP.NAV.VOR_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

ATSEP.NAV.VOR_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.
ATSEP.NAV.VOR_1.3.2	Appreciate the relation between the VOR station design and operational	3	Siting, coverage, ID code, backup systems.

	requirements.		

SUB-TOPIC 1.4: Transmitter subsystem

ATSEP.NAV.VOR_1.4.1	Characterize main signal parameters for a CVOR and/or DVOR.	2	Carrier frequency stability, output power, signals generated.
ATSEP.NAV.VOR_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

ATSEP.NAV.VOR_1.5.1	Explain VOR antenna characteristics.	2	Impedance, polar diagram, polarization, types of antennas.
ATSEP.NAV.VOR_1.5.2	Appreciate the interface between power stage and the antennas.	3	SWR, radiated power.
ATSEP.NAV.VOR_1.5.3	Appreciate protection areas.	3	Obstacles, ICAO Annex 10. e.g. Manufacturers' manuals.

SUB-TOPIC 1.6: Monitoring and control subsystem

ATSEP.NAV.VOR_1.6.1	Describe the purpose of monitoring.	2	Integrity, continuity of service, availability.
ATSEP.NAV.VOR_1.6.2	Describe which VOR parameters are monitored.	2	ICAO and RTCA/EUROCAE requirements. e.g. NSA requirements.
ATSEP.NAV.VOR_1.6.3	Describe the principles of the CVOR and/or DVOR monitoring systems.	2	Near-field sensors, far-field sensors, local and remote monitoring.
ATSEP.NAV.VOR_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.
ATSEP.NAV.VOR_1.6.5	Describe the issues associated with VOR obstacle limitations and obstacle removal.	2	Surrounding environment, multipath prevention.

SUB-TOPIC 1.7: On-board equipment

ATSEP.NAV.VOR_1.7.1	Describe the on-board equipment.	2	Antenna, receiver, HMI. e.g. CDI, RMI, HSI, ND, PFD.
ATSEP.NAV.VOR_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

ATSEP.NAV.VOR_1.8.1	Appreciate the conformity to international and national regulations.	2	ITU regulations (EMC + SAR), ICAO Annex 10.
ATSEP.NAV.VOR_1.8.2	Perform typical system measurements.	3	In space modulation, phase sideband/carrier, ground check for bearing errors.
ATSEP.NAV.VOR_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.
ATSEP.NAV.VOR_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.
ATSEP.NAV.VOR_1.8.5	Analyse the origins of CVOR and/or DVOR errors.	4	CVOR: system-dependent, adjustments, drifts, multipath, on-board errors; and/or DVOR: North adjustment e.g. DVOR: antenna feeding; DVOR and CVOR: multipath, EMC, interference with radio broadcast transmissions.

SUBJECT 7: GROUND-BASED SYSTEMS — DME

TOPIC 1: DISTANCE MEASURING EQUIPMENT (DME)

SUB-TOPIC 1.1: Use of the system

ATSEP.NAV.DME_1.1.1	Describe the overall performance of DME.	2	Coverage, accuracy, availability of the system, integrity, continuity, number of users.
ATSEP.NAV.DME_1.1.2	Explain the limitations of DME.	2	Accuracy, integrity, capacity.

ATSEP.NAV.DME_1.1.3	Describe the current situation.	2	e.g. Number, types, users, user groups, national context, regional context.
ATSEP.NAV.DME_1.1.4	State the role of the DME infrastructure in future navigation applications.	1	PBN.
ATSEP.NAV.DME_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

ATSEP.NAV.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.
ATSEP.NAV.DME_1.2.2	Explain the frequency spectrum and the channel spacing allocated.	2	ICAO Annex 10, EUROCAE ED-57, L-band.

SUB-TOPIC 1.3: Ground station architecture

ATSEP.NAV.DME_1.3.1	Describe the main components of a DME ground station.	2	Electronic cabinet, antenna system, power supply, remote controls and monitoring.
ATSEP.NAV.DME_1.3.2	Identify the relation between the DME station design and operational requirements.	3	Coverage, ID code, siting.

SUB-TOPIC 1.4: Receiver subsystem

ATSEP.NAV.DME_1.4.1	Explain the main receiver parameters for a DME.	2	Sensitivity, selectivity, dynamic range, jamming immunity.
ATSEP.NAV.DME_1.4.2	Appreciate the typical measurements on the interrogation signals.	3	Sensitivity, selectivity, dynamic range, jamming immunity.

SUB-TOPIC 1.5: Signal processing

ATSEP.NAV.DME_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).
ATSEP.NAV.DME_1.5.2	Appreciate 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

ATSEP.NAV.DME_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.
ATSEP.NAV.DME_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

ATSEP.NAV.DME_1.7.1	Explain DME antenna characteristics.	2	Patterns, antennas.
ATSEP.NAV.DME_1.7.2	Appreciate the interface between power stage and the antenna.	3	SWR, radiated power, propagation delay, distribution circuit (e.g. duplexer, circulator).
ATSEP.NAV.DME_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

ATSEP.NAV.DME_1.8.1	Describe the purpose of monitoring.	2	Integrity, continuity of service, availability.
ATSEP.NAV.DME_1.8.2	Describe which DME parameters are monitored.	2	ICAO and RTCA/EUROCAE requirements. e.g. Regional and national requirements.
ATSEP.NAV.DME_1.8.3	Appreciate how the operational status of the DME monitoring system is checked.	3	—
ATSEP.NAV.DME_1.8.4	Describe the issues associated with DME obstacle limitations and obstacle removal.	2	Multipath, blanking.

SUB-TOPIC 1.9: On-board equipment

ATSEP.NAV.DME_1.9.1	Describe the on-board equipment.	2	Transmitter, antenna, receiver, HMI. e.g. HSI, DME range indication, ND.
ATSEP.NAV.DME_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

ATSEP.NAV.DME_1.10.1	Appreciate the conformity to international and national regulations.	2	ITU regulations (EMC + SAR), ICAO Annex 10.
ATSEP.NAV.DME_1.10.2	Appreciate calibration tasks and flight inspection results.	3	e.g. Maintenance and flight inspection manuals, procedures and reports.
ATSEP.NAV.DME_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.
ATSEP.NAV.DME_1.10.4	Appreciate the origin of DME errors.	3	e.g. Multipath, EMC, interference with radio broadcast transmissions (harmonics).

SUBJECT 8: GROUND-BASED SYSTEMS — ILS

TOPIC 1: INSTRUMENT LANDING SYSTEM (ILS)

SUB-TOPIC 1.1: Use of the system

ATSEP.NAV.ILS_1.1.1	Describe the overall performance of an ILS.	2	ICAO Annexes 10 and 14. Coverage, accuracy, availability of the system, integrity, continuity, number of users.
ATSEP.NAV.ILS_1.1.2	Explain the limitations of an ILS.	2	ICAO Annexes 10 and 14. Only 40 channels, no segmented paths of approach, beam corruption due to multipath.
ATSEP.NAV.ILS_1.1.3	Explain ILS facility performance categories.	2	ICAO Annexes 10 and 14. CAT I, CAT II, CAT III. Different operational category depending on operational minima, equipment and airport facilities.

ATSEP.NAV.ILS_1.1.4	Explain the importance and need for ILS obstacle-free zones.	2	ICAO Annexes 10 and 14. Dimensions, ILS beam protection, increased significance during LVP conditions, e.g. national regulations.
ATSEP.NAV.ILS_1.1.5	Consider the need for ATC ILS status indications.	2	No continuous monitoring by ATSEP.

SUB-TOPIC 1.2: Fundamentals of an ILS

ATSEP.NAV.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.
ATSEP.NAV.ILS_1.2.2	Characterize the signals to be radiated.	2	Amplitude and phase relationship, antenna systems.
ATSEP.NAV.ILS_1.2.3	Appreciate the relation between the adjustment of signals generated and the resulting beam patterns and standards.	3	Phases and amplitudes in antenna array, modulations on carrier signal, phase and amplitude of side band.
ATSEP.NAV.ILS_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

ATSEP.NAV.ILS_1.3.1	Explain the limitations of a 1F system.	2	Multipath in adverse environment and terrain.
ATSEP.NAV.ILS_1.3.2	Describe the capture effect.	2	Capture effect in receiver circuits and its consequences for monitoring.
ATSEP.NAV.ILS_1.3.3	Explain radiation parameters for 2FLOC and 2F-GP.	2	Types of antenna arrays, patterns, coverage, signal distribution, radiated power and their consequences for monitoring.

SUB-TOPIC 1.4: Ground station architecture

ATSEP.NAV.ILS_1.4.1	Describe the layout of an ILS.	2	—
ATSEP.NAV.ILS_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.

ATSEP.NAV.ILS_1.4.3	Identify the relation between an ILS station design and operational requirements.	3	Coverage, ID code, siting.
ATSEP.NAV.ILS_1.4.4	Explain the optional DME interface.	2	Identity coding ratio.

SUB-TOPIC 1.5: Transmitter subsystem

ATSEP.NAV.ILS_1.5.1	Appreciate the main signal parameters for the LOC (1F and 2F), GP (1F and 2F) and markers.	3	Carrier frequency, output power, signals generated.
ATSEP.NAV.ILS_1.5.2	Explain the block diagram of the ILS transmitters.	2	LOC, GP, marker beacons. Synthesizer, modulator, power amplifier, control coupler, RF changeover.

SUB-TOPIC 1.6: Antenna subsystem

ATSEP.NAV.ILS_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

ATSEP.NAV.ILS_1.7.1	Describe the purpose of monitoring.	2	Integrity, continuity of service, availability.
ATSEP.NAV.ILS_1.7.2	Describe the parameters for monitoring according to ICAO Annex 10: LOC, GP and marker beacons.	2	RF level, DDM, SDM on position and width.
ATSEP.NAV.ILS_1.7.3	Explain the key additional monitoring required: LOC and GP.	2	External, internal and integral monitoring.
ATSEP.NAV.ILS_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).
ATSEP.NAV.ILS_1.7.5	Describe (with a diagram) the monitoring system: LOC, GP, FFM and marker beacons.	2	Near-field, integral network, internal network, monitor signal processor. e.g. DME.

SUB-TOPIC 1.8: On-board equipment

ATSEP.NAV.ILS_1.8.1	Describe the on-board equipment associated with the LOC, GP and marker beacon.	2	Antennas, receiver, pilot interface (cross pointer). e.g. FMS.
ATSEP.NAV.ILS_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

ATSEP.NAV.ILS_1.9.1	Appreciate the conformity of the LOC, GP and marker beacons to international and national regulations.	2	ITU regulations (EMC + SAR), ICAO Annex 10.
ATSEP.NAV.ILS_1.9.2	Explain the occasions when it is necessary to downgrade an ILS facility performance category.	2	e.g. System failures, environmental changes/disturbance.
ATSEP.NAV.ILS_1.9.3	Explain the implications of ILS facility performance categories to the pilot.	2	Link with prevailing instrument RVR, weather dictating decision height.
ATSEP.NAV.ILS_1.9.4	Perform some typical measurements.	3	Output power, spectrum analysis, modulation, ID code.
ATSEP.NAV.ILS_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.
ATSEP.NAV.ILS_1.9.6	Appreciate troubleshooting of the 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.
ATSEP.NAV.ILS_1.9.7	Appreciate the origin of ILS errors.	3	e.g. Multipath, EMC, interference with radio broadcast transmissions (harmonics).

SUBJECT 9: GNSS

TOPIC 1: GLOBAL NAVIGATION SATELITE SYSTEM (GNSS)

SUB-TOPIC 1.1: General view

ATSEP.NAV.GNS_1.1.1	Explain the importance of continuing the development of GNSS in aviation.	2	ICAO Doc 9849, SESAR ATM Master Plan, NextGen Strategic Plan.
ATSEP.NAV.GNS_1.1.2	Describe the elements of GNSS.	2	Core systems GPS, GLONASS, Galileo, BeiDou, Augmentations. e.g. Augmentation systems: RAIM, AAIM, EGNOS, WAAS, GBA.
ATSEP.NAV.GNS_1.1.3	Appreciate the sources of interference to GNSS signals.	3	Intentional, unintentional, ionospheric interference, solar activity, jamming, spoofing.
ATSEP.NAV.GNS_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.
ATSEP.NAV.GNS_1.1.5	Appreciate the impact of the modernization of GNSS on the ARNS bands.	3	Introduction of L5, E5A, E5B.
ATSEP.NAV.GNS_1.1.6	Describe the purpose of the GNSS NOTAM.	2	ICAO Annex 10, Volume 1, e.g. AUGUR.

SUBJECT 10: ON-BOARD EQUIPMENT

TOPIC 1: ON-BOARD SYSTEMS

SUB-TOPIC 1.1: On-board systems

ATSEP.NAV.OBE_1.1.1	Explain the purpose and use of a navigation computer.	2	Sensors, navigation database.
ATSEP.NAV.OBE_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

ATSEP.NAV.OBE_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

ATSEP.NAV.OBE_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).

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

SUBJECT 1: VOICE

TOPIC 1: AIR-GROUND

Note.— This topic and associated objectives are inherited from course on communication, subject 1 (section B.2).

SUB-TOPIC 1.2: Radio antenna systems

ATSEP.COM.VCE_1.2.1	Explain antenna parameters.	2	Impedance, polar diagram, bandwidth, polarization, types of antennas.
ATSEP.COM.VCE_1.2.2	Characterize the coverage of the radio system.	2	Polar diagram, types of antennas, frequency bands, propagation mode.

SUBJECT 2: TRANSMISSION PATH

TOPIC 1: LINES

Note.— This topic and its associated objective are inherited from course on communication, subject 3 (section B.2).

SUB-TOPIC 1.3: Types of lines

ATSEP.COM.TRP_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, crosstalk.

SUBJECT 3: PRIMARY SURVEILLANCE RADAR (PSR)

TOPIC 1: PRIMARY SURVEILLANCE RADAR (PSR)

SUB-TOPIC 1.1: Use of PSR for air traffic services

ATSEP.SUR.PSR_1.1.1	Describe the operational requirements of an en-route or an approach PSR.	2	Range, resolution, coverage, availability.
ATSEP.SUR.PSR_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)

ATSEP.SUR.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

ATSEP.SUR.PSR_1.3.1	Describe the basic characteristics of a transmitter.	2	Timing, coherence, modulation, pulse width, pulse compression, pulse energy, frequency diversity/agility.
ATSEP.SUR.PSR_1.3.2	Describe the signals at all key points.	2	Supply, EHT, RF source (appropriate to type chosen), modulation, interlocks.
ATSEP.SUR.PSR_1.3.3	Describe a generic transmitter block diagram for both compressed and non-compressed systems.	2	e.g. Solid state, klystron, magnetron, travelling wave tube.
ATSEP.SUR.PSR_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.
ATSEP.SUR.PSR_1.3.5	State constraints and problems in 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

ATSEP.SUR.PSR_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

ATSEP.SUR.PSR_1.5.1	Describe the basic characteristics of a receiver.	2	Low noise, high dynamic range, bandwidth, detection, frequency, sensitivity, selectivity.
ATSEP.SUR.PSR_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.
ATSEP.SUR.PSR_1.5.3	Appreciate the importance of STC.	3	Saturation, RF-IF dynamic range.

SUB-TOPIC 1.6: Signal processing and plot extraction

ATSEP.SUR.PSR_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.

ATSEP.SUR.PSR_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.
ATSEP.SUR.PSR_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

ATSEP.SUR.PSR_1.7.1	Describe the basic function of plot combining.	2	Secondary/primary combining, secondary/primary assigning, prime target, range and azimuth collimation.
ATSEP.SUR.PSR_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

ATSEP.SUR.PSR_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

ATSEP.SUR.PSR_2.1.1	Describe the operational requirements of SMR.	2	Range, resolution, coverage, MTBF, availability.
ATSEP.SUR.PSR_2.1.2	Relate key parameters and necessity to achieve performance.	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

ATSEP.SUR.PSR_2.2.1	Explain the layout of SMR.	2	Dual system, service display.
ATSEP.SUR.PSR_2.2.2	Describe the basic functions of the receiver/transmitter unit.	2	Hardware/function overview.
ATSEP.SUR.PSR_2.2.3	Describe how to operate a sensor.	2	e.g. Block diagram, timing relations, video path, frequency diversity, polarization, controller structure.
ATSEP.SUR.PSR_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

ATSEP.SUR.PSR_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 4: SECONDARY SURVEILLANCE RADAR (SSR)

TOPIC 1: SECONDARY SURVEILLANCE RADAR (SSR) AND MONOPULSE SECONDARY SURVEILLANCE RADAR (MSSR)

SUB-TOPIC 1.1: Use of SSR for air traffic services

ATSEP.SUR.SSR_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.
ATSEP.SUR.SSR_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)

ATSEP.SUR.SSR_1.2.1	Describe the principles of the SSR/MSSR antenna.	2	Monopulse antenna techniques, coaxial connection, sum, difference and control pattern, off-boresight angle measurement, azimuth encoding, beam sharpening, side lobes.

SUB-TOPIC 1.3: Interrogator

ATSEP.SUR.SSR_1.3.1	Describe the characteristics of an interrogator.	2	Frequency, spectrum, interrogation modes, duty cycle, ISLS, IISLS, staggering.
ATSEP.SUR.SSR_1.3.2	Explain a generic interrogator.	2	Timing, interface, modulator, BITE.
ATSEP.SUR.SSR_1.3.3	Explain the need and methods for integrity monitoring.	2	Safeguards against erroneous transmission, BITE, power and temperature monitoring.

SUB-TOPIC 1.4: Transponder

ATSEP.SUR.SSR_1.4.1	Explain the operational use of the transponder.	2	Diagram of interaction between transponder and aeroplane.
ATSEP.SUR.SSR_1.4.2	Define the global performance.	1	Range, accuracy, fixed delay to respond.
ATSEP.SUR.SSR_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.
ATSEP.SUR.SSR_1.4.4	Explain the advantages of the transponder.	2	Longer range, more information.
ATSEP.SUR.SSR_1.4.5	Explain the limitations of the transponder.	2	Hundreds of feet precision, 3A limited codes.
ATSEP.SUR.SSR_1.4.6	Describe the conformity to regulations.	2	Equipage obligations, ICAO Annex 10.
ATSEP.SUR.SSR_1.4.7	Describe the data format of the received transponder messages.	2	P1, P2, P3, P4, P5, P6 signals and DPSK modulation (P6).
ATSEP.SUR.SSR_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).
ATSEP.SUR.SSR_1.4.9	Describe the basic characteristics of a	2	Timing, modulation, pulse width, power

	transmitter.		output.
ATSEP.SUR.SSR_1.4.10	Describe the use of the transponder as a field monitor.	2	—

SUB-TOPIC 1.5: Receivers

ATSEP.SUR.SSR_1.5.1	Describe the basic characteristics of an SSR receiver.	2	Standard/MSSR receiver, sensibility, bandwidth, dynamic range, GTC (normal, sectorized), monopulse processor, RSLS, multi-path and interferences.

SUB-TOPIC 1.6: Signal processing and plot extraction

ATSEP.SUR.SSR_1.6.1	Describe monopulse extraction.	2	Phase and amplitude modulation, off-boresight angle calculation, azimuth encoding.
ATSEP.SUR.SSR_1.6.2	Describe sliding window SSR extraction.	2	Leading edge, trailing edge, azimuth accuracy, azimuth encoding.
ATSEP.SUR.SSR_1.6.3	Describe signal processing.	2	Video digitizer, pulse processor, reply decoder (bracket pair detector), synchronous reply correlator.
ATSEP.SUR.SSR_1.6.4	Decode a transponder message.	3	Standard message with SPI set. e.g. Mode S.
ATSEP.SUR.SSR_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.
ATSEP.SUR.SSR_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

ATSEP.SUR.SSR_1.7.1	Describe the basic function of plot combining.	2	Secondary/primary combining, secondary/primary assigning, prime target, range and azimuth collimation.
ATSEP.SUR.SSR_1.7.2	Describe the basic functions of a current	2	—

	radar plot combiner.		

SUB-TOPIC 1.8: Test and measurement

ATSEP.SUR.SSR_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

ATSEP.SUR.SSR_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).
ATSEP.SUR.SSR_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.
ATSEP.SUR.SSR_2.1.3	Explain the complementary use of Mode S and conventional SSR.	2	Mode interlace pattern, operational use of all-call, roll-call.
ATSEP.SUR.SSR_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

ATSEP.SUR.SSR_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.
ATSEP.SUR.SSR_2.2.2	Describe testing possibilities for Mode S.	2	e.g. SASS-C.

TOPIC 3: MULTILATERATION (MLAT)

SUB-TOPIC 3.1: MLAT in use

ATSEP.SUR.SSR_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.
ATSEP.SUR.SSR_3.1.2	Describe the ground mode of	2	Aircraft interrogations, squitters, change

	transponders.		of transponder mode.

SUB-TOPIC 3.2: MLAT principles

ATSEP.SUR.SSR_3.2.1	Explain the MLAT system architecture.	2	Standards, transmitters and receivers, data processing/fusion, redundancy, performance, costs, timing solutions, etc.
ATSEP.SUR.SSR_3.2.2	Appreciate the principles of the MLAT system.	3	Triangulation, coverage, position calculation. e.g. SCAS.
ATSEP.SUR.SSR_3.2.3	Describe how to operate the system.	2	Tracking, map creation and blanking.
ATSEP.SUR.SSR_3.2.4	Describe testing possibilities for MLAT.	2	e.g. SASS-C.

TOPIC 4: SSR ENVIRONMENT

SUB-TOPIC 4.1: SSR Environment

ATSEP.SUR.SSR_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.
ATSEP.SUR.SSR_4.1.2	Describe the users of the 1030 MHz–1090 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 5: AUTOMATIC DEPENDENT SURVEILLANCE (ADS)

TOPIC 1: GENERAL VIEW ON AUTOMATIC DEPENDENT SURVEILLANCE (ADS)

SUB-TOPIC 1.1: Definition of ADS

ATSEP.SUR.ADS_1.1.1	Describe the basic characteristics of ADS.	2	Performance, integrity, latency, QoS, implementation options (e.g. ATN/FANS).
ATSEP.SUR.ADS_1.1.2	List the types of navigation sensors.	1	GNSS, INS, radio NAVAIDs, navigation solutions from FMS, FoM.
ATSEP.SUR.ADS_1.1.3	State the latest developments, implementation plans and projects.	1	e.g. Current and recent tests and trials, ICAO status, EUROCONTROL, FAA and other authorities' positions, airline and equipment manufacturer positions, ATC procedures, time scales.

TOPIC 2: AUTOMATIC DEPENDENT SURVEILLANCE — BROADCAST (ADS-B)

SUB-TOPIC 2.1: Introduction to ADS-B

ATSEP.SUR.ADS_2.1.1	Explain the basic principles of ADS-B.	2	Autonomous operation, navigation solutions, link options, aircraft situation awareness.
ATSEP.SUR.ADS_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

ATSEP.SUR.ADS_2.2.1	Explain the characteristics of the data links used in ADS-B.	2	VDL Mode 4, 1090 MHz extended squitter (1090 ES), UAT.
ATSEP.SUR.ADS_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

ATSEP.SUR.ADS_2.3.1	Describe the use of VDL Mode 4.	2	High-level description.

SUB-TOPIC 2.4: 1090 MHz extended squitter

ATSEP.SUR.ADS_2.4.1	Describe the use of the 1090 MHz extended squitter (1090 ES).	2	High-level description.
ATSEP.SUR.ADS_2.4.2	Explain the principles related to signals in space.	2	Modulation scheme, signal structure, key data and frequency.
ATSEP.SUR.ADS_2.4.3	Explain the principles related to random access technology.	2	Consequences on the RF environment (1090 MHz).
ATSEP.SUR.ADS_2.4.4	Explain the relevant messages.	2	Information in each field, information encoding and decoding.
ATSEP.SUR.ADS_2.4.5	Recognize the structure of a Mode S extended squitter signal.	1	Signal timing and sequencing, data encoding.
ATSEP.SUR.ADS_2.4.6	Explain the interface between the BDS and the extended squitter message.	2	—

SUB-TOPIC 2.5: Universal access transceiver (UAT)

ATSEP.SUR.ADS_2.5.1	State the use of the UAT.	1	—

SUB-TOPIC 2.6: ASTERIX

ATSEP.SUR.ADS_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: AUTOMATIC DEPENDENT SURVEILLANCE — CONTRACT (ADS-C)

SUB-TOPIC 3.1: Introduction to ADS-C

ATSEP.SUR.ADS_3.1.1	Explain the basic principles of ADS-C.	2	Contract, multi-contract, time, event triggering.
ATSEP.SUR.ADS_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

ATSEP.SUR.ADS_3.2.1	Explain the characteristics of the data links used in ADS-C.	2	e.g. Subnetworks (VDLs, AMSS, HFDL).

SUBJECT 6: HUMAN-MACHINE INTERFACE (HMI)

TOPIC 1: HUMAN-MACHINE INTERFACE (HMI)

SUB-TOPIC 1.1: ATCO HMI

ATSEP.SUR.HMI_1.1.1	Describe the display types available.	2	Video, synthetic, mixed.
ATSEP.SUR.HMI_1.1.2	State the type of selections available.	1	Source, range, maps, filters.
ATSEP.SUR.HMI_1.1.3	Describe the advantages of different display types.	2	Clarity, configurability, fallback, data integration.

SUB-TOPIC 1.2: ATSEP HMI

ATSEP.SUR.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.
ATSEP.SUR.HMI_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

ATSEP.SUR.HMI_1.3.1	Describe the transponder interface.	2	Mode A, change procedure, SPI, Mode C, deselection, hijack.
ATSEP.SUR.HMI_1.3.2	Recognize the ACAS/TCAS display and future potential developments.	1	Characteristics, accuracy, alerts, ADS-B, CDTI.
ATSEP.SUR.HMI_1.3.3	Recognize the EGPWS display and future potential developments.	1	—

SUB-TOPIC 1.4: Displays

ATSEP.SUR.HMI_1.4.1	Describe the display types available and their advantages and disadvantages.	2	Raster/rotating, raw/synthetic, monochrome/colour, CRT/LCD, performance (cost, availability, maintainability, ergonomics).

SUBJECT 7: SURVEILLANCE DATA TRANSMISSION (SDT)

TOPIC 1: SURVEILLANCE DATA TRANSMISSION (SDT)

SUB-TOPIC 1.1: Technology and protocols

ATSEP.SUR.SDT_1.1.1	Describe the implementation of formats and protocols.	2	Network protocols, surveillance data networks. e.g. RADNET, messages CAT 1+.
ATSEP.SUR.SDT_1.1.2	Decode ASTERIX messages.	3	e.g. Categories 1, 2, 20, 21, 34, 48, 62.
ATSEP.SUR.SDT_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.
ATSEP.SUR.SDT_1.1.4	Characterize the degradations of the surveillance transmission network.	2	e.g. Saturation, excess latency.

SUB-TOPIC 1.2: Verification methods

ATSEP.SUR.SDT_1.2.1	Identify the causes of a fault based on test tool measurements.	3	e.g. Data analyser, line analyser.

SUBJECT 8: DATA PROCESSING SYSTEMS (DPS)

Note.— This topic and associated objectives are inherited from the course on data processing/automation, subject 7 (section B.5).

TOPIC 2: SYSTEM COMPONENTS

SUB-TOPIC 2.3: Surveillance data processing (SDP) systems

ATSEP.DPR.DPS_2.3.1	Identify all the 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. ARTAS tracker.
ATSEP.DPR.DPS_2.3.2	Describe all the major components of SDP.	2	Functional architecture, technical architecture.
ATSEP.DPR.DPS_2.3.3	Differentiate SDP features in the ATS units.	2	Area control centres, approach control units, aerodrome control towers.
ATSEP.DPR.DPS_2.3.4	Appreciate how to operate the system.	3	e.g. Configuration, adjust parameters, start up and shut down, monitoring.
ATSEP.DPR.DPS_2.3.5	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

Note.— The following topics and associated objectives are inherited from course on communication, subject 2 (section B.2).

TOPIC 1: INTRODUCTION TO NETWORKS

SUB-TOPIC: 1.1 Types

ATSEP.COM.DTA_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.
ATSEP.COM.DTA_1.1.2	Explain how networks meet requirements.	2	Redundancy, bandwidth, BER, time delay, network security.

SUB-TOPIC 1.2: Networks

ATSEP.COM.DTA_1.2.1	Analyse the features of a network.	4	Routing scheme, rate, internal networking, routers, gateways, switches, firewalls. e.g. Wireless networks, bridges, modems, IRB, VRF, EtherChannel, VLAN-trunking, NFV, spanning tree, IPsec tunnels, hierarchical design mode.
ATSEP.COM.DTA_1.2.2	Describe network standards and devices.	2	Ethernet, fibre optic, wireless.
ATSEP.COM.DTA_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

ATSEP.COM.DTA_1.3.1	Explain aspects of external network services.	2	Provided QoS. e.g. SLAs.

SUB-TOPIC 1.4: Measuring tools

ATSEP.COM.DTA_1.4.1	Identify the main parameters of the network to be measured and the corresponding instruments to be used.	3	Types of measurements, typical parameters. e.g. Data analyser (sniffer), NETSCOUT, Wireshark.

SUB-TOPIC 1.5: Troubleshooting

ATSEP.COM.DTA_1.5.1	Appreciate how to troubleshoot a network.	3	e.g. Broken lines, unusable network components, overload, integrity problems.

ATSEP.COM.DTA_1.5.2	Explain the principles of troubleshooting a network.	2	—

TOPIC 2: PROTOCOLS

SUB-TOPIC 2.1: Fundamental theory

ATSEP.COM.DTA_2.1.1	Appreciate the principles of layers.	3	Differences between layers, e.g. layer(s) of sniffer information.
ATSEP.COM.DTA_2.1.2	Appreciate the principles of network addressing.	3	Masks, prefixes, subnets, IP addressing, (unicast, multicast) IPv4 and IPv6, MAC addressing. e.g. Same logical network computers and systems, broadcast, multicast MAC addressing, DHCPv4, DHCPv6.
ATSEP.COM.DTA_2.1.3	Appreciate the principles of an IP routing strategy.	3	Routing tables, preferences, fault tolerance, static and dynamic routing protocols for IPv4 and IPv6, HSRP/VRRP. e.g. Unicast, multicast, broadcast, OSPF, BGP, IS-IS, IDRP, multicast routing, ECMP, route summarization.

SUB-TOPIC 2.2: General protocols

ATSEP.COM.DTA_2.2.1	Describe the general protocol structure.	2	IPv4 and IPv6 (header, fragmentation), UDP and TCP headers, TCP reliable transport. e.g. MPLS, frame structure, PDH, SDH.
ATSEP.COM.DTA_2.2.2	Appreciate the general application layer protocols using the appropriate tools and documentation.	3	NTP, FTP. e.g. SIP (session initiation protocol), SMTP, HTTP.

SUB-TOPIC 2.3: Specific protocols

ATSEP.COM.DTA_2.3.1	Describe the specific protocols.	2	FMTP e.g. BATAP – ARINC 620.

TOPIC 3: NATIONAL NETWORKS

SUB-TOPIC 3.1: National networks

ATSEP.COM.DTA_3.1.1	Name the national networks to which the organization is connected.	1	e.g. ANSP, MET, military, commercial telecom providers, airlines, national network(s).
ATSEP.COM.DTA_3.1.2	Describe the interfaces between national and global networks.	2	—

TOPIC 5: GLOBAL NETWORKS

SUB-TOPIC 5.2: Global architecture

ATSEP.COM.DTA_5.2.2	Describe the SWIM concept.	2	Main SWIM standards, SWIM profiles, standards and protocols, TCP/IP version, compatibility issues. e.g. Topology, potential development, challenges (cybersecurity), opportunities.
ATSEP.COM.DTA_5.2.3	Describe SWIM data.	2	Types of aeronautical data (dynamic, static), other data relevant for aviation, e.g. AMHS data, MET data, 4D trajectory data, aerodrome data, flight procedures.

SUBJECT 2: SURVEILLANCE PRIMARY

TOPIC 1: ATC SURVEILLANCE

Note.— This topic and its associated objective are inherited from the course on surveillance, subject 3 (section B.4).

SUB-TOPIC 1.1: Use of PSR for air traffic services

ATSEP.SUR.PSR_1.1.1	Describe the operational requirements of an en-route or an approach PSR.	2	Range, resolution, coverage, availability.

SUBJECT 3: SURVEILLANCE SECONDARY

Note.— These topics and associated objectives are inherited from the course on surveillance, subject 4 (section B.4).

TOPIC 1: SECONDARY SURVEILLANCE RADAR (SSR) AND MONOPULSE SECONDARY SURVEILLANCE RADAR (MSSR)

SUB-TOPIC 1.1: Use of SSR for air traffic services

ATSEP.SUR.SSR_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

ATSEP.SUR.SSR_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).
ATSEP.SUR.SSR_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.
ATSEP.SUR.SSR_2.1.3	Explain the complementary use of Mode S and conventional SSR.	2	Mode interlace pattern, operational use of all-call, roll-call.
ATSEP.SUR.SSR_2.1.4	Explain Mode S implementation.	2	Elementary and enhanced surveillance, II and SI codes, use of BDS.

TOPIC 3: MULTILATERATION (MLAT)

SUB-TOPIC 3.2: MLAT principles

ATSEP.SUR.SSR_3.2.1	Explain the MLAT system architecture.	2	Standards, transmitters and receivers, data processing/fusion, redundancy, performance, costs, timing solutions, etc.
ATSEP.SUR.SSR_3.2.2	Appreciate the principles of the MLAT system.	3	Triangulation, coverage, position calculation. e.g. SCAS.
ATSEP.SUR.SSR_3.2.3	Describe how to operate the system.	2	Tracking, map creation and blanking.

ATSEP.SUR.SSR_3.2.4	Describe testing possibilities for MLAT.	2	e.g. SASS-C.

SUBJECT 4: SURVEILLANCE — HMI

TOPIC 1: HUMAN-MACHINE INTERFACE (HMI)

Note.— This topic and associated objectives are inherited from the course on surveillance, subject 6 (section B.4).

SUB-TOPIC 1.1: ATCO HMI

ATSEP.SUR.HMI_1.1.1	Describe the display types available.	2	Video, synthetic, mixed.
ATSEP.SUR.HMI_1.1.2	State the type of selections available.	1	Source, range, maps, filters.
ATSEP.SUR.HMI_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 (SDT)

Note.— This topic and associated objectives are inherited from the course on surveillance, subject 7 (section B.4).

SUB-TOPIC 1.1: Technology and protocols

ATSEP.SUR.SDT_1.1.1	Describe the implementation of formats and protocols.	2	Network protocols, surveillance data networks (e.g. RADNET), messages CAT 1+.
ATSEP.SUR.SDT_1.1.2	Decode ASTERIX messages.	3	e.g. Categories 1, 2, 20, 21, 34, 48, 62.
ATSEP.SUR.SDT_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.
ATSEP.SUR.SDT_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: Software integrity and security

ATSEP.DPR.FST_1.1.1	Appreciate how a system can be defended against potential hostile intent via the data processing systems/Internet.	3	Input verification, secure sources. e.g. Leased lines, private networks, eligibility, firewall protection, user/password management, VPN connection.
ATSEP.DPR.FST_1.1.2	Explain how the normal input of a system could be used by unauthorized persons with hostile intent.	2	e.g. Obstruction of radar/sensor communication and location (Mode S, ADS-B, etc.)
ATSEP.DPR.FST_1.1.3	Estimate the impact of security and integrity failures on the operational service.	3	e.g. System crashes due to incorrect input data; main, standby and fallback systems all have same input; possible loss of entire system, results in capacity reductions and safety consequences.
ATSEP.DPR.FST_1.1.4	Appreciate error detection and handling in data, hardware and processes.	3	Identification, consequence, scope, reporting, fault tolerance, soft fail, failsafe, monitoring, fallback.

SUBJECT 7: DATA PROCESSING SYSTEMS (DPS)

TOPIC 1: USER REQUIREMENTS

SUB-TOPIC 1.1: Controller requirements

ATSEP.DPR.DPS_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.
ATSEP.DPR.DPS_1.1.2	Explain ATCO missions and services needed in an approach control unit.	2	Operational requirements. e.g. Vectoring, sequencing, AMAN, CDM.
ATSEP.DPR.DPS_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

ATSEP.DPR.DPS_1.2.1	State different types of trajectories.	1	e.g. FPL-based, surveillance data-based, FMS-based.
ATSEP.DPR.DPS_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

ATSEP.DPR.DPS_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

ATSEP.DPR.DPS_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.
ATSEP.DPR.DPS_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.
ATSEP.DPR.DPS_1.4.3	Explain the benefit of these tools for safety and efficiency.	2	—

TOPIC 2: SYSTEM COMPONENTS

SUB-TOPIC 2.1: Processing systems

ATSEP.DPR.DPS_2.1.1	Describe all the major components of a data processing system.	2	Functional architecture, technical architecture, supervision.

SUB-TOPIC 2.2: Flight data processing systems

ATSEP.DPR.DPS_2.2.1	Identify all the 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, Mode S.
ATSEP.DPR.DPS_2.2.2	Describe all the major components of an FDP.	2	Functional architecture, technical architecture. e.g. HMI, ATC tools, support tools (technical supervision, QoS monitors and logging).
ATSEP.DPR.DPS_2.2.3	Differentiate FDP features in the ATS units.	2	Area control centres, approach control units, aerodrome control towers.
ATSEP.DPR.DPS_2.2.4	Appreciate how to operate the system.	2	e.g. Configuration, adjust parameters, start up and shut down, monitoring.
ATSEP.DPR.DPS_2.2.5	Explain the principles of emergency switching.	2	System degradation, e.g. automatic versus manual cluster takeover, need to notify ATCO's supervisor, operational consequences.

SUB-TOPIC 2.3: Surveillance data processing (SDP) systems

ATSEP.DPR.DPS_2.3.1	Identify all the 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.
ATSEP.DPR.DPS_2.3.2	Describe all the major components of SDP.	2	Functional architecture, technical architecture.
ATSEP.DPR.DPS_2.3.3	Differentiate SDP features in the ATS units.	2	Area control centres, approach control units, aerodrome control towers.
ATSEP.DPR.DPS_2.3.4	Appreciate how to operate the system.	3	e.g. Configuration, adjust parameters, start up and shut down, monitoring.
ATSEP.DPR.DPS_2.3.5	Explain the principles of emergency switching.	2	—

SUBJECT 8: DATA PROCESS

TOPIC 1: SOFTWARE PROCESS

SUB-TOPIC 1.1: Middleware

ATSEP.DPR.PRC_1.1.1	Characterize middleware.	2	Additional specialized function built on the OS.
ATSEP.DPR.PRC_1.1.2	List the middleware used in the major national systems.	1	e.g. CORBA, UBSS, OTM, EJB.
ATSEP.DPR.PRC_1.1.3	Describe the use of middleware in an ATM environment.	2	Dual processing system.

SUB-TOPIC 1.2: Operating systems (OS)

ATSEP.DPR.PRC_1.2.1	Describe the major aspects of a relevant OS.	2	e.g. Design, start-up, configuration, backup and restoring.
ATSEP.DPR.PRC_1.2.2	Identify relevant OS commands.	3	e.g. Linux systems.
ATSEP.DPR.PRC_1.2.3	Characterize typical consequences of an OS upgrade.	2	Some possible implications on hardware (performance, memory), middleware (compatibility) and software components.
ATSEP.DPR.PRC_1.2.4	Explain downward compatibility.	2	Checks on embedded software modules' ability to run under new OS version.
ATSEP.DPR.PRC_1.2.5	Take account of hardware/software compatibility.	2	Examples of hardware requirements for specific software implementations.
ATSEP.DPR.PRC_1.2.6	Describe interactions between an application and OS.	2	Examples of OS calls by the application software if no middleware is in use.
ATSEP.DPR.PRC_1.2.7	Describe the life cycle management of an OS.	2	e.g. Versions, releases, patches, migration.
ATSEP.DPR.PRC_1.2.8	Appreciate different installation methods.	3	Standard (COTS) edition versus customised edition OS, consideration of security, upgradeability and compatibility.

SUB-TOPIC 1.3: Configuration control

ATSEP.DPR.PRC_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

ATSEP.DPR.PRC_1.4.1	State the main software development processes.	1	SWALs e.g. Life cycle, waterfall model, RUP.
ATSEP.DPR.PRC_1.4.2	List the main steps of two of the main software development processes.	1	—
ATSEP.DPR.PRC_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

ATSEP.DPR.PRC_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 consequences (e.g. personnel, training, spares, procedures), environmental requirements (e.g. size, power requirements, temperature, interfaces), testing.

SUB-TOPIC 2.2: COTS

ATSEP.DPR.PRC_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

ATSEP.DPR.PRC_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.
ATSEP.DPR.PRC_2.3.2	Describe techniques for virtualization.	2	Hypervisor e.g. Hypervisor type 1 and type 2; container technology (LXC, Docker)

SUB-TOPIC 2.4: Maintainability

ATSEP.DPR.PRC_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

ATSEP.DPR.PRC_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.
ATSEP.DPR.PRC_3.1.2	Appreciate the techniques available for system testing and integration.	3	e.g. System integration testing, load testing, regression testing.

TOPIC 4: VIRTUALIZATION

SUB-TOPIC 4.1: Introduction to virtualization

ATSEP.DPR.PRC_4.1.1	Explain the concept of virtualization.	2	Working principles, advantages and disadvantages.
ATSEP.DPR.PRC_4.1.2	Describe the virtualization technologies and tools in use.	2	e.g. VMware, hypervisor.
ATSEP.DPR.PRC_4.1.3	Consider how virtualization can be used in an ATM environment.	2	—

SUBJECT 9: DATA

TOPIC 1: DATA ESSENTIALS FEATURES

SUB-TOPIC 1.1: Data significance

ATSEP.DPR.DTA_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

ATSEP.DPR.DTA_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

ATSEP.DPR.DTA_1.3.1	Name the authority responsible for standards.	1	e.g. ICAO, ISO, RSOO, national authority.
ATSEP.DPR.DTA_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.
ATSEP.DPR.DTA_1.3.3	Decode a typical OLDI message.	3	e.g. ACT, PAC.
ATSEP.DPR.DTA_1.3.4	State the nature of ATM processing requirements.	1	Data volatility (e.g. radar), system integrity, consequences of failure.

TOPIC 2: ATM DATA DETAILED STRUCTURE

SUB-TOPIC 2.1: System area

ATSEP.DPR.DTA_2.1.1	Describe how a system area is defined.	2	e.g. Size, system centre (reference point).
ATSEP.DPR.DTA_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

ATSEP.DPR.DTA_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.
ATSEP.DPR.DTA_2.2.2	Explain the importance of characteristic points in the correct presentation of data.	2	—
ATSEP.DPR.DTA_2.2.3	Describe the process by which amended adaptation files are introduced.	2	—

SUB-TOPIC 2.3: Aircraft performance

ATSEP.DPR.DTA_2.3.1	List the performance data used in the FDPS.	1	Example of data from an in-house system.
ATSEP.DPR.DTA_2.3.2	Describe the structure of aircraft performance data.	2	—
ATSEP.DPR.DTA_2.3.3	Define speeds, rates and levels.	1	—
ATSEP.DPR.DTA_2.3.4	Explain the consequences of the use of the wrong type of aircraft.		—

SUB-TOPIC 2.4: Screen manager

ATSEP.DPR.DTA_2.4.1	Describe how the screen manager is used to set up the ATC HMI.	2	—

SUB-TOPIC 2.5: Auto-coordination messages

ATSEP.DPR.DTA_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.
ATSEP.DPR.DTA_2.5.2	Describe the characteristics of the remote centres relevant to OLDI.	2	Civil and military.

SUB-TOPIC 2.6: Configuration control data

ATSEP.DPR.DTA_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.

ATSEP.DPR.DTA_2.7.1	Explain the structure of the physical configuration data.	2	External configuration, device configuration.

SUB-TOPIC 2.8: Relevant meteorology data

ATSEP.DPR.DTA_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

ATSEP.DPR.DTA_2.9.1	Explain the importance of alert and error messages.	2	—
ATSEP.DPR.DTA_2.9.2	Describe different categories of alert and error messages.	2	—

SUB-TOPIC 2.10 Alert and error messages to ATCO

ATSEP.DPR.DTA_2.10.1	Describe the structure of the data used in these types of message.	2	MSAW, conflict alert parameters.
ATSEP.DPR.DTA_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

Note.— The following topics and associated objectives are inherited from the course on communication, subject 1 (section B.2).

TOPIC 1: AIR-GROUND

SUB-TOPIC 1.4: Controller working position

ATSEP.COM.VCE_1.4.1	Describe the most common features of a controller working position and the HMI.	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

ATSEP.COM.VCE_2.1.1	Describe the different types of interfaces.	2	e.g. Analogue (2, 4, 6 and 8 wires), digital ISDN (64 Kb, 2 Mb, IP).

SUB-TOPIC 2.3: Switch

ATSEP.COM.VCE_2.3.1	State the similarities between ground-ground and air-ground switches.	1	Switching techniques.
ATSEP.COM.VCE_2.3.2	Describe the most commonly used functionality of PABX.	2	General architecture, digital, analogue, multiplex types, PCM30, e.g. IPBX.
ATSEP.COM.VCE_2.3.3	Explain conversion analogue-digital, digital-analogue.	2	General architecture, analogue-digital-analogue.

SUB-TOPIC 2.5: Controller working position

ATSEP.COM.VCE_2.5.1	Describe the most common features of a controller working position and the HMI.	2	—

SUBJECT 2: COMMUNICATION DATA

Note.— The following topics and associated objectives are inherited from the course on communication, subject 2 (section B.2).

TOPIC 4: NETWORKS

SUB-TOPIC 4.1: Network technologies

ATSEP.COM.DTA_4.1.1	State current and emerging network technologies.	1	e.g. as used in AMHS, PENS.
ATSEP.COM.DTA_4.1.2	Describe the characteristics of the current networks.	2	Surveillance data, flight plan data and AIS networks. e.g. Quality of service, architecture, FMTP, AMHS.

TOPIC 5: GLOBAL NETWORKS

SUB-TOPIC 5.1: Networks and standards

ATSEP.COM.DTA_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 Global architecture

ATSEP.COM.DTA_5.2.2	Describe the SWIM concept.	2	Main SWIM standards, SWIM profiles, standards and protocols, TCP/IP version, compatibility issues. e.g. Topology, potential development, challenges (cybersecurity), opportunities.
ATSEP.COM.DTA_5.2.3	Describe SWIM data.	2	Types of aeronautical data (dynamic, static), other data relevant for aviation, e.g. AMHS data, MET data, 4D trajectory data, aerodrome data, flight procedures.

SUBJECT 3: COMMUNICATION RECORDERS

TOPIC 1: LEGAL RECORDERS

Note.— This topic and associated objectives are inherited from the course on communication, subject 3 (section B.2).

SUB-TOPIC 1.1: Regulations

ATSEP.COM.REC_1.1.1	Explain international regulations.	2	ICAO (recording and reproducing).
ATSEP.COM.REC_1.1.2	Explain national regulations.	2	Appropriate national regulations.
ATSEP.COM.REC_1.1.3	Consider recording and reproducing processes.	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

ATSEP.COM.REC_1.2.1	Explain the principles of voice recording.	2	Recording interfaces, codecs, ambient recording. e.g. Analogue: A/D converters, E1, VoIP office telephony, VoIP VCS ED-137; A-law, u-law codecs; frequency range (300 to 3400 Hz).
ATSEP.COM.REC_1.2.2	Explain the principles of video recording.	2	Software recording, hardware recording, evidence.

ATSEP.COM.REC_1.2.3	Explain the security of recorded data.	2	Confidentiality, protection against tampering, access protection, access logging.
ATSEP.COM.REC_1.2.4	Explain the principles of replay.	2	Synchronisation of screen/radar and voice recording, replay limitations, e.g. inability to measure separation on screen replay.

SUBJECT 4: NAVIGATION — GROUND-BASED SYSTEMS — NDB

TOPIC 1: NON-DIRECTIONAL BEACON (NDB)

Note.— This topic and associated objectives are inherited from the course on navigation, subject 4 (section B.3).

SUB-TOPIC 1.1: Use of the system

ATSEP.NAV.NDB_1.1.1	Appreciate the principles of an NDB.	3	Relative bearing, measuring method.
ATSEP.NAV.NDB_1.1.2	Describe the overall performance.	2	Coverage, accuracy, availability of the system, integrity, continuity.
ATSEP.NAV.NDB_1.1.3	Explain the technical limitations of an NDB.	2	Lack of accuracy, lack of integrity, sensitivity to interference.
ATSEP.NAV.NDB_1.1.4	Describe the current situation.	2	e.g. Number, type, users, user groups, regional context.

SUBJECT 5: NAVIGATION — GROUND-BASED SYSTEMS — DF

TOPIC 1: DIRECTION FINDER (DF)

Note.— This topic and associated objectives are inherited from the course on navigation, subject 5 (section B.3).

SUB-TOPIC 1.1: Use of the system

ATSEP.NAV.DFI_1.1.1	State the different types of DFs.	1	VDF, DDF, IDF.
ATSEP.NAV.DFI_1.1.2	Describe the user HMI.	2	Indication on radar picture, DF indicator.
ATSEP.NAV.DFI_1.1.3	Appreciate the principles of DFs.	3	Bearing, measuring method (standard, Doppler, interferometry).
ATSEP.NAV.DFI_1.1.4	Describe the overall performance.	2	Coverage, accuracy, availability of the system, integrity, continuity.

ATSEP.NAV.DFI_1.1.5	Explain the technical limitations of DFs.	2	Sensitivity to interference.
ATSEP.NAV.DFI_1.1.6	Describe the current situation.	2	e.g. Number, type, users, national context.

SUBJECT 6: NAVIGATION — GROUND-BASED SYSTEMS — VOR

TOPIC 1: VERY HIGH FREQUENCY OMNIDIRECTIONAL RADIO RANGE (VOR)

Note.— This topic and associated objectives are inherited from the course on navigation, subject 6 (section B.3).

SUB-TOPIC 1.1: Use of the system

ATSEP.NAV.VOR_1.1.1	State the types of VOR systems.	1	Conventional, Doppler.
ATSEP.NAV.VOR_1.1.2	Describe the overall performance.	2	Coverage, accuracy, availability of the system, integrity, continuity.
ATSEP.NAV.VOR_1.1.3	Explain the technical limitations of CVOR.	2	Type of information (azimuth), accuracy, integrity, suitable for a network of fixed routes.
ATSEP.NAV.VOR_1.1.4	Appreciate the differences between CVOR and DVOR.	3	Signal broadcast differences, bearing information robustness.
ATSEP.NAV.VOR_1.1.5	Describe the current situation.	2	e.g. Number, type, users, user groups, national context, regional context.

SUBJECT 7: NAVIGATION — GROUND-BASED SYSTEMS — DME

TOPIC 1: DISTANCE MEASURING EQUIPMENT (DME)

Note.— This topic and associated objectives are inherited from the course on navigation, subject 7 (section B.3).

SUB-TOPIC 1.1: Use of the system

ATSEP.NAV.DME_1.1.1	Describe the overall performance of DME.	2	Coverage, accuracy, availability of the system, integrity, continuity, number of users.
ATSEP.NAV.DME_1.1.2	Explain the limitations of DME.	2	Accuracy, integrity, capacity.
ATSEP.NAV.DME_1.1.3	Describe the current situation.	2	e.g. Number, types, users, user groups, national context, regional context.

ATSEP.NAV.DME_1.1.4	State the role of the DME infrastructure in future navigation applications.	1	PBN.
ATSEP.NAV.DME_1.1.5	Explain the differences between DME and TACAN for civilian use.	2	e.g. Azimuth and range.

SUBJECT 8: NAVIGATION — GROUND-BASED SYSTEMS — ILS

TOPIC 1: INSTRUMENT LANDING SYSTEM (ILS)

Note.— This topic and associated objectives are inherited from the course on navigation, subject 8 (section B.3).

SUB-TOPIC 1.1: Use of the system

ATSEP.NAV.ILS_1.1.1	Describe the overall performance of an ILS.	2	ICAO Annexes 10 and 14. Coverage, accuracy, availability of the system, integrity, continuity, number of users.
ATSEP.NAV.ILS_1.1.2	Explain the technical limitations of an ILS.	2	ICAO Annexes 10 and 14. Only 40 channels, no segmented paths of approach, beam corruption due to multi-path.
ATSEP.NAV.ILS_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.
ATSEP.NAV.ILS_1.1.4	Explain the importance and need for ILS obstacle-free zones.	2	ICAO Annexes 10 and 14. Dimensions, ILS beam protection, increased significance during LVP conditions, e.g. national regulations.
ATSEP.NAV.ILS_1.1.5	Consider the need for ATC ILS status indications.	2	No continuous monitoring by ATSEP.

SUBJECT 9: SURVEILLANCE — PRIMARY

TOPIC 1: PRIMARY SURVEILLANCE RADAR (PSR)

Note.— This topic and its associated objective are inherited from the course on surveillance, subject 3 (section B.4).

SUB-TOPIC 1.1: Use of PSR for air traffic services

ATSEP.SUR.PSR_1.1.1	Describe the operational requirements of an en-route or an approach PSR.	2	Range, resolution, coverage, availability.

SUBJECT 10: SECONDARY SURVEILLANCE

Note.— The following topics and associated objectives are inherited from the course on surveillance, subject 4 (section B.4).

TOPIC 1: SECONDARY SURVEILLANCE RADAR (SSR) AND MONOPULSE SECONDARY SURVEILLANCE RADAR (MSSR)

SUB-TOPIC 1.1: Use of SSR for air traffic services

ATSEP.SUR.SSR_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

ATSEP.SUR.SSR_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).
ATSEP.SUR.SSR_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.
ATSEP.SUR.SSR_2.1.3	Explain the complementary use of Mode S and conventional SSR.	2	Mode interlace pattern, operational use of all-call, roll-call.
ATSEP.SUR.SSR_2.1.4	Explain Mode S implementation.	2	Elementary and enhanced surveillance, II and SI codes, use of BDS.

TOPIC 3: MULTILATERATION (MLAT)

SUB-TOPIC 3.2: MLAT principles

ATSEP.SUR.SSR_3.2.1	Explain the MLAT system architecture.	2	Standards, transmitters and receivers, data processing/fusion, redundancy, performance, costs, timing solutions, etc.
ATSEP.SUR.SSR_3.2.2	Appreciate the principles of the MLAT system.	3	Triangulation, coverage, position calculation. e.g. SCAS.
ATSEP.SUR.SSR_3.2.3	Describe how to operate the system.	2	Tracking, map creation and blanking.
ATSEP.SUR.SSR_3.2.4	Describe testing possibilities for MLAT.	2	e.g. SASS-C.

SUBJECT 11: SURVEILLANCE — HMI

TOPIC 1: HUMAN-MACHINE INTERFACE (HMI)

Note.— This topic and associated objectives are inherited from the course on surveillance, subject 6 (section B.4).

SUB-TOPIC 1.1: ATCO HMI

ATSEP.SUR.HMI_1.1.1	Describe the display types available.	2	Video, synthetic, mixed.
ATSEP.SUR.HMI_1.1.2	State the type of selections available.	1	Source, range, maps, filters.
ATSEP.SUR.HMI_1.1.3	Describe the advantages of different display types.	2	Clarity, configurability, fallback, data integration.

SUBJECT 12: SURVEILLANCE — DATA TRANSMISSION

TOPIC 1: SURVEILLANCE DATA TRANSMISSION (SDT)

Note.— This topic and associated objectives are inherited from the course on surveillance, subject 7 (section B.4).

SUB-TOPIC 1.1: Technology and protocols

ATSEP.SUR.SDT_1.1.1	Describe the implementation of formats and protocols.	2	Network protocols, surveillance data networks. e.g. RADNET, messages CAT 1+.
ATSEP.SUR.SDT_1.1.2	Decode ASTERIX messages.	3	e.g. Categories 1, 2, 20, 21, 34, 48, and

			62.
ATSEP.SUR.SDT_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.
ATSEP.SUR.SDT_1.1.4	Characterize the degradations of the surveillance transmission network.	2	e.g. Saturation, excess latency.

SUBJECT 13: DATA PROCESSING — DPS SYSTEMS

Note.— The following topics and associated objectives are inherited from the course on data processing/automation, subject 7 (section B.5).

TOPIC 1: USER REQUIREMENTS

SUB-TOPIC 1.1: Controller requirements

ATSEP.DPR.DPS_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.
ATSEP.DPR.DPS_1.1.2	Explain ATCO missions and services needed in an approach control unit.	2	Operational requirements. e.g. Vectoring, sequencing, AMAN, CDM.
ATSEP.DPR.DPS_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

ATSEP.DPR.DPS_1.2.1	State different types of trajectories.	1	e.g. FPL-based, surveillance data-based, FMS-based.
ATSEP.DPR.DPS_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

ATSEP.DPR.DPS_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

ATSEP.DPR.DPS_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.
ATSEP.DPR.DPS_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.
ATSEP.DPR.DPS_1.4.3	Explain the benefit of these tools for safety and efficiency.	2	—

SUBJECT 14: DATA PROCESSING — DATA PROCESS

Note.— The following topics and associated objectives are inherited from the course on data processing/automation, subject 8 (section B.5).

TOPIC 1: SOFTWARE PROCESS

SUB-TOPIC 1.2: Operating systems (OS)

ATSEP.DPR.PRC_1.2.2	Identify relevant OS commands.	3	e.g. Linux systems.

TOPIC 2: HARDWARE PLATFORM

SUB-TOPIC 2.1: Equipment upgrade

ATSEP.DPR.PRC_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 consequences (e.g. personnel, training, spares, procedures), environmental requirements (e.g. size, power requirements, temperature, interfaces), testing.

SUB-TOPIC 2.2: COTS

ATSEP.DPR.PRC_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

ATSEP.DPR.PRC_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.

SUBJECT 15: DATA PROCESSING — DATA

TOPIC 1: DATA ESSENTIALS FEATURES

Note.— This topic and associated objectives are inherited from the course on data processing/automation, subject 9 (section B.5).

SUB-TOPIC 1.1: Data significance

ATSEP.DPR.DTA_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

ATSEP.DPR.DTA_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

ATSEP.DPR.DTA_1.3.1	Name the authority responsible for standards.	1	e.g. ICAO, ISO, RSOO, national authority.
ATSEP.DPR.DTA_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.
ATSEP.DPR.DTA_1.3.3	Decode a typical OLDI message.	3	e.g. ACT, PAC.
ATSEP.DPR.DTA_1.3.4	State the nature of ATM processing requirements.	1	Data volatility (e.g. radar), system integrity consequences of failure.

SUBJECT 16: ANS STRUCTURE

TOPIC 1: ANSP ORGANIZATION AND OPERATION

SUB-TOPIC 1.1: ANSP organization and operation

ATSEP.SMC.ANS_1.1.1	Describe the SMC function within the organization.	2	What SMC does, interfaces with other functions, similarities and major differences between the SMC function at different sites.
ATSEP.SMC.ANS_1.1.2	Describe the structure, roles and responsibilities of the SMC team and any direct interfaces.	2	—
ATSEP.SMC.ANS_1.1.3	Explain the duties of the ATC supervisor.	2	—

TOPIC 2: ANSP MAINTENANCE PROGRAMME

SUB-TOPIC 2.1: Policy

ATSEP.SMC.ANS_2.1.1	Describe, in general terms, the ANSP maintenance policy.	2	—
ATSEP.SMC.ANS_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

ATSEP.SMC.ANS_3.1.1	Describe the ATM requirements and the related services provided by SMC.	2	Service level agreements, working arrangements. e.g. ASM, ATFCM.

TOPIC 4: ANSP ADMINISTRATIVE PRACTICES

SUB-TOPIC 4.1: Administration

ATSEP.SMC.ANS_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 17: ANS SYSTEM/EQUIPMENT

TOPIC 1: OPERATIONAL IMPACTS

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

ATSEP.SMC.ASE_1.1.1	Describe the importance of monitoring system performance.	2	—
ATSEP.SMC.ASE_1.1.2	Describe possible ways in which SMC may become aware of degradation of services and/or systems.	2	e.g. Monitoring systems, telephone calls, aural alerts, user complaint.
ATSEP.SMC.ASE_1.1.3	Take account of the end users/customers affected.	2	e.g. ATC units, airports, airlines.
ATSEP.SMC.ASE_1.1.4	Appreciate the implications for end users/customers.	3	—
ATSEP.SMC.ASE_1.1.5	Appreciate the appropriate actions to restore service.	3	e.g. Switching, replacing, reconfiguration, calling external service provider.
ATSEP.SMC.ASE_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

ATSEP.SMC.ASE_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

ATSEP.SMC.ASE_2.2.1	Appreciate SMC working position performance to agreed parameters.	3	—

SUBJECT 18: SMC — TOOLS, PROCESSES AND PROCEDURES

TOPIC 1: REQUIREMENTS

SUB-TOPIC 1.1: SMS

ATSEP.SMC.TPP_1.1.1	Describe the ICAO and regional requirements and the national and ATSP	2	ICAO Annex 19, regional requirements.

	SMS.		

SUB-TOPIC 1.2: Quality management system (QMS)

ATSEP.SMC.TPP_1.2.1	Describe QMS requirements.	2	e.g. ISO, EFQM.

SUB-TOPIC 1.3: SMS application in the working environment

ATSEP.SMC.TPP_1.3.1	Describe the relationship between the SMS and the application of SMC.	2	Reporting procedures.
ATSEP.SMC.TPP_1.3.2	Explain which occurrences require incident reporting and follow-up action(s).	2	e.g. National categories for reporting, safety event processing.
ATSEP.SMC.TPP_1.3.3	Apply incident reporting procedures to example occurrence(s).	3	e.g. Safety event procedure.

TOPIC 2: REQUIREMENTS FOR MAINTENANCE AGREEMENTS WITH OUTSIDE AGENCIES

SUB-TOPIC 2.1: Principles of agreements

ATSEP.SMC.TPP_2.1.1	Describe the principles of and need for maintenance agreements.	2	e.g. Types of service levels provided.
ATSEP.SMC.TPP_2.1.2	Describe within which functional areas maintenance agreements will occur.	2	e.g. Network providers, facilities management, communications.
ATSEP.SMC.TPP_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

ATSEP.SMC.TPP_3.1.1	Describe the role and general method of operation of SMC.	2	—
ATSEP.SMC.TPP_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.

ATSEP.SMC.TPP_3.1.3	Describe the coordination role of SMC.	2	e.g. ATSEP, ATCOs, external service providers, ATM stakeholders.
ATSEP.SMC.TPP_3.1.4	Describe how risk analysis can contribute to decision-making.	2	e.g. Assessing risk, handling of service interventions.

TOPIC 4: MAINTENANCE MANAGEMENT SYSTEMS

SUB-TOPIC 4.1: Reporting

ATSEP.SMC.TPP_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.
ATSEP.SMC.TPP_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 19: TECHNOLOGY

TOPIC 1: TECHNOLOGIES AND PRINCIPLES

SUB-TOPIC 1.1: General

ATSEP.SMC.TEC_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

ATSEP.SMC.TEC_1.2.1	Describe the key aspects of control and monitoring system capabilities.	2	e.g. Parameters presented to SMC and types of actions that can be taken.
ATSEP.SMC.TEC_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

ATSEP.SMC.TEC_1.3.1	Describe the key aspects of control and monitoring system capabilities.	2	e.g. Parameters presented to SMC and types of actions that can be taken.
ATSEP.SMC.TEC_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

ATSEP.SMC.TEC_1.4.1	Describe the key aspects of control and monitoring system capabilities.	2	e.g. Parameters presented to SMC and types of actions that can be taken.
ATSEP.SMC.TEC_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

ATSEP.SMC.TEC_1.5.1	Describe the key aspects of control and monitoring system capabilities.	2	e.g. Parameters presented to SMC and types of actions that can be taken.
ATSEP.SMC.TEC_1.5.2	Appreciate the impact of the replacement of components in the data processing chain.	3	Continuity of service, data processing, chain integrity.

SUB-TOPIC 1.6: Facilities

ATSEP.SMC.TEC_1.6.1	Describe the key aspects of system management capabilities.	2	e.g. Parameters presented to SMC and types of actions that can be taken.
ATSEP.SMC.TEC_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

ATSEP.INF.PWS_1.1.1	Describe the power distribution system at a typical site.	2	Commercial net, UPS, engine generator set, battery stations, redundancy, solar systems.
ATSEP.INF.PWS_1.1.2	Design the block diagram of the power distribution system at a typical site.	4	Components.

SUB-TOPIC 1.2: Safety

ATSEP.INF.PWS_1.2.1	Explain any appropriate local and ICAO regulations in force.	2	Company rules.
ATSEP.INF.PWS_1.2.2	Discuss the precautions to be taken when working on power equipment.	5	High voltage, earthing techniques, personal safety, precautions to take to handle batteries.

TOPIC 2: Uninterruptible power supply (UPS)

SUB-TOPIC 2.1: Design and operational requirements

ATSEP.INF.PWS_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.
ATSEP.INF.PWS_2.1.2	Design a block diagram of a UPS.	4	Inputs/outputs, rectifier, inverter, converter, static switch, control panel, filters, bypass, batteries.
ATSEP.INF.PWS_2.1.3	Analyse and interpret the components and performance of a UPS.	4	Inputs/outputs, rectifier, inverter, converter, static switch, control panel, filters, bypass, batteries.
ATSEP.INF.PWS_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

ATSEP.INF.PWS_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.
ATSEP.INF.PWS_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.
ATSEP.INF.PWS_3.1.3	Analyse and interpret the components and performance of GenSet.	4	Engines, generator, control panel, power transfer switch, bypass, fuel system, air supply system and filters.
ATSEP.INF.PWS_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

ATSEP.INF.PWS_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.
ATSEP.INF.PWS_4.1.2	Design a block diagram of a battery station.	4	Batteries, connections (parallel, serial), chargers, types, characteristics.
ATSEP.INF.PWS_4.1.3	Explain and analyse the main components and performance of batteries and battery stations.	2	Batteries, connections (parallel, serial), chargers, types, characteristics.
ATSEP.INF.PWS_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

ATSEP.INF.PWS_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.
ATSEP.INF.PWS_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.
ATSEP.INF.PWS_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

ATSEP.INF.PWS_6.1.1	State the role of ATSEP in safety management routines and in reporting processes.	1	Safety assessment documentation related to the power supply system, safety reports and occurrences, safety monitoring.

SUB-TOPIC 6.2: Functional safety

ATSEP.INF.PWS_6.2.1	Describe the implications of functional failures in terms of exposure time, environment and 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 policies.

TOPIC 7: HEALTH AND SAFETY

SUB-TOPIC 7.1: Hazard awareness

ATSEP.INF.PWS_7.1.1	State potential hazards to health and safety generated by power supply equipment.	1	Mechanical hazards, electrical hazards (HV/LV, EMI), chemical hazards.

SUB-TOPIC 7.2: Rules and procedures

ATSEP.INF.PWS_7.2.1	State applicable international requirements.	1	Relevant international documents.
ATSEP.INF.PWS_7.2.2	State any applicable legal national requirement.	1	Relevant national documents.
ATSEP.INF.PWS_7.2.3	State the safety procedure for 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

ATSEP.INF.PWS_7.3.1	In a practical situation, apply and demonstrate the procedures and techniques to be followed.	2	e.g. Replacing fuses or boards, starting up or shutting down a station, climbing procedures.

SUB-TOPIC 7.4: Resuscitation techniques

ATSEP.INF.PWS_7.4.1	Apply and demonstrate resuscitation techniques.	2	First aid, rescue procedures, resuscitation.

TOPIC 8: Air conditioning

SUB-TOPIC 8.1: Cooling

ATSEP.INF.PWS_8.1.1	Explain the importance of cooling for the CNS/ATM system.	1	Operational and technical point of view.
ATSEP.INF.PWS_8.1.2	Check and troubleshoot a cooling system.	3	Monitoring, maintenance, periodic testing.

SUB-TOPIC 8.2: Heating

ATSEP.INF.PWS_8.2.1	Explain the importance of heating for air conditioning systems.	1	Operational and technical point of view.
ATSEP.INF.PWS_8.2.2	Check and troubleshoot a heating system.	3	Monitoring, maintenance, periodic testing.

SUB-TOPIC 8.3: Fresh air supply

ATSEP.INF.PWS_8.3.1	Explain the importance of fresh air supply for air conditioning systems.	1	Operational and technical point of view.
ATSEP.INF.PWS_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: Need for engineering

ATSEP.ENG.EGI_1.1.1	Define the role of engineering in an ANSP.	1	—

SUB-TOPIC 1.2: Engineering basics

ATSEP.ENG.EGI_1.2.1	Describe the importance of engineering standards and procedures.	2	—
ATSEP.ENG.EGI_1.2.2	Describe engineering quality management.	2	—

ATSEP.ENG.EGI_1.2.3	Describe engineering standards.	2	—
ATSEP.ENG.EGI_1.2.4	Describe the equipment life cycle.	2	—

TOPIC 2: SAFETY

SUB-TOPIC 2.1: Laboratory safety procedures

ATSEP.ENG.EGI_2.1.1	Describe safety procedures.	2	—

SUB-TOPIC 2.2: Personnel/equipment safety procedures

ATSEP.ENG.EGI_2.2.1	Describe personnel safety.	2	—

SUB-TOPIC 2.3: Electrostatic discharge precautions

ATSEP.ENG.EGI_2.3.1	Describe safety equipment.	2	—
ATSEP.ENG.EGI_2.3.2	Describe fire and emergency procedures.	2	—

SUB-TOPIC 2.4: Fire and emergency procedures

ATSEP.ENG.EGI_2.4.1	Describe electrostatic discharge.	2	—
ATSEP.ENG.EGI_2.4.2	Describe fire and emergency procedures.	2	—

TOPIC 3: RESILIENCE

SUB-TOPIC 3.1: Resilience and safety

ATSEP.ENG.EGI_3.1.1	Take account of modelling state-of-the-art approaches.	2	—

SUB-TOPIC 3.2: Applicable models

ATSEP.ENG.EGI_3.2.1	Take account of modelling state-of-the-art approaches.	2	—

SUB-TOPIC 3.3: STAMP – Accident causation model

ATSEP.ENG.EGI_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

ATSEP.ENG.EGI_3.4.1	Take account of following resilient engineering concepts; take account of modelling state-of-the-art approaches of design and implement them.	2	—
ATSEP.ENG.EGI_3.4.2	Take account of following resilient engineering concepts.	2	—

SUBJECT 2: REQUIREMENTS AND SPECIFICATIONS

TOPIC 1: DEFINING

SUB-TOPIC 1.1: Regulations

ATSEP.ENG.RES_1.1.1	Describe the purpose of regulations.	2	—
ATSEP.ENG.RES_1.1.2	Define regulations.	1	—

SUB-TOPIC 1.2: Performance

ATSEP.ENG.RES_1.2.1	Define specifications.	1	—
ATSEP.ENG.RES_1.2.2	Balance/assess technical solutions.	5	—
ATSEP.ENG.RES_1.2.3	Analyse requirements and project utilization onto the operational environment.	4	—
ATSEP.ENG.RES_1.2.4	Interpret needs and translate into specifications.	5	—

SUB-TOPIC 1.3: Maintenance

ATSEP.ENG.RES_1.3.1	Define maintenance objectives.	1	—
ATSEP.ENG.RES_1.3.2	Define maintenance requirements.	1	—

ATSEP.ENG.RES_1.3.3	Define maintenance procedures.	1	—

SUB-TOPIC 1.4: Training

ATSEP.ENG.RES_1.4.1	Define training requirements.	1	—
ATSEP.ENG.RES_1.4.2	Organize training programmes.	4	—
ATSEP.ENG.RES_1.4.3	Organize training courses.	4	—
ATSEP.ENG.RES_1.4.4	Assess training results.	5	—

TOPIC 2: INSTALLATION REQUIREMENTS

SUB-TOPIC 2.1: Human resources

ATSEP.ENG.RES_2.1.1	Manage teams.	4	—

TOPIC 3: TRACE

SUB-TOPIC 3.1: Monitor evolution

ATSEP.ENG.RES_3.1.1	Take account of mandatory legislative updates.	2	—

SUBJECT 3: DESIGN

TOPIC 1: PROJECT MANAGEMENT

SUB-TOPIC 1.1: Design and planning

ATSEP.ENG.DES_1.1.1	Demonstrate project management and estimate the cost.	2	—
ATSEP.ENG.DES_1.1.2	Describe design and planning.	2	—
ATSEP.ENG.DES_1.1.3	Describe the implementation phase.	2	—
ATSEP.ENG.DES_1.1.4	State the various phases of an installation project.	1	—
ATSEP.ENG.DES_1.1.5	Describe the project brief.	2	—

SUB-TOPIC 1.2: Problem reporting and change request

ATSEP.ENG.DES_1.2.1	Describe problem reporting and change request.	2	—

SUB-TOPIC 1.3: Cost

ATSEP.ENG.DES_1.3.1	Describe budgetary concerns.	2	—

SUB-TOPIC 1.4: Conception

ATSEP.ENG.DES_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

ATSEP.ENG.DES_1.5.1	Identify risks.	3	—
ATSEP.ENG.DES_1.5.2	Analyse risks.	4	—
ATSEP.ENG.DES_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

ATSEP.ENG.VAT_1.1.1	Apply standards and adapt frameworks.	3	—

SUB-TOPIC 1.2: Unit testing

ATSEP.ENG.VAT_1.2.1	Apply a unit test plan.	3	—

SUB-TOPIC 1.3: Integration testing

ATSEP.ENG.VAT_1.3.1	Apply an integration test plan.	3	—

SUB-TOPIC 1.4: System testing

ATSEP.ENG.VAT_1.4.1	Apply a system test plan.	3	—

TOPIC 2: OPERATIONAL VALIDATION

SUB-TOPIC 2.1: Requirements compliance

ATSEP.ENG.VAT_2.1.1	Comply with user requirements/system requirements/test results traceability.	4	—
ATSEP.ENG.VAT_2.1.2	Appreciate results.	3	—
ATSEP.ENG.VAT_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

ATSEP.ENG.INS_1.1.1	Describe how to configure installation items.	2	—
ATSEP.ENG.INS_1.1.2	Describe installation instructions.	2	—
ATSEP.ENG.INS_1.1.3	Describe installation standards and practices.	2	—
ATSEP.ENG.INS_1.1.4	Describe spares and special tools.	2	—
ATSEP.ENG.INS_1.1.5	Describe NOTAMs.	2	—
ATSEP.ENG.INS_1.1.6	Describe impact assessment.	2	—

SUB-TOPIC 1.2: Explain the procurement process

ATSEP.ENG.INS_1.2.1	Describe the requisition on supply.	2	—
ATSEP.ENG.INS_1.2.2	Describe purchasing methods.	2	—
ATSEP.ENG.INS_1.2.3	Describe budgetary concerns.	2	—

TOPIC 2: PHYSICAL INSTALLATION

SUB-TOPIC 2.1: Explain panel assembly

ATSEP.ENG.INS_2.1.1	Describe AC power distribution.	2	—
ATSEP.ENG.INS_2.1.2	Describe DC power distribution.	2	—
ATSEP.ENG.INS_2.1.3	Describe AC ground.	2	—
ATSEP.ENG.INS_2.1.4	Describe signal grounding.	2	—
ATSEP.ENG.INS_2.1.5	Describe protective devices.	2	—
ATSEP.ENG.INS_2.1.6	Describe RF cables and systems.	2	—
ATSEP.ENG.INS_2.1.7	Describe antennas and structures.	2	—
ATSEP.ENG.INS_2.1.8	Describe control cables.	2	—
ATSEP.ENG.INS_2.1.9	Describe cross connections.	2	—

SUB-TOPIC 2.2: Explain rack mechanical assembly

ATSEP.ENG.INS_2.2.1	Describe AC power distribution.	2	—
ATSEP.ENG.INS_2.2.2	Describe DC power distribution.	2	—
ATSEP.ENG.INS_2.2.3	Describe AC ground.	2	—
ATSEP.ENG.INS_2.2.4	Describe signal grounding.	2	—
ATSEP.ENG.INS_2.2.5	Describe protective devices.	2	—
ATSEP.ENG.INS_2.2.6	Describe RF cables and systems.	2	—
ATSEP.ENG.INS_2.2.7	Describe antennas and structures.	2	—
ATSEP.ENG.INS_2.2.8	Describe control cables.	2	—
ATSEP.ENG.INS_2.2.9	Describe cross connections.	2	—

SUB-TOPIC 2.3: Explain rack electrical assembly

ATSEP.ENG.INS_2.3.1	Describe AC power distribution.	2	—
ATSEP.ENG.INS_2.3.2	Describe DC power distribution.	2	—
ATSEP.ENG.INS_2.3.3	Describe AC ground.	2	—
ATSEP.ENG.INS_2.3.4	Describe signal grounding.	2	—
ATSEP.ENG.INS_2.3.5	Describe protective devices.	2	—
ATSEP.ENG.INS_2.3.6	Describe RF cables and systems.	2	—
ATSEP.ENG.INS_2.3.7	Describe antennas and structures.	2	—
ATSEP.ENG.INS_2.3.8	Describe control cables.	2	—
ATSEP.ENG.INS_2.3.9	Describe cross connections.	2	—

Appendix C

TRAINING OBJECTIVES TAXONOMY

DEFINITION OF VERBS FOR EACH LEVEL OF ACCOMPLISHMENT

Definition of verbs — Level 1

Level 1: Requires basic knowledge of the subject. The trainee is able to remember essential points and is expected to memorize and retrieve data.

Verb	*Definition*	*Example*	*Level*
Define	State what something is and what its limits are; state the definition.	Define the global performance of 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 software development processes used in industries.	1
Name	Give the name of objects or procedures.	Name the person designated to authorize changes in operational data.	1
Quote	Repeat what is written or said to underline.	Quote the ICAO definition of ATC services.	1
Recognize	To know what something is because you have seen it before.	Recognize on a diagram all the elements of 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: The student understands the subject sufficiently to discuss it intelligently. Individuals are able to represent for themselves 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 the consequences of an OS upgrade.	2
Consider	To think carefully about something.	Consider institutional issues and service provider responsibilities.	2
Demonstrate	Describe and explain; logically or mathematically prove the truth of a statement.	Demonstrate the possible use of GBAS for approach and landing.	2
Describe	Say what something 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 account of wind influence when calculating ground speed.	2

Definition of verbs — Level 3

Level 3: Requires thorough knowledge of the subject and the ability to apply it with accuracy. Students should be able to make use of their 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 the criticality of the conditions.	3

Verb	*Definition*	*Example*	*Level*
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 that 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 a number of options, 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 the availability of the constellation using a software package or GPS receiver.	3
Execute	Perform an action.	Execute an arrival sequence.	3
Extract	Copy out, make extracts from, find, deduce.	Extract data from a flight plan.	3
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 the flight data display.	3

Verb	*Definition*	*Example*	*Level*
Measure	Ascertain extent or quality of (something) 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	Provide an answer, perform answering or corresponding action.	Respond to the loss of aircraft radar identification.	3
Scan	Look intently at all parts successively.	Scan the 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 ICAO documentation to explain the principles related to signals in space.	3
Verify	Establish truth of.	Verify the impact of requirements on the ground station location and type.	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 an NDB station according to operational requirements.	4
Detect	Discover the existence of.	Detect disturbances.	4
Ensure	Make safe, make certain.	Ensure that 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
Manage	Handle, wield, conduct.	Manage aerodrome surface movements.	4
Organize	Give orderly structure to, frame and put into working order.	Organize arrival sequence.	4

Verb	*Definition*	*Example*	*Level*
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 a 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
Resolve	Solve, clear up, settle.	Resolve conflict.	5

Verb	*Definition*	*Example*	*Level*
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 an 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 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, and 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 *OJT 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 that 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 of 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, section 1.2.2). This module should be developed, implemented and delivered in compliance with the 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 will 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 the ATSEP activities and profile, and in accordance with approved standards and requirements.

3.2.2 In a given situation, the engineering or installation ATSEP will 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 the system or equipment at the final stage of the life cycle. This module should be developed, implemented and delivered in compliance with the 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 taken 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 will 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 the sound cooperation of all stakeholders involved in 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, section 1.2.2). This module should be developed, implemented and delivered in compliance with the 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 blueprints, 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 will 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 the sound cooperation of all stakeholders involved in the deployment activities (e.g. 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 MANAGERS

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 in 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 will 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 of the training objectives below assume that trainees have access to the relevant reference material.

4.2 Training objective for safety ATSEP managers

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 operational 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 references.

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

a) describe the 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 regulations as follows:

a) appraise the safety impact from installation, operation and/or maintenance activities 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 actions in order to mitigate the risk during installation, operation and/or maintenance actions on a CNS/ATM system and/or equipment;

d) apply the 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 managers

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 the CNS/ATM systems environment as follows:

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 activities on the 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 actions in order to mitigate the risk during installation, operation and/or maintenance actions on a CNS/ATM system and/or equipment;

d) apply the 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 managers

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 cyberattacks.

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 the CNS/ATM systems environment:

a) describe the local technical environment; and

b) explain the risks of security breach using any type of connection on the CNS/ATM system and/or equipment.

4.4.6 Trainees will apply security regulations as follows:

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

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

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

d) apply the 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 managers

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 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 regulations for 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 will 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.

— END —

ISBN 978-92-9258-942-4