9003329 0020657 917

FAA-STD-028B

NOTICE

U.S. Department of Transportation
Federal Aviation Administration

N 3000.65

5/1/93

Cancellation
Date: 5/1/94

SUBJ: Contract Training Programs

1. PURPOSE. This notice transmits FAA-STD-028B, Contract Training Programs, as the official standard for contractors who develop and deliver training for the Federal Aviation Administration (FAA).

2. DISTRIBUTION. This notice is distributed to the branch level in Washington headquarters, regions, and centers, with limited distribution to field offices and facilities.

3. BACKGROUND. FAA-STD-028B replaces FAA-STD-028, issued March 28, 1985, and FAA-STD-028A (draft) circulated in 1988. The newly revised standard is being issued to strengthen the Instructional Systems Design (ISD) guidelines, to provide additional training Data Item Descriptions (DID's), and to support the acquisition of computer-based training technologies including courseware for training devices.

4. APPENDICES. Appendix 1 provides further explanation of the revisions that are reflected in FAA-STD-028B. Appendix 2 contains a copy of the revised standard.

5. ACTION. During the effective period of this notice, comments and recommendations for revision of FAA-STD-028B are requested from its users. Please provide written recommendations for improvement by July 30, 1993, to AHT-10. For further information, contact FTS (202) 366-6993.

for Belinda R. Farmer
Joseph P. Kisicki
Director, Office of Training
and Higher Education, AHT-1

Distribution: A-WXYZ-3; A-FOF-O (LTD)

Initiated By: AHT-1

Information Handling Services, 1999
August 11, 1999 10:18:24

APPENDIX 1. EXPLANATION OF CHANGES IN FAA-STD-028B

1. **PURPOSE.** FAA-STD-028 and FAA-STD-028A (draft) have been revised based on the lessons learned during the acquisition of contractor-developed training materials and courses. The result is FAA-STD-028B. This standard has been strengthened to support the requirements of the FAA training communities during the review of contract training deliverables. Listed below are the major changes reflected in FAA-STD-028B.

2. **FRONT MATTER.** The front matter has been revised as follows:

a. **Reorganization of the front matter chapters.** This sequence begins with the "Introduction, Procurement and Administration" chapters. It is followed by the "Overview of the Systematic Training Development Process" and the specific chapters on each of the five phases of that process.

b. **Amplification of information** on the types of training conferences that are generally held for a training contract. These are post award conferences, technical interchange meetings, and in-progress reviews.

c. **Specification of the roles of FAA personnel** who support contractor-developed training, to include instructional systems design specialists.

d. **Specification of the requirements for training materials** developed according to "best commercial practice." When best commercial practice is permitted by a program office, this approach will not be used to shortcut a systems approach to training development. Best commercial practice will provide flexibility in format, not content. All formats will be approved by the FAA prior to use. In addition, traceability to tasks selected for training will be required.

e. **Strengthening and clarification of instructional systems design requirements:**

(1) **Development of training outcomes** during the design phase rather than the analysis phase.

(2) **Changes in terminology** from "instructional" and "lesson" objectives to "terminal" and "enabling" objectives.

(3) **Specification of training outcomes** at the duty level, of terminal objectives at the task level, and of enabling objectives at the subtask level.

Information Handling Services, 1999
August 11, 1999 10:18:24

(4) Specification of terminal objectives as job performance behaviors rather than training behaviors.

(5) Addition of the requirement for traceability of duties and tasks selected for training to training outcomes and terminal objectives, respectively.

3. DATA ITEM DESCRIPTIONS (DID's). Revisions have been made to existing DID's and new DID's have been added as follows:

a. The Task and Skills Analysis DID has been revised to define job performance requirements more accurately and to provide thorough documentation that is directly related to the job. In addition, the DID was broadened to accommodate management as well as technical training analyses. Finally, the category of task "elements" was added to the task hierarchy so that specific data may be obtained for analyses that are conducted in support of computer human interface (CHI) training. Specification of task analysis data at the element level is optional.

b. A Cognitive Analysis DID has been developed as a follow-on to task analyses which indicate that specific tasks have strong cognitive components. These types of tasks would require the performer to exercise judgment, solve problems, and make decisions. While a task analysis provides procedural information on job performance, a cognitive analysis will provide a systematic means of determining the cognitive processes and strategies that support job performance.

c. A Job Aids DID has been developed for the design of instructional tools that provide information on the steps in a procedure or that guide the user in making decisions related to a specific job task. Examples of job aids are checklists, procedural lists, flow charts, and illustrations.

d. A series of DID's have been developed for computer-based instruction and video disc courseware. This series includes the following DID's: Lesson Specifications, CBI Testing, Validation Plan and Report, Video Treatments, Storyboards and Scripts, Video Shot List, and CBI Program Documentation.

e. A DID has been developed to support interactive courseware for training devices. This DID documents the requirements for deliverables that are developed as part of the interactive courseware for a training device. The DID is applicable to computer-aided as well as computer-based courseware.

Information Handling Services, 1999
August 11, 1999 10:18:24

f. **A DID has been developed for Video Courseware.** This DID documents the information that the FAA needs to evaluate a contractor's decisions concerning the content, treatment, and organization of video courseware.

g. **A DID has been developed for Developmental Tryouts** of course materials. This DID provides the minimum requirements for developmental tryouts that are conducted to assess the effectiveness of materials when they are in a semi-finished or draft form. The materials are presented to representatives of the target population, in a training environment, for their use and comment.

h. **Existing DID's have been strengthened** consistent with the additional guidelines for instructional systems design that have been added to the front matter of the standard. One example is the requirement for traceability among training outcomes, learning objectives, and task analysis data in the Course Design Guide.

i. **A requirement has been added to the Lesson Plan DID** for establishing a bridge between management and technical processes and procedures, as currently performed and how they will be performed in the future as the result of new equipment or workforce changes. This requirement will apply when supplemental training is being developed. The sample lesson plan format was also revised to provide additional guidance on the type of information that should be included in each section.

j. **In the Student Achievement Test DID increased emphasis has been placed on the need for performance checklists** when hands-on performance is required.

k. **A requirement has been added to the Commercial Off-the-Shelf (COTS) Report DID** for FAA copyrights to COTS materials.

Information Handling Services, 1999
August 11, 1999 10:18:24

9003329 0020662 284

FAA STANDARD 028B

CONTRACT TRAINING PROGRAMS

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

May 1, 1993

DISTRIBUTION: A-WXYZ-3; A-FOF-0 (LTD) **INITIATED BY:** AHT-1

Information Handling Services, 1999
August 11, 1999 10:18:24

FOREWORD

This standard replaces FAA-STD-028, issued on March 28, 1985, and FAA-STD-028A (draft), circulated in 1988. This standard contains specifications for contractors who analyze, design, develop, deliver, and evaluate training for the Federal Aviation Administration (FAA).

The application of the principles and practices of a systematic training development process, such as Instructional Systems Design (ISD), and the use of a job-centered training approach are the FAA's greatest assurances that quality training products will be submitted by contractors to the FAA. The products, required by this standard, provide evidence to the FAA that a contractor is applying the principles and practices of a systematic process for developing training.

Chapters 1 through 9 of this standard provide guidance for training development and delivery by a contractor. The Data Item Descriptions (DID's) in Appendix 1 specify the format, content, and procedures for products submitted to the FAA for review and approval.

Recommendations, additions, deletions, and other pertinent information which would improve this standard should be addressed to the Strategic Planning, Policy, and Budget Staff, AHT-10, Federal Aviation Administration, 400 Seventh Street, S.W., Washington, D.C. 20591.

Joseph P. Kisicki
Director, Office of Training
and Higher Education

CHAPTER 1. INTRODUCTION 1-1

1-1. Purpose 1-1
1-2. Distribution 1-1
1-3. Cancellation 1-1
1-4. Background 1-1
1-5. Systematic Development Process 1-1
1-6. Explanation of Changes 1-1
1-7. Definitions 1-2
1-8. Requests for Information 1-2
1-9. Application of This Standard 1-2

CHAPTER 2. PROCUREMENT 2-1

2-1. Purpose 2-1
2-2. Description of the Procurement Phase 2-1
2-3. Critical Actions 2-1
2-4. Documentation 2-1
2-5. DID-1 Contractor's Proposal for Training 2-2
2-6. Contract Award 2-3
2-7. DID-2 Milestone Chart 2-3
2-8. DID-3 Personnel Qualifications Report 2-3

CHAPTER 3. ADMINISTRATION 3-1

3-1. Purpose 3-1
3-2. Accident Prevention 3-1
3-3. Copyrighted Material 3-1
3-4. Classroom, Laboratory, and Shop Facilities . . . 3-1
3-5. Housing, Dining, and Transportation Facilities . 3-2
3-6. Course Schedule 3-3
3-7. Student Reporting 3-3
3-8. Student-to-Instructor Ratio 3-3
3-9. FAA System or Equipment Availability 3-3
3-10. Training Equipment and Material 3-3
3-11. Contractor Furnished Training Equipment 3-4
3-12. Government Furnished Training Equipment 3-4
3-13. Security Regulations 3-4

CHAPTER 4. AN OVERVIEW OF THE SYSTEMATIC TRAINING DEVELOPMENT PROCESS 4-1

4-1. Purpose 4-1
4-2. Phases 4-1
4-3. Training Development Process for Contractor Developed Training 4-1
4-4. Review and Approval Process 4-1
4-5. Deliverable Specifications 4-1
4-6. FAA/Contractor Conferences 4-2
4-7. Roles of FAA Personnel 4-5

CHAPTER 5. ANALYSIS 5-1

5-1. Purpose 5-1
5-2. Description of the Analysis Phase 5-1
5-3. Critical Actions 5-1
5-4. Documentation 5-1
5-5. DID-4 Task and Skills Analysis Report 5-1
5-6. Hierarchy 5-2
5-7. Task and Subtask Characteristics 5-3
5-8. Validation of the Train/No Train Decisions . . . 5-4
5-9. Traceability of Tasks to Training Development . . 5-5
5-10. DID-5 Cognitive Task Analysis 5-5

CHAPTER 6. DESIGN 6-1

6-1. Purpose 6-1
6-2. Description of the Design Phase 6-1
6-3. Critical Actions 6-1
6-4. Documentation 6-1
6-5. DID-6 Course Design Guide (CDG) 6-1
6-6. Training Outcomes 6-2
6-7. Description of Objectives 6-2
6-8. Sequencing of Objectives and Content 6-3
6-9. Hierarchy of Objectives 6-3
6-10. Methods and Media 6-3
6-11. Test Type 6-3
6-12. DID-7 Course Schedule 6-3
6-13. Concurrent Submission Process 6-4

CHAPTER 7. DEVELOPMENT 7-1

7-1. Purpose 7-1
7-2. Description of the Development Phase 7-1
7-3. Critical Actions 7-1
7-4. Documentation 7-1
7-5. DID-8 Student Achievement Tests 7-2
7-6. Selecting the Appropriate Test Type 7-2
7-7. DID-9 Lesson Plan 7-2
7-8. DID-10 Student Materials 7-3
7-9. DID-11 Media Materials 7-3
7-10. DID-12 Commercial Off-The-Self Training Materials Report 7-3
7-11. DID-13 On-The-Job Training Instructor Handbook . 7-3
7-12. DID-14 Job Aids 7-3
7-13. DID-15 Correspondence Study Materials 7-3
7-14. DID-16 CBI Lesson Specifications 7-4
7-15. DID-17 Plan for Computer-Based Instruction Testing 7-4
7-16. DID-18 CBI Validation Plan and Validation Report 7-4
7-17. DID-19 Video Treatments 7-4

7-18. DID-20 Storyboards/Scripts 7-4
7-19. DID-21 Video Shot List 7-4
7-20. DID-22 CBI Program Documentation 7-4
7-21. DID-23 Interactive Courseware for Training Devices 7-4
7-22. DID-24 Video Courseware 7-4
7-23. Developing Effective Instructional Materials . . 7-5
7-24. Characteristics of the Target Population 7-5
7-25. Reading Level 7-5
7-26. Gender-Free Wording 7-5
7-27. Validating Instructional Materials 7-5
7-28. DID-25 Developmental Tryout(s) 7-6
7-29. Need for Developmental Tryout(s) 7-6
7-30. DID-26 Course Walk-Through 7-6
7-31. Conducting the Course Walk-Through 7-7
7-32. Letter of Authorization 7-7
7-33. End of the Developmental Phase 7-7
7-34. Submission Process 7-7

CHAPTER 8. DELIVERY 8-1

8-1. Purpose 8-1
8-2. Description of the Delivery Phase 8-1
8-3. Critical Actions 8-1
8-4. Documentation 8-1
8-5. DID-27 First Course Conduct and Course Report . . 8-1
8-6. Subsequent Course Conduct 8-2
8-7. Data 8-2
8-8. Final Documentation 8-2
8-9. Transmittal Letter 8-3

CHAPTER 9. EVALUATION 9-1

9-1. Purpose 9-1
9-2. Description of the Evaluation Phase 9-1
9-3. Documentation. 9-1
9-4. Course Report 9-1
9-5. Evaluation/Validation of Computer-Delivered Courseware 9-1

APPENDICES

Page No.

APPENDIX 1. DATA ITEM DESCRIPTIONS

DID-1	Contractor's Proposal for Training	DID 1-1
DID-2	Milestone Chart	DID 2-1
DID-3	Personnel Qualifications Report	DID 3-1
DID-4	Task and Skills Analysis Report	DID 4-1
DID-5	Cognitive Task Analysis	DID 5-1
DID-6	Course Design Guide	DID 6-1
DID-7	Course Schedule	DID 7-1
DID-8	Student Achievement Tests	DID 8-1
DID-9	Lesson Plan	DID 9-1
DID-10	Student Materials	DID 10-1
DID-11	Media Materials	DID 11-1
DID-12	Commercial Off-the-Shelf Training Materials Report	DID 12-1
DID-13	On-the-Job Training Instructor Handbook	DID 13-1
DID-14	Job Aids	DID 14-1
DID-15	Correspondence Study Materials	DID 15-1
DID-16	CBI Lesson Specifications	DID 16-1
DID-17	Plan for Computer-Based Instruction Testing	DID 17-1
DID-18	CBI Validation Plan and Validation Report	DID 18-1
DID-19	Video Treatments	DID 19-1
DID-20	Storyboards/Scripts	DID 20-1
DID-21	Video Shot List	DID 21-1
DID-22	CBI Program Documentation	DID 22-1
DID-23	Interactive Courseware for Training Devices	DID 23-1
DID-24	Video Courseware	DID 24-1
DID-25	Developmental Tryout	DID 25-1
DID-26	Course Walk-Through	DID 26-1
DID-27	First Course Conduct and Validation Report	DID 27-1

APPENDIX 2. GLOSSARY . . . . . Ap 2-1

APPENDIX 3. ACRONYM LIST . . . . . Ap 3-1

LIST OF FIGURES

Figure No.		Page No.
4-1	Systematic Process for Contractor Developed Training	4-3
4-2	Review and Revision of Contractor Developed Training Deliverables	4-4
5-1	Levels of a Task Analysis Hierarchy	5-2
5-2	An Example of a Task Analysis Flowchart	5-6
DID-2 Fig. 1	Sample Milestone Chart	DID 2-3
DID-4 Fig. 1	Task & Skills Analysis Data Sheet	DID 4-7
DID-6 Fig. 1	Sample Course Design Guide, Part II, Course Design	DID 6-9
Fig. 2	Sample Course Design Guide, Part III, Cross Reference Matrix	DID-6-10
DID-7 Fig. 1	Sample Course Schedule With Major Course Topics	DID 7-4
Fig. 2	Sample Class Schedule With Lesson Titles	DID 7-5
DID-9 Fig. 1	Sample Lesson Plan Cover Sheet	DID 9-9
Fig. 2	Sample Lesson Plan	DID 9-10
DID-10 Fig. 1	Sample Job Sheet Format	DID 10-9
DID-16 Fig. 1	Example of Course Flowchart	DID 16-5
DID-27 Fig. 1	Sample Instructor Checklist	DID 27-9
Fig. 2	Sample Lesson Evaluation Checklist	DID 27-10
Fig. 3	Sample Student Critique Sheet	DID 27-11
Fig. 4	Sample End-of-Course Evaluation Questionnaire (Equipment)	DID 27-12
Fig. 5	Sample End-of-Course Evaluation Questionnaire (Non-Equipment Oriented)	DID 27-16
Fig. 5	Sample End-of-Course Evaluation Questionnaire (Section A)	DID 27-17
Fig. 5	Sample End-of-Course Evaluation Questionnaire (Section B)	DID 27-18
Fig. 6	Sample Training Outcomes Section of the Validation Report	DID 27-19
Fig. 7	Sample Test Data Listing	DID 27-20
Fig. 8	Sample Ease Index for Test Items	DID 27-21

Information Handling Services, 1999
August 11, 1999 10:18:24

CHAPTER 1. INTRODUCTION

1-1. **Purpose**. This standard establishes procedures for contractor developed and/or delivered training through the application of the principles and procedures of a systematic training development process. Order 3000.6C, Training, governs the application of this standard. This standard shall be applied to all training procurements. Deliverables shall be developed as specified in the DID's and shall be delivered in accordance with the contract.

1-2. **Distribution**. This standard is distributed to the branch level in FAA headquarters, regions, and centers, with limited distribution to all field offices and facilities.

1-3. **Cancellation**. FAA-STD-028, issued March 28, 1985, is canceled. FAA-STD-028A (draft), circulated in 1988, is superseded by this standard.

1-4. **Background**. FAA training, developed and delivered by contractors, has increased significantly since the first standard, FAA-STD-028, for contractor training programs was issued in 1985. Faced with increased responsibilities for procuring, monitoring, reviewing, and approving contractor training deliverables, the FAA is strengthening the specifications for its contractor training deliverables by issuing a revised standard, FAA-STD-028B.

1-5. **Systematic Development Process**. The application of the principles and practices of a systematic development process and the use of a job-centered training approach are the FAA's greatest assurances that quality training deliverables will be submitted by a contractor to the FAA. The deliverables, required by this standard, provide evidence to the FAA that a contractor is applying the principles and practices of a systematic training development process.

1-6. **Explanation of Changes**. This standard has been revised to accomplish the following:

a. Strengthen the specifications stated in the DIDs.

b. Ensure traceability between job tasks and training objectives and materials.

c. Develop a more rigorous review and approval process to ensure accountability.

Information Handling Services, 1999
August 11, 1999 10:18:24

d. Provide Data Item Descriptions (DIDs) for development of computer-based instruction (CBI).

e. Incorporate the best available examples of deliverables.

f. Ensure consistency between this standard and the agency's policy for training, Order 3000.6C.

1-7. **Definitions**. Definitions for the terms used in this standard are provided in the glossary, located in Appendix 2. A list of acronyms used in this standard is located in Appendix 3.

1-8. **Requests for Information**. Further information or clarification about this standard is available from the Office of Training and Higher Education (AHT-10), Federal Aviation Administration, 800 Independence Avenue, S.W., Washington, D.C. 20591.

1-9. **Application of This Standard**. When conflict exists between the requirements of this standard and its referenced documents, this standard shall take precedence. Where the requirements of the Government Printing Office Style Manual conflict with the requirements specified in this standard, the requirements of this standard shall take precedence. Questions concerning the application of this standard to a specific contract shall be directed to the appropriate FAA Contracting Officer's Technical Representative (COTR).

Information Handling Services, 1999
August 11, 1999 10:18:24

CHAPTER 2. PROCUREMENT

2-1. Purpose. This chapter discusses the procurement phase and its relationship to the phases of the systematic development process.

2-2. Description of the Procurement Phase.

a. Changes in Job Requirements. Changes in job requirements, which may necessitate a change in training requirements, may result from:

(1) Installation of new technology.

(2) New versions of equipment already in use in the FAA.

(3) Workforce expansion.

(4) Improved workforce proficiency.

b. When the program office responsible for a change releases a procurement request (PR), training is requested to support the change. The program office, in accordance with the latest edition of Order 4400.4, Guide for Preparing Procurement Requests, coordinates training requirements and specifications with the appropriate AHT division and service organization. Contractors respond with their proposed solutions in a technical proposal, which follows the guidelines in DID-1.

2-3. Critical Actions. Activities during this phase focus primarily on the management of the proposed training course. During procurement the:

a. Bidding contractors propose the development and delivery of training in accordance with the specifications stated in the solicitation and in DID-1, the Contractor's Proposal for Training.

b. Contract is awarded to the training contractor who is likely to provide the most cost effective training and the most qualified personnel.

c. Schedule for submission and review of the deliverables is prepared following contract award, as specified in the contract.

2-4. Documentation. The deliverables associated with the training procurement phase include the:

Information Handling Services, 1999
August 11, 1999 10:18:24

a. Contractor's Proposal for Training (DID-1)

b. Milestone Chart (DID-2)

c. Personnel Qualifications Report (DID-3)

2-5. DID-1 Contractor's Proposal for Training. DID-1, the Contractor's Proposal for Training, provides contractors with guidance about the preparation and inclusions for their proposal for training. DID-1 also serves to provide guidance to the FAA, specifically for writers of the specifications for the bid and for members of the FAA proposal evaluation team.

a. Training Staff. DID-1 requires a description of the training staff and their skills for the proposed training. It should be emphasized that the selection and use of appropriately qualified personnel is critical to the development of effective training. Each individual must bring special skills to the task to design, develop and deliver effective training. The categories of personnel are:

(1) Instructional Systems Design (ISD) personnel, both for the government and for the contractor who manage the effort, plan the strategies and are responsible for the final product.

(2) Subject Matter Experts (SMEs), who are responsible for lesson content and work with the ISD team.

(3) Instructional developer, who is responsible for developing and documenting the lesson content and sequence as specified by the designer and the SME.

(4) Computer-based instruction (CBI) programmer who takes CBI materials developed by the ISD team and programs the CBI lessons.

(5) Instructor, who delivers the instruction and must possess a wide variety of teaching, counseling, evaluation, and adult learning skills.

b. Commercial Off-The-Shelf Training Materials. When commercial off-the-shelf training materials (COTS) are proposed, the contractor shall provide the information required by the Commercial Off-the-shelf Training Materials Report (DID-12) and submit the proposed materials for FAA assessment.

c. Best Commercial Practice. When training materials are to be developed according to "best commercial practice," the following requirements shall be met:

Information Handling Services, 1999
August 11, 1999 10:18:24

1) A systems approach to training development shall be used.

2) Traceability between the task analysis data and the course design guide shall be provided. Terminal objectives shall be traceable to tasks selected for training.

3) Best commercial practice shall provide flexibility from the standpoint of format, not content. It shall not be used to shortcut the application of instructional systems design processes and procedures.

4) Formats for best commercial practice shall be submitted to the FAA COTR for review and approval prior to use.

2-6. **Contract Award**. The FAA awards the contract after reviewing each contractor's proposal for training.

2-7. **DID-2 Milestone Chart**. DID-2, Milestone Chart, specifies the format and items to be included in a timeline for the development and delivery of the course(s). Although such information is provided in the contract, a Gantt-like chart format is extremely useful as a management tool for the FAA COTR and other FAA personnel involved with the review of the deliverables. The milestone chart is updated to reflect changes to the delivery schedule which are authorized by the FAA Contracting Officer. Within 10 days of the approved change, the contractor is required to submit the milestone chart indicating the appropriate revision(s).

2-8. **DID-3 Personnel Qualifications Report**. DID-3, Personnel Qualifications Report, provides the requirements to be addressed in the report for all contractor personnel assigned to training development and delivery tasks. A resume for each individual identified in the report is required for approval by the FAA. The FAA reserves the right to approve changes in key personnel for training development and delivery.

Information Handling Services, 1999
August 11, 1999 10:18:24

CHAPTER 3. ADMINISTRATION

3-1. Purpose. The purpose of this chapter is to provide guidance about logistical aspects pertinent to training delivery.

3-2. Accident Prevention. Safety precautions and an awareness of accident prevention are prime considerations in all training activities. Any instruction developed for the FAA by a contractor using this standard shall emphasize each person's accident prevention responsibilities, both as an individual and as a representative of the FAA.

3-3. Copyrighted Material. All material required by this standard shall be free from all encumbrances which prohibit their reproduction or use by the FAA for training purposes. This includes, but is not limited to, copyrighted, registered documentation and software. All material developed for the FAA contractors shall be the sole property of the FAA and shall not be used by the contractor for any purpose other than those in the contract.

3-4. Classroom, Laboratory, and Shop Facilities. Classroom,laboratory, and shop facilities are subject to inspection and approval by the FAA Contracting Officer, or designee, either before or during the contract period. The contractor shall correct any deficiencies identified before the start of training. If training is already in progress, the deficiencies shall be corrected within 10 days, or within the time period specified by the FAA Contracting Officer.

a. Space. Not less than 30 square feet gross per student shall be provided.

b. Lighting. Lighting shall not be less than 50 foot candles on the surface of the student's desk. If computer terminals are used, classroom lighting shall be variable by means of appropriate lighting controls.

c. Noise. Ambient, unoccupied room level noise, as measured with a General Radio Company Permissible Sound Level Meter Type 1565B, or equivalent, shall not exceed 40 dBa at any point in the classroom or 70 dBa in laboratory environment under the following conditions: all equipment and room doors closed, covers on, and equipment in operation.

d. Heating and Cooling. Temperature levels shall be adjustable within an ambient temperature range of 70 degrees F (21 degrees C) and 75 degrees F (24 degrees C) for classroom and laboratory facilities.

Information Handling Services, 1999
August 11, 1999 10:18:24

e. Safety. The training environment and facilities shall comply with all standards established by the National Electrical Code, National Fire Code, United States of America's Standards Institute and United States Government Occupational Safety and Health Administration.

f. Cleaning. As a minimum, the contractor shall provide the following janitorial services if facilities are not Government furnished:

(1) Daily

(a) Clean chalkboards.
(b) Clean student desk tops.
(c) Empty wastebaskets.

(2) Weekly

(a) Sweep floors.
(b) Dust all room furniture and equipment.

(3) Monthly

(a) Mop or vacuum floor as appropriate.

g. Furniture. Students shall be seated at desks, tables, or provided with a proper rest on the side of the chair for writing or taking notes. Sufficient storage space shall be provided in the vicinity of the student's desk to store training manuals and other course related material. If computer terminals are to be used, they shall be placed to make viewing and keyboard entries convenient and non-fatiguing.

h. Training Aids. Training aids such as chalkboards, overhead projectors, slide projectors, and audiovisuals shall be provided as required in the training documentation.

i. Sanitary Facilities. Sanitary, separate restroom facilities for men and women shall be available within convenient distance of classroom or laboratory. Restroom facilities shall be provided for handicapped persons.

3-5. Housing, Dining, and Transportation Facilities. The contractor shall not be responsible for housing, dining facilities, or transportation. However, for training courses conducted at other than Government facilities, the contractor shall provide directions to the training facility and a list of housing, dining, and transportation facilities available in the vicinity of the training facility. This information shall be

Information Handling Services, 1999
August 11, 1999 10:18:24

provided to the FAA COTR at least six weeks prior to the scheduled first class of the course.

3-6. Course Schedule. Course schedules shall be prepared in accordance with DID-6. Training shall be scheduled for eight hours per day for five work days per week, unless otherwise specified by the FAA Contracting Officer. Federal holidays shall not be class days and shall not be absorbed in the overall course length.

a. Length of Instruction. Class instruction periods for lecture/demonstration shall normally be 50 minutes duration with a 10-minute break between periods of instruction. Length of practical application periods may vary as the situation requires.

b. Accelerated Training. To meet urgent requirements, the acquiring activity may direct a second shift or accelerated training where circumstances and availability of system or equipment so dictate. The daily schedule of the training course(s) shall be conducted so as to allow optimum utilization of the system or equipment by the using FAA activity.

3-7. Student Reporting. The students shall be directed to report to a designated individual at the training facility. The names of students authorized to attend the training course shall be provided to the contractor prior to the first day of the course. The contractor shall ensure that only personnel designated by the FAA attend and participate in training programs procured under the provisions of this standard. If a student who is authorized to attend the training course fails to arrive on the first day of the course or any day thereafter, the contractor shall immediately notify the FAA COTR.

3-8. Student-to-Instructor Ratio. The student-instructor ratio shall be no greater than 16 to 1 in the theoretical phase of the course and no greater than 4 to 1 in the practical application phase. Deviations may be waived with prior written approval from the FAA Contracting Officer.

3-9. FAA System or Equipment Availability. If training is conducted at a FAA field site, the system or equipment to be used in the training course(s) at the FAA site shall be available to the contractor for a minimum of four hours per day. If a conflict arises with the FAA site's daily schedule, the system or equipment shall be available for training after 8:00 PM local time, Monday through Friday.

3-10. Training Equipment and Material. Any contract for the delivery of training services shall state whether training equipment is contractor furnished or Government furnished. Any

Information Handling Services, 1999
August 11, 1999 10:18:24

information for private purposes which is not available to the general public.

Information Handling Services, 1999
August 11, 1999 10:18:24

CHAPTER 4. AN OVERVIEW OF THE SYSTEMATIC TRAINING DEVELOPMENT PROCESS

4-1. **Purpose**. This chapter provides an overview of the events that occur during a contractor's development and delivery of training for the FAA.

4-2. **Phases**. Prior to the start of the systematic development process, the FAA specifies the training deliverables to be developed and submitted by a contractor. The deliverables provide evidence of the application of the principles and procedures of a systematic development process. This process consists of the five phases of analysis, design, development, delivery, and evaluation. Each phase has specific deliverables and critical decisions associated with it.

4-3. **Training Development Process for Contractor Developed Training**. Figure 4-1 illustrates the relationship of the phases, the associated DIDs, deliverables, and review points which occur during the development and delivery process.

4-4. **Review and Approval Process**. Figure 4-2 depicts the stages of contractor developed training deliverables. For each training deliverable specified in a contract, the contractor submits a draft to the FAA for review. Following the review, the contractor incorporates the FAA's comments into the deliverable and submits it as a revised draft. The contractor shall include change bars in revised deliverables to indicate where information has been modified or deleted. The change bars shall be removed from all camera-ready final deliverables that have been approved by the government. The contractor shall revise the deliverable if the FAA considers it inadequate and/or inconsistent with the comments received during the FAA review.

a. Revised Draft Approval. The FAA's approval of the revised draft signifies an acceptance of the deliverable for subsequent development and validation activities, and authorizes the contractor to proceed with development of the next deliverable(s).

b. Final Deliverable. Following validation of the course, the contractor submits a final version of the deliverable(s), reflecting the comments from the first course conduct. The contractor furnishes the final deliverable(s) in the format specified in the contract. Final format takes one of two forms: camera ready copy or master reproducible.

4-5. **Deliverable Specifications**. Deliverables, submitted as documents, shall be provided: (1) on 8 1/2 by 11 inch bond paper

Information Handling Services, 1999
August 11, 1999 10:18:24

with the page number at the bottom of each page and the date of submission, and (2) on electronic media, i.e., compatible disks. All deliverables submitted by the contractor shall be free of errors in punctuation, spelling, and grammar. All instructional materials, unless otherwise specified, shall be identified with numbers/labels that are consistent with the identification system of the FAA organization for which the training is developed.

4-6. FAA/Contractor Conferences. There are three types of conferences that will be held during the course of a contract for training development and/or delivery: a post award conference, technical interchange meetings, and in-progress reviews. The contractor shall prepare agendas for the technical interchange meetings and in-progress reviews. Minutes of these two types of meetings shall be prepared by the contractor and submitted to the FAA COTR for concurrence.

a. Post Award Conference. No later than 30 days after the award of a training contract (or exercise of a training option of a contract), a post-award conference shall be convened by the FAA Contracting Officer who shall serve as chairperson and designate the location for the conference. The conference shall:

1) Establish a liaison between the contractor, FAA Contracting Officer, FAA Technical Officer, FAA COTR, and other FAA personnel specified in the contract and charged with the responsibility for contract administration.

2) Permit inspection of the contractor's facility and establish a working relationship with contractor personnel.

3) Discuss the proposed course development methods and the requirements associated with each deliverable required from the contractor.

4) Review the milestone chart for the training effort.

b. Technical Interchange Meetings (TIM's). TIM's are formal checkpoints and opportunities to share information between the contractor and the government. TIM's may occur at any point in the training development process.

c. In-Progress Reviews (IPR's). IPR's are formal presentations by the contractor to the government concerning the progress that has been made on the training development or delivery effort to date. The frequency and scheduling of IPR's will be stated in the contract.

Information Handling Services, 1999
August 11, 1999 10:18:24

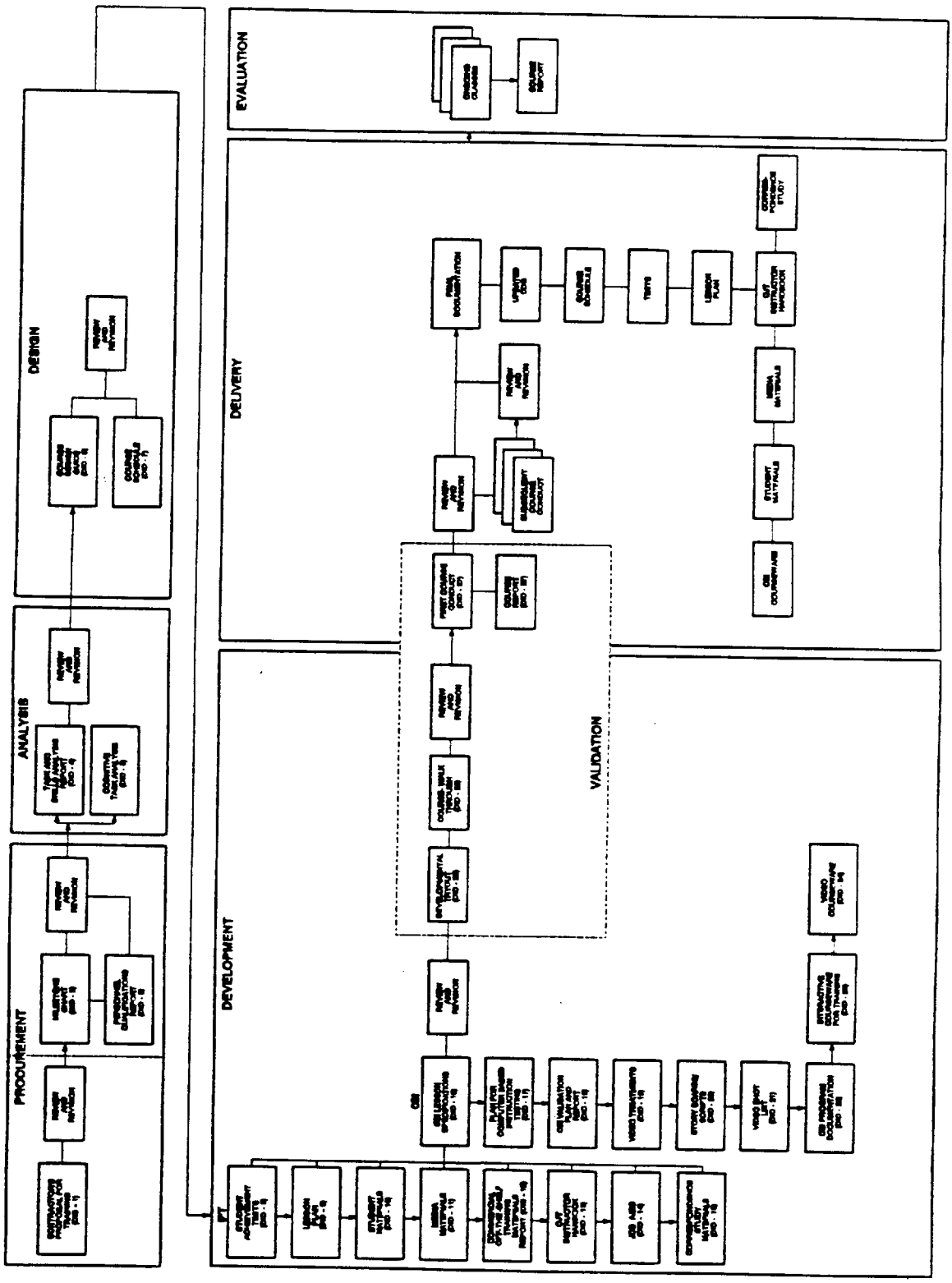
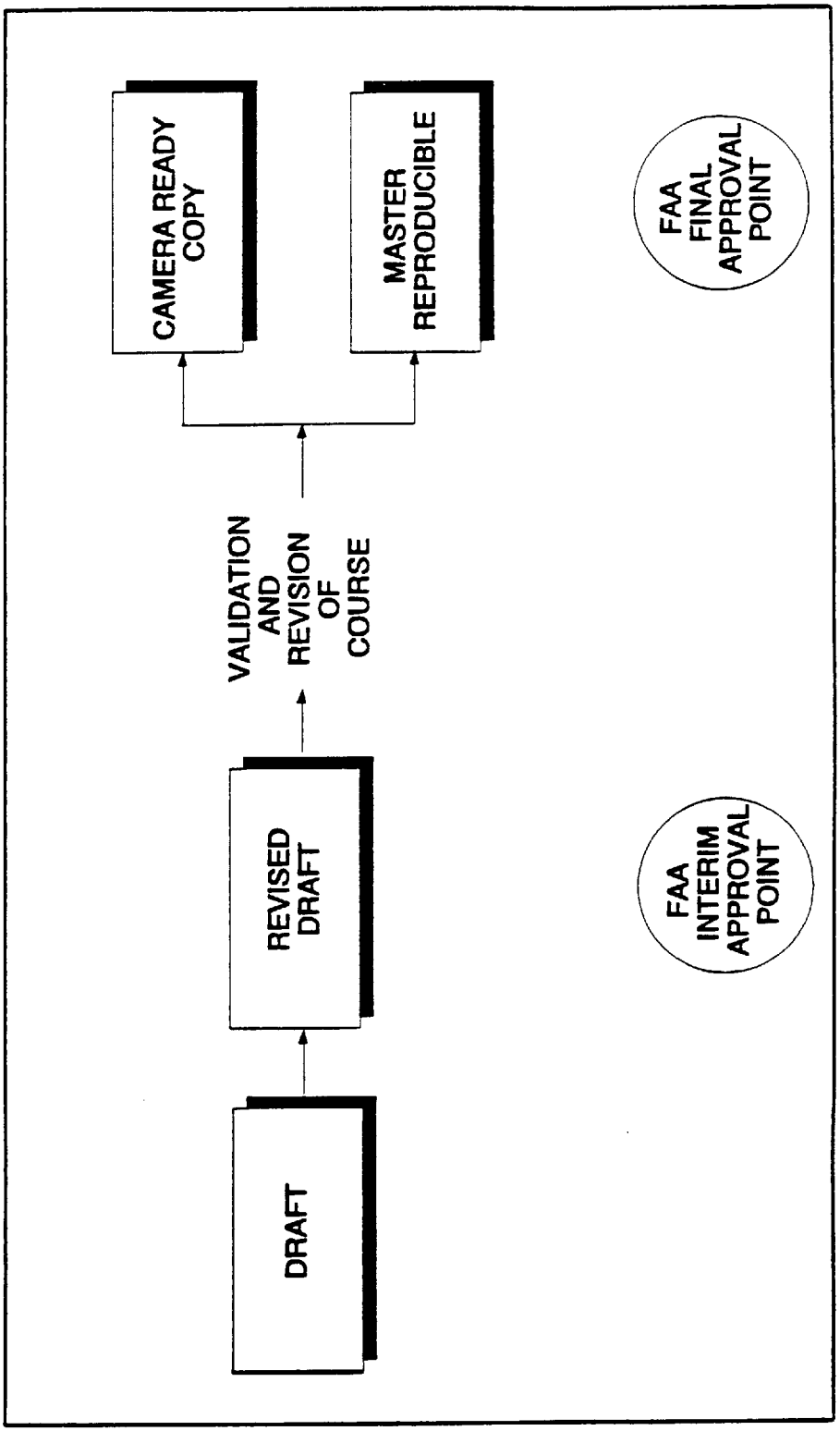


FIGURE 4-1. SYSTEMATIC PROCESS FOR CONTRACTOR DEVELOPED TRAINING

Information Handling Services, 1999
August 11, 1999 10:18:24

9003329 0020681 136

FIGURE 4-2. REVIEW AND REVISION OF CONTRACTOR DEVELOPED TRAINING DELIVERABLES



Information Handling Services, 1999
August 11, 1999 10:18:24

4-7. Roles of FAA Personnel. The FAA personnel, typically involved in contractor developed training, and their roles are described below.

a. Contracting Officer. The FAA Contracting Officer provides contractual approval of deliverables and authorizes modifications to the contract.

b. Technical Officer. The FAA Technical Officer provides special expertise and advises on the technical aspects of the contract.

c. Contracting Officer's Technical Representative (COTR). The FAA COTR provides technical training oversight of the contractor's efforts and is a designee of the FAA Contracting Officer. An FAA COTR is assigned for each line item in the contract.

d. Instructional Systems Design (ISD) Specialist. This FAA specialist provides guidance on the application of ISD processes and procedures in accordance with FAA-STD-028B.

Information Handling Services, 1999
August 11, 1999 10:18:24

CHAPTER 5. ANALYSIS

5-1. **Purpose**. This chapter discusses the analysis phase of the systematic development process. Analysis is the foundation for all desired training outcomes. Analysis determines the tasks that require training and the characteristics of each task. The analysis is used in the design phase to determine the most effective manner of training employees to achieve the desired job performances.

5-2. **Description of the Analysis Phase**. The analysis phase includes the determination of job performance requirements. The job performance requirements are the tasks which a person must perform, the conditions under which these tasks must be accomplished, and the standards of performance.

5-3. **Critical Actions**. During the analysis phase the following items are determined:

a. Desired job performance

b. Tasks and subtasks that make up the job performance

c. Conditions, standards, knowledge, and skills required for successful performance of each task

d. Tasks which require training

5-4. **Documentation**. The determinations made in the analysis phase are documented in:

a. The task and skills analysis which is described in the Task and Skills Analysis Report (DID-4).

b. The deliverables associated with a cognitive task analysis which is described in the Cognitive Task Analysis (DID-5). These deliverables are:

(1) The cognitive analysis plan

(2) The preliminary cognitive analysis data

(3) The cognitive analysis report

5-5. **DID-4 Task and Skills Analysis Report**. A task analysis is conducted when job task(s) change due to the introduction of a new piece of equipment or technology, or when there is a change in some part of a system or workforce requirements. A task and

Information Handling Services, 1999
August 11, 1999 10:18:24

skills analysis provides specific information about job performances which is needed for the design and development of quality training. A task analysis should be updated to incorporate current job information.

5-6. **Hierarchy**. A task analysis results in a hierarchy that depicts the relationship of the various levels of a job performance. The most comprehensive level of the hierarchy is the job. The job is divided into duties. Each duty consists of tasks which are further divided into subtasks. The hierarchical levels of a task analysis are depicted in Figure 5-1. The figure uses the numerical labels specified in DID-4, Task and Skills Analysis report.

```
JOB  1.0

     DUTY  1.1

          Task  1.1.1
                Subtask 1.1.1.1
                Subtask 1.1.1.2

          Task 1.1.2
                Subtask 1.1.2.1
                Subtask 1.1.2.2
                Subtask 1.1.2.3

     DUTY 1.2

          Task 1.2.1
                Subtask 1.2.1.1

          Task 1.2.2
                Subtask 1.2.2.1
```

FIGURE 5-1. LEVELS OF A TASK ANALYSIS HIERARCHY

Information Handling Services, 1999
August 11, 1999 10:18:24

5-7. **Task and Subtask Characteristics**. DID-4 requires that, at a minimum, the following characteristics of a task (and its associated subtasks) must be observed, documented, and analyzed:

a. Criticality. Tasks have varying degrees of importance in job performance. Some tasks are vital to job performance while others may be of lesser consequence. Task criticality is rated according to the consequences for inadequate performance (for example, injury to personnel, major functions are not accomplished, damage to equipment). Criticality ratings ensure that tasks essential to safe and successful job performance are identified for training.

b. Frequency. Frequency refers to how often a task and subtask are performed. Frequency shall be coded as follows: continuous activity (CA), hourly (H), daily (D), weekly (W), monthly (M), and as required (AR).

c. Difficulty. Difficulty refers to the mental and physical effort required by an employee to master task performance. Rating the difficulty of a task requires considering the typical situations involved in performing the task, rather than unusual circumstances or locations rarely encountered on the job. In judging task difficulty, two major factors should be considered: cognitive activities and motor coordination.

(1) Cognitive activities include:

(a) Retention and recall (for example, remembering the correct sequence of procedures for completing a task).

(b) Recognition, evaluation, comprehension, and understanding (for example, understanding the effect on a system of closing a specific valve).

(c) Problem solving (for example, determining the cause of an equipment malfunction).

(2) Motor coordination includes:

(a) Gross motor coordination (for example, entering data manually while communicating orally).

(b) Fine manual dexterity (for example, calibrating an instrument).

(c) Performing tasks under restricted conditions (for example, while wearing bulky clothing).

Information Handling Services, 1999
August 11, 1999 10:18:24

d. New or Old Task. Identifying new and old tasks contributes to the overall train/no train decision for a task. If a task is old, job incumbents are probably familiar with the task because they have been performing it on the job. If any portion of a task is new then the entire task needs training.

e. Initiating Cues, Conditions, and Standards. Identifying initiating cues and conditions for each task contributes to the full description of the task. Cues are the indicators that the task is to be performed. Conditions are the "givens" for task performance. The identification of performance standards for each task supplies the foundation for the development of criteria for determining whether or not the task has been adequately trained.

f. Knowledge and Skills. Identifying the knowledge and skills necessary for the performance of each task contributes to decisions as to the instructional methods and media which should be used.

g. Team or Individual Task Performance. Each task should be analyzed to determine if it is performed by an individual or a team. This differentiation will impact the way the task will be trained.

h. Time to Perform. Identifying the length of time personnel take to perform a task contributes to the development of criteria for determining whether or not the task has been adequately trained.

5-8. Validation of the Train/No Train Decisions. The contractor recommends a train/no train decision for each specific task, as required by DID-4. These preliminary decisions shall be reviewed by job incumbents, or at a minimum, personnel familiar with the environment in which a set of tasks are performed, to assess the technical aspects of the train/no train decisions. These preliminary decisions become final only when the FAA COTR approves the deliverable.

a. Flowcharting. A flowchart is a visual roadmap of a task. It is a graphic way of sequencing the steps and decisions that go into performing a task. A flowchart of a job task is a map of what the person does on the job, not a map of the learning process. Flowcharting is an effective tool for analyzing a task because it:

(1) Reveals complexities in the task.

(2) Provides all the information necessary to perform the task.

Information Handling Services, 1999
August 11, 1999 10:18:24

(3) Makes it easy to identify the skills needed to perform each step of the task.

(4) Often reveals easier ways to perform a task or exposes unnecessary steps in a task.

Figure 5-2 provides an example of a task analysis flowchart.

b. Flowchart Symbology. Flowcharts use a set of symbols to represent specific occurrences. The simplest symbology consists of two flowchart symbols:

(1)	Start or Stop Box	Indicates the point at which a process starts or stops.
(2)	Action Box	Indicates some specific action, other than a decision, is to be performed at this point in the sequence.
(3)	Decision Diamond	Indicates that some logical decision is to be made, usually a "yes" or "no" alternative.

5-9. Traceability of Tasks to Training Development. The ability to trace task information throughout the training development process is essential for successful training development and for the subsequent revision of training documentation. During the analysis phase the tasks are arranged in a hierarchy where a numerical label is assigned to each task. It is this label and its subsequent elaborations which provide a tracking system for each task. Refer to Figure 5-1 for an example of a task analysis hierarchy. This labeling shall be used in the Course Design Guide to trace tasks to terminal objectives and training outcomes.

5-10. DID-5 Cognitive Task Analysis. This type of analysis is performed when a traditional task analysis yields tasks which have a strong cognitive component, such as those which require the performer to solve problems and make decisions. Examples are air traffic control tasks related to situation monitoring and maintenance tasks related to equipment troubleshooting. DID-5 describes the content and format of cognitive analysis deliverables.

Information Handling Services, 1999
August 11, 1999 10:18:24

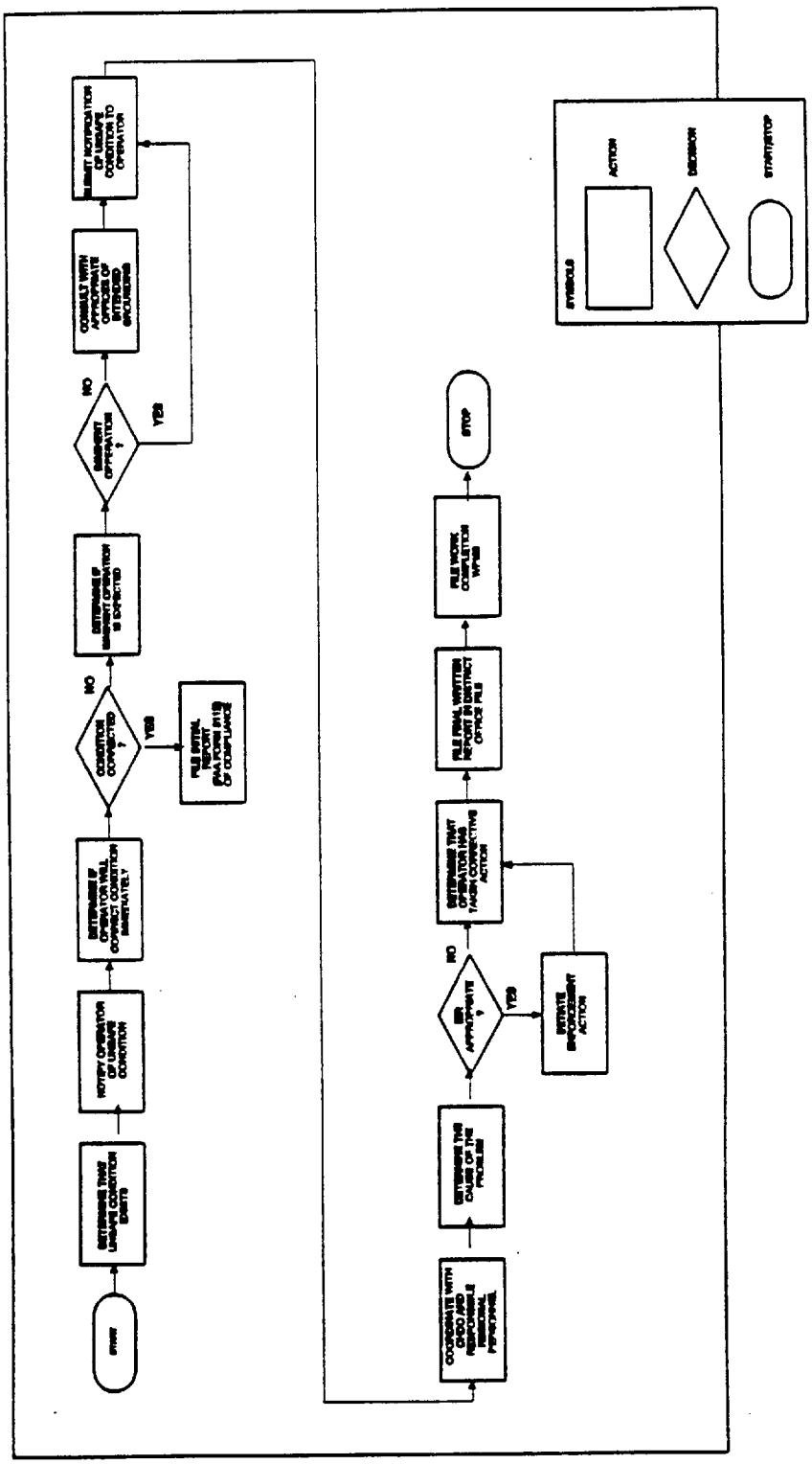


FIGURE 5-2: AN EXAMPLE OF A TASK ANALYSIS FLOWCHART

Information Handling Services, 1999
August 11, 1999 10:18:24

CHAPTER 6. DESIGN

6-1. **Purpose**. This chapter discusses the design phase of the systematic development process in which the training course structure is documented. The design phase focuses on the most effective manner in which to train employees to achieve the desired job performance.

6-2. **Description of the Design Phase**. The purpose of the design phase is to prepare a detailed plan of a training course, based on the information gathered in the analysis phase. In the design phase training outcomes and their associated objectives are developed and sequenced. Instructional methods and media and testing activities are also identified.

6-3. **Critical Actions**. The design of the training, using information developed during the analysis phase is critical to training development. During the design phase the following are determined:

a. Learning objectives and their sequence.

b. Most effective methods and media for each objective.

c. Appropriate emphasis for each objective, as represented by the amount and type of instructional materials for each objective.

d. Estimated time for accomplishing each objective.

e. Traceability of tasks to the objectives and to the instructional materials.

f. Development of appropriate test design strategies commensurate with the learning objectives.

6-4. **Documentation**. The determinations made in the design phase are documented in the:

a. Course Design Guide (CDG) (DID-6).

b. Course Schedule (DID-7).

6-5. **DID-6 Course Design Guide (CDG)**. This is a major document in the systematic process for developing effective instruction and in tracking the status of the course during its development. The CDG documents how the learning expected of students will be

Information Handling Services, 1999
August 11, 1999 10:18:24

accomplished. Training outcomes and objectives for the training are developed, sequenced, and documented in the CDG.

6-6. Training Outcomes. Training outcomes shall be developed for job performances at the duty level of the task and skills analysis. Training outcomes shall consist of three parts: performance, conditions, and standards, and shall be documented in the Course Design Guide.

6-7. Description of Objectives. One or more terminal learning objectives shall be developed for each task selected for training in the tasks and skills analysis (TASA). Terminal learning objectives shall state job performance behaviors rather than training behaviors. Enabling learning objectives shall be written for each terminal learning objective based on the knowledge and skills required to perform each terminal learning objective. This determination shall require an analysis of the subtasks and task elements documented in the TASA which support the task and terminal objective. Enabling learning objectives may be written as training performance behaviors and knowledge items. All learning objectives shall consist of three parts: performance, conditions and standards:

a. Performance. Each learning objective must specify a precise statement that documents what students must do to show that they learned what they were expected to learn. This part of a learning objective is referred to as the performance, or the behavior.

b. Conditions. A properly prepared objective clearly states the limits and/or conditions within which the student is expected to perform. Conditions answer questions such as the following: What does the student have to work with? Must the student select specific tools? Can the student use notes or technical orders for guidance? What information will be provided to the student as a starting point? Examples of conditional statements used in objectives include: "Given an operating Model 1 terminal..."; or "Given a schematic diagram, assorted electrical components, and a dc power source." Conditions may also state the cues that trigger an individual to perform an action.

c. Standards. A third requirement of a good objective is a clearly stated standard of performance. This standard reflects a job requirement. This portion of the objective describes how fast (for example "in 1 hour"), how accurately (for example, "8 out of 10" or "in accordance with Order 7110.65, para. 3-106" or "20 mill separation"), or the actual responses that are considered acceptable performances. Technical manuals, such as the Manufacturer's Instruction Book

Information Handling Services, 1999
August 11, 1999 10:18:24

(MIB), when used in a standard of performance, should provide a specific reference; for example, "MIB T.I.-8690-1". When a technical manual is referenced in a standard of performance, the technical manual shall be, at a minimum, in draft form and provided with the draft CDG for the FAA review. References to technical manuals and other written documentation shall be stated at the paragraph level, at a minimum.

6-8. **Sequencing of Objectives and Content.** The objectives establish the framework for the instruction, and show relationships between components of the instruction. Proper sequencing also avoids unnecessary duplication in course content and improves the efficiency of the instruction. One method of sequencing is to use the order in which tasks are performed. This method fosters the transfer of learning from the instructional setting to the job setting. Another method of sequencing is to arrange the instruction in the easiest learning order. This usually means moving from the simple to the complex, from the known to the unknown, or from the concrete to the abstract.

6-9. **Hierarchy of Objectives.** Levels of objectives are established during the design phase and documented in the CDG. Training outcomes occupy the highest level of the hierarchy in the CDG, followed by terminal objectives and their supporting enabling objectives.

6-10. **Methods and Media.** The appropriate methods and media for training must be selected. This selection is a critical part of the design process. The choices must be appropriate for the needs of the target population to be trained, the content to be taught, and the resource constraints. Methods and media affect how well the students will be able to learn and to transfer new knowledge and skills to the job.

6-11. **Test Type.** Identification of the type of tests used to measure the achievement of the objectives is a critical step in preparing the CDG. Tests assess the extent of learning by measuring the behaviors specified in the objectives. Either a written or performance test is identified for each objective stated in the CDG. Consistency shall be maintained between the behavior required in each learning objective and the type of test item selected. For example, learning objectives that require hands-on performance shall require hands-on practice and hands-on test items.

6-12. **DID-7 Course Schedule.** The course schedule provides the FAA with an overview of the course chronology. It records the contractor's expected schedule for each day of each week of the course in a grid format. Laboratory time, tests, and other

Information Handling Services, 1999
August 11, 1999 10:18:24

instructional events are included. The course schedule is submitted concurrently with the CDG and shows the major course segments as specified in the CDG. The course schedule is updated throughout the development process. At the course walk-through the detailed course schedule is submitted to the FAA with the lesson presentation.

6-13. **Concurrent Submission Process.** The FAA requires that the contractor deliver the draft form of the CDG and the course schedule concurrently for FAA review and approval.

Information Handling Services, 1999
August 11, 1999 10:18:24

CHAPTER 7. DEVELOPMENT

7-1. **Purpose**. This section discusses the development phase of the systematic development process in which the training design is translated into instructional materials. As instructional materials are developed, they are validated through developmental tryouts and a course walk-through to determine their effectiveness in addressing the course objectives and the design specifications. Validation begins in the development stage with the developmental tryouts and course walk-through, and is completed in the delivery stage with the first course conduct.

7-2. **Description of the Development Phase**. In the development phase the instructional materials for the course are developed, validated, and revised. Effective instructional materials are created through the application of learning principles to the learning activities.

7-3. **Critical Actions**. During the development phase the following activities occur:

a. Translation of the instructional design stated in the CDG into effective instructional materials.

b. Creation of consistent and uniform instructional materials which are traceable to previous and subsequent documentation.

c. Revision of the instructional materials based upon the validation activities consisting of the developmental tryout(s) and the course walk-through.

7-4. **Documentation**. The deliverables associated with the development phase include the:

a. Student Achievement Tests (DID-8).

b. Lesson Plan (DID-9).

c. Student Materials (DID-10).

d. Media Materials (DID-11).

e. Commercial Off-the-shelf Training Materials Report (DID-12).

f. On-the-job (OJT) Training Instructor Handbook (DID-13).

Information Handling Services, 1999
August 11, 1999 10:18:24

g. Job Aids (DID-14).

h. Correspondence Study Materials (DID-15).

i. CBI Lesson Specifications (DID-16).

j. Plan for Computer-Based Instruction Testing (DID-17).

k. CBI Validation Plan and Validation Report (DID-18).

l. Video Treatments (DID-19).

m. Storyboards/Scripts (DID-20).

n. Video Shot List (DID-21).

o. CBI Program Documentation (DID-22).

p. Interactive Courseware for Training Devices (DID-23).

q. Video Courseware (DID-24).

r. Developmental Tryout (DID-25).

s. Course Walk-Through (DID-26).

7-5. DID-8 Student Achievement Tests. This DID specifies the means by which learning performance is measured and reported. The use of written and performance tests is defined, and guidelines for their production are provided.

7-6. Selecting the Appropriate Test Type. For each terminal objective and enabling objective, the appropriate test type must be selected. The test type must be consistent with the type of learning associated with each objective. Written tests measure student knowledge, understanding and ability to apply concepts and principles. Written tests shall be prepared in accordance with FAA-D-2706, Theory of Operations Examinations, Preparation and Validation of. Performance tests measure the execution of tasks and subtasks and involve operations with observable results. For Airway Facilities, performance tests shall be developed in accordance with FAA-D-2781, Airway Facilities Performance Examinations, Preparation and Validation of.

7-7. DID-9 Lesson Plan. Lesson plans are used by the course instructor as a guide for delivering the training. Each lesson plan contains an introduction, content presentation, and summary.

Information Handling Services, 1999
August 11, 1999 10:18:24

Lesson plans follow an outline format for easy reference by an instructor and reflect instructor and student activities. Lesson plans shall relate new learning to the current job when supplemental training is being delivered.

7-8. DID-10 Student Materials. Student materials such as guides, workbooks, and manuals directly correspond to the instructor lesson plans. The student materials support the instruction, are sequenced in the same manner as the lesson plans, and are developed from the content of the instructor lesson plan. However, student materials do not duplicate word-for-word the content of the instructor lesson plan. Student materials include informational handouts, reading assignments, learning activities, job sheets, and review exercises which the students use during the lessons.

7-9. DID-11 Media Materials. Media materials include all video, audio, and visual materials which can support and enhance the instructional presentation. Media material selection is dependent on the training situation for which they are used and the objectives they are to support.

7-10. DID-12 Commercial Off-The-Shelf Training Materials Report. The commercial off-the-self training materials report provides the FAA with information for assessing the suitability of commercial off-the-shelf (COTS) training materials. The analysis presented in this report shall be traceable to the task and skills analysis and the CDG.

7-11. DID-13 On-The-Job Training Instructor Handbook. The on-the-job instructor handbook is used by the on-the-job (OJT) instructor as a guide for delivering training. The on-the-job instructor handbook is organized by lessons. Each lesson contains the activities to be undertaken by the instructor and the student, presented in an outline format.

7-12. DID-14 Job Aids. Job aids are often used to supplement instruction or as an alternative to instruction. They may provide information on the steps in a procedure or may guide the user in making decisions related to a specific job task. Job aids may be used to help in remembering procedural information or to decrease the need for memorization. When used in place of training, some instruction must still be provided on the use of the job aid. Examples of job aids are: checklists, procedural lists, flowcharts, diagrams, and illustrations.

7-13. DID-15 Correspondence Study Materials. Correspondence study materials are individualized, self-paced study materials used in a correspondence course. Correspondence materials shall be developed in accordance with the CDG.

Information Handling Services, 1999
August 11, 1999 10:18:24

7-14. DID-16 CBI Lesson Specifications. CBI lesson specifications document the design of each CBI lesson and the hardware, software and conventions to be used to produce the lesson. The CBI lesson specifications provide the transition from analysis to the design and production of draft CBI courseware. The CBI lesson specifications are prepared in accordance with the CDG.

7-15. DID-17 Plan for Computer-Based Instruction Testing. The plan for computer-based instruction testing describes how students will be tested using CBI and how resulting test information will be managed by the instructor and/or student.

7-16. DID-18 CBI Validation Plan and Validation Report. The CBI validation plan specifies the activities to be performed to assess the effectiveness and efficiency of CBI materials. The validation report documents the results of the activities described in the CBI validation plan.

7-17. DID-19 Video Treatments. Video treatments are narrative descriptions of the proposed specific content of all video sequences to be included in the CBI courseware. The treatment explains how the video portion will present the course content for the student. The FAA will use these descriptions to evaluate the feasibility of obtaining the necessary images.

7-18. DID-20 Storyboards/Scripts. Storyboards for CBI reflect the instructional intent of each CBI frame. Storyboards provide a picture or detailed script of the content and words that accompany the video. Scripts detail the video sequences to be included in the CBI courseware. Storyboards/scripts shall be developed in accordance with the CDG.

7-19. DID-21 Video Shot List. The video shot list is a listing of all video motion and still frame shots to be used in the CBI development.

7-20. DID-22 CBI Program Documentation. The CBI program documentation supplies a detailed record of the software programming which produces on-screen material for a CBI course.

7-21. DID-23 Interactive Courseware for Training Devices. This DID documents the requirements for deliverables that are developed as part of the interactive courseware for a training device.

7-22. DID-24 Video Courseware. This DID documents the information that the government needs to evaluate the contractor's decisions concerning the content, treatment, and organization of video courseware.

Information Handling Services, 1999
August 11, 1999 10:18:24

7-23. Developing Effective Instructional Materials. Important principles for writing effective materials include the following:

a. Keep the characteristics of the target population in mind.

b. Use a reading level that is appropriate for the target audience.

c. Use a clear writing style.

d. Use gender-free wording.

7-24. Characteristics of the Target Population. Instructional materials should be developed to address the target population which is specified in the contract for training. Target populations often differ from each other by:

a. Specific terminology used on the job.

b. Job environment (for example, individual versus team.)

c. Workforce demographics (for example, inexperienced employee versus experienced employee).

7-25. Reading Level. Another factor to consider when developing instructional materials is the reading comprehension level of the audience. Reading comprehension of all contractor developed instructional materials shall be at the 9th grade level, unless otherwise specified in the contract.

7-26. Gender-Free Wording. All instructional materials developed for the FAA shall use gender-free wording. For example, use "he/she" or "the student" instead of "he" and "she" when addressing the student in tests, student materials, or lesson plans. Another technique for gender-free wording is to use the plural (for example, students) which permits the use of the pronouns "they/them/their". For example, "Students will complete student critique sheets. Their comments will be summarized in the validation report."

7-27. Validating Instructional Materials. Validation of the instructional materials begins in the development phase and is accomplished through the:

a. Developmental tryout(s) conducted by the contractor.

Information Handling Services, 1999
August 11, 1999 10:18:24

b. Course walk-through conducted by the contractor with FAA representatives in attendance.

7-28. DID-25 Developmental Tryout(s). The developmental tryout(s) is an assessment of the effectiveness of the instructional materials when they are in a semi-finished or draft form. The contractor presents the instructional materials to representatives of the target population and/or other contractor personnel to elicit discussion. The areas to be assessed include the:

a. Appropriateness of instructions.

b. Readability of visuals.

c. Clarity of test items.

7-29. Need for Developmental Tryout(s). The developmental tryout(s) is an integral part of the development phase. The FAA believes that this methodology aids in producing high quality training products. By taking advantage of this informal process, the contractor should be able to avoid costly revisions to the instructional materials in the later phases of the training development process.

7-30. DID-26 Course Walk-Through. The course walk-through provides a formal point at which the development of the instructional materials is assessed by the FAA. The course walk-through allows for the evaluation of the traceability and integration of the training outcomes, the terminal objectives, and the enabling objectives with the instructional materials. The effectiveness of the technical content, testing strategy, and instructor activities are also assessed during the course walk-through.

7-31. Conducting the Course Walk-Through. The course walk-through is conducted by the contractor and presented to the FAA. The contractor shall provide a team, consisting of the course developer, instructor, and subject matter experts, for the course walk-through. The FAA should be represented at the walk-through by SMEs, education specialists/instructional technologists, and the FAA COTR. No FAA students shall attend the course walk-through.

a. Materials. The approved, revised draft of all instructional materials (lesson plans, tests, student materials, media materials) shall be made available to the FAA during the course walk-through. For example, if a videotape is called for in the lesson plans, it shall be available for viewing, should the FAA choose to do so. A course schedule, which includes

Information Handling Services, 1999
August 11, 1999 10:18:24

lesson titles, shall be made available at the course walk-through.

b. Presentation. The contractor shall present a shortened version of each lesson of the course in enough detail and depth so that the effectiveness of the training materials, learning sequence, performance activities, tests, and the time allocations can be fully assessed.

7-32. Letter of Authorization. The FAA Contracting Officer provides a formal letter of authorization to the contractor after the course walk-through is completed. The letter authorizes the contractor to perform the first course conduct and specifies the revisions to the instructional materials and CDG before the first class is conducted.

7-33. End of the Development Phase. The course walk-through is the end point of the development phase. At this stage the instructional materials have been validated to determine how well they meet the training needs which were documented in the analysis phase.

7-34. Submission Process. The instructional materials described in this section closely follow one another and shall be submitted in draft form in the following order:

a. The lesson plan.

b. Achievement tests reflecting revisions to the lesson plan.

c. Student materials which include revision to the lesson plan, activities and tests.

Information Handling Services, 1999
August 11, 1999 10:18:24

CHAPTER 8. DELIVERY

8-1. Purpose. This chapter discusses the delivery phase of the systematic development process in which the course is presented to the student population. The validation process is continued during this phase and is completed after the first formal presentation of the course has been conducted and the course report has been submitted to the FAA.

8-2. Description of the Delivery Phase. The contractor shall present the first conduct of the course, as specified in the contract. Guidelines for the first course conduct are presented in DID-27. FAA representatives who evaluate the technical accuracy and the instructional effectiveness of the course will attend the first course conduct. The FAA representatives will use the lesson plans in conjunction with the course evaluation checklist, specified in DID-27, to review the first course conduct. Since the lesson plans are used as a tool for evaluation, the contractor shall ensure that all instructional materials are current at the time of the first course conduct. These materials shall include revisions/changes made through the previous validation process.

8-3. Critical Actions. Activities during this phase emphasize the integration and success of the instruction, including the determination of the:

a. Effectiveness of the components of the instruction.

b. Methods for revising the course to correct any deficiencies noted.

8-4. Documentation. The deliverable associated with the delivery phase is the course report which is included in the First Course Conduct and Course Report (DID-27).

8-5. DID-27 First Course Conduct and Course Report. The contractor shall conduct the first formal presentation of the course, as specified in the contract.

a. Contractor Supplied Materials. For the first course conduct the contractor shall supply each student with a set of student materials which shall become the property of the student after the training is completed. The contractor shall supply each student with a set of reference materials to be kept in the classroom or laboratory and which shall not be retained by the student.

Information Handling Services, 1999
August 11, 1999 10:18:24

b. Data Collection. The contractor shall collect and analyze information from three sources during the first course conduct: the attending FAA representatives, the instructor conducting the first course, and the students. The FAA COTR will specify the end-of-course evaluation questionnaire to be completed by the students.

c. Course Report. The course report, submitted to the FAA after the first course conduct, shall document the extent to which the students achieved the objectives, the deficiencies in the instruction, and the accuracy of the time allocations. In the course report the contractor shall recommend revisions to the instruction and a timeline for completion of the revisions by the contractor. The earlier review points in the analysis, design, and development phases should ensure that only minor revisions are required at this point.

8-6. Subsequent Course Conduct. If specified by the contract, the contractor shall conduct a number of classes following the first course conduct. Before conducting subsequent classes, the revisions identified during the first course conduct shall be incorporated. This allows subsequent classes to be taught with revised documentation. As with the first course conduct, the contractor shall supply each student with a set of student materials which shall become the property of the student after the training is completed. The contractor shall also supply each student with a set of reference materials to be kept in the classroom or laboratory which shall not be retained by the student. The contractor shall also supply each student with an end-of-course evaluation questionnaire to be completed after each subsequent class is conducted.

8-7. Data. Following each subsequent class delivery, the contractor shall provide a letter to the FAA which provides the following:

a. Roster of students attending the course.

b. Information for each test, including:

(1) Class average.
(2) Range of scores.
(3) Number of students passing.

c. Original, student, end-of-course, evaluation questionnaires.

d. Originals of all the student tests.

Information Handling Services, 1999
August 11, 1999 10:18:24

8-8. Final Documentation. Final documentation shall take one of two forms: camera ready format or master reproducible format. The contract specifies the final format for each training deliverable. Final documentation of the course includes the instructional materials and an updated CDG which reflects the current status of the course. Specification 2494, Technical Instruction Book Manuscript: Electronic, Electrical, and Mechanical Equipment, Requirements for Preparation of Manuscript and Production of Books, contains the guidelines for preparing camera ready copy. Depending upon the contract and the timeline for revision, specified in the validation report, all or some of the subsequent classes may be conducted before submission of the final documentation to the FAA.

8-9. Transmittal Letter. A letter of transmittal, from the contractor to the FAA COTR, shall accompany the final course documentation and certify that the approved revisions have been completed.

Information Handling Services, 1999
August 11, 1999 10:18:24

CHAPTER 9. EVALUATION

9-1. Purpose. This section discusses the evaluation phase of the systematic development process which provides feedback for revision.

9-2. Description of the Evaluation Phase. Evaluation is an ongoing process that determines the effectiveness of a program or course and which identifies needed changes. Evaluation takes two forms: formative and summative. Evaluation activities provide quality control throughout the phases of the systematic development process.

a. Formative Evaluation. Formative evaluation is a process for determining technical accuracy and instructional soundness of materials prior to use. Formative evaluation occurs throughout the training development process and provides feedback that is incorporated into the analysis, design, development, and delivery of the training.

b. Summative Evaluation. Summative evaluation is the assessment of the impact of the training on job performance. This type of evaluation is a process that assesses the effectiveness of the instructional materials in addressing the training and job performance requirements. Summative evaluation activities are generally conducted by the FAA.

9-3. Documentation. Evaluation information is submitted to the FAA COTR in the course report. The FAA documents its evaluation of a course in the course report.

9-4. Course Report. The evaluation phase is completed by the FAA and documented in a course report. The course report certifies that the course described in the CDG has been successfully developed.

9-5. Evaluation/Validation of Computer-Delivered Courseware. Formative evaluation of computer-delivered courseware shall be conducted in accordance with DID-18, CBI Validation Plan and Validation Report.

Information Handling Services, 1999
August 11, 1999 10:18:24

9003329 0020704 563

APPENDIX 1

DATA ITEM DESCRIPTIONS

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -1

1. Title:

Contractor's Proposal for Training

3. Description/Purpose:

This DID establishes the minimum requirements for the content of the contractor's proposal for training. The contractor's proposal for training documents the:

a. Contractor's cost estimates for each line item of the solicitation.

b. Contractor's technical approach to the training requirements stated in the solicitation.

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains the preparation instructions for the format and content of the contractor's proposal for training.

7.2 This DID is applicable to all responses to FAA-initiated solicitations for proposals for training development and/or delivery.

10. Preparation Instructions:

10.1 Reference Documents. The contractor's proposal for training shall be prepared in accordance with the documents referenced in the solicitation.

10.2 Format. The contractor's proposal for training shall be prepared in accordance with the following format requirements, unless otherwise specified in the solicitation:

10.2.1 The contractor's proposal for training shall be delivered on 8.5" x 11" bond paper and bound following the contractor's commercial practice. Foldout pages may be used as required. All pages shall be numbered at the bottom center.

Information Handling Services, 1999
August 11, 1999 10:18:24

(a) Type 1 functions: All Type 1 functions are mandatory under the standard.

(b) Type 2 functions: Type 2 functions are optional.

(c) Type 3 functions: The following Type 3 functions shall be supported:

(1) Priority

(2) Quality of Service

3.2.2.2.2.1.2 Provision of the Underlying Service. NAS open end-systems shall provide the subnetwork dependent convergence function as specified in ISO 8473 - clause 8.5.2. The convergence function will map the connectionless services of the Network Layer to the services provided by the X.25 connection-oriented network access protocol. ISO 8473/AD3 shall be implemented for open end-systems providing ISO 8473 over an OSI data link service.

3.2.2.2.2.1.3 Provision for Routing Protocols. NAS open end-systems, requiring communications via routers, shall implement the End System (ES) to Intermediate System (IS) Routing Protocol in conjunction with ISO 8473. NAS intermediate systems providing NAS routing shall implement shall implement the IS to IS Intra-Domain Routing Protocol. NAS intermediate systems providing routing to external networks shall use the Boundary Intermediate System (BIS) Inter-Domain Routing Protocol.

3.2.2.2.2.1.3.1 End System to Intermediate System Routing Protocol. NAS open end-systems, that require communication through routers, shall use the ES-IS routing protocol to enable routing service. The ES-IS protocol shall be in accordance with ISO 9542 and the OIW Stable Agreement for Open Systems Interconnection Protocols and shall be used in conjunction with ISO 8473.

3.2.2.2.2.1.3.2 Intermediate System to Intermediate System Intra-Domain Routing Protocol. NAS open intermediate systems, providing NAS routing, shall use the IS-IS intra-domain routing protocol to enable routing within the NAS routing domain. The IS-IS protocol shall be in accordance with ISO 10589 and the NIST Stable Agreement for Open Systems Interconnection Protocols and shall be used in conjunction with ISO 8473. Intra-domain routing between the NAS and the ATN shall be in accordance with the ATN Manual.

3.2.2.2.2.1.3.3 Boundary Intermediate System to Boundary Intermediate System Inter-Domain Routing Protocol. NAS open boundary intermediate systems, providing routing, shall use the BIS-BIS inter-domain routing protocol to enable routing between the NAS routing domain and an external routing domain (e.g., ATN routing domain). The BIS-BIS protocol shall be in accordance with ISO 10747 and the NIST Stable Agreement for Open Systems Interconnection Protocols and shall be used in conjunction with ISO 8473. Inter-domain routing between the NAS and the ATN shall be in accordance with the ATN Manual.

3.2.2.2.2.2 Connection-Oriented Network Service (CONS). The CONS provides the Transport Layer with a network connection service where network connections between end-systems are to be established. CONS shall be implemented in accordance with ISO 8880-1 and ISO 8880-2. CONS may be used over a specific interface provided there are either no intermediary networks or only X.25 intermediary networks. For NAS open end-systems communicating over X.25 wide area networks, CONS shall be provided as defined in ISO 8878, Use of X.25 to Provide OSI Connection-mode Network Service.

Information Handling Services, 1999
August 11, 1999 11:13:47

10.3 Content Requirements. The contractor's proposal for training shall be prepared in accordance with the descriptions provided below:

10.3.1 **Scope of Work.** The scope of work which will be provided by the contractor or subcontractor shall be described in detail for each line item (sub-item) in the solicitation CDRL. The scope of work description shall include:

a. Services to be performed.

b. Development tasks to be performed in order of performance.

c. A milestone schedule for the project as described in DID-2, Milestone Schedule.

10.3.2 **Systematic Development of Training.** The contractor's understanding of, and approach to, a systematic training development process shall be described to accomplish the tasks specified in the statement of work. This section of the proposal shall include discussion of: training analysis, design, development, implementation, and evaluation as each relates to the tasks in the statement of work.

10.3.3 **Methodology.** The contractor's proposed method for determining the following aspects of each course shall be stated in the proposal:

a. Estimated total course length in hours.

b. Estimated time by instructional type and quantity in hours.

c. Special tools, test equipment, and other devices that are necessary to conduct training and are furnished by or arranged for by the contractor.

d. Course materials, including any necessary technical or operational manuals furnished to each student and retained by the student upon completion of the course, reference materials furnished to each student but not retained by the student upon completion of the course, and CBI courseware.

e. Any software or firmware to be taught as a part of a hardware maintenance course, including recognizing

Information Handling Services, 1999
August 11, 1999 10:18:24

instruction codes, writing programs, installing software patches, and using diagnostic and/or utility routines.

f. Contractor training facilities and a description of each.

g. The contractor's plan for maintaining up-to-date courseware when several iterations of a course will be delivered over time and changes to training content may occur as the result of hardware or software updates to equipment and systems.

10.3.4 **Personnel Qualifications.** The qualifications of the contractor's training personnel shall be described in this section of the proposal. Personnel descriptions shall include the following information:

a. The name, instructional design expertise of key training personnel, and relevant technical expertise of key subject matter experts. Key personnel shall consist of those positions performing the training analysis, design, development, delivery, and evaluation, as well as the project manager.

b. The contractor management capabilities, available resources, and organization.

c. The type and quantity of work to be performed by a subcontractor(s), including specific tasks and products.

d. The degree of control to be exercised over subcontractor performance by the prime training contractor.

e. The subcontractor's capabilities, including technical expertise, qualifications to perform specific tasks, and available resources to assure successful performance.

10.3.5 **Commercial Off-the-shelf Training Materials.** If the contractor proposes commercial off-the-shelf training materials as a course or for any part of a course, the contractor shall provide the information specified in paragraph 10.3 of DID-12, Commercial Off-the-shelf Training Materials Report, as a section of the proposal.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.3.6 **Best Commercial Practice.** When training materials are to be developed according to best commercial practice, the following requirements shall be met:

a. A systems approach to training development shall be used.

b. Traceability between the task analysis data and the course design guide shall be provided. Terminal objectives shall be traceable to tasks selected for training.

c. Best commercial practice shall provide flexibility from the standpoint of format, not content. It shall not be used to shortcut the application of instructional systems design processes and procedures.

d. Formats for best commercial practice shall be submitted to the FAA COTR for review and approval prior to use.

10.3.7 **Assumptions.** The contractor shall state any assumptions made in the proposal such as government-furnished equipment and/or information, level of fault isolation to be taught, equipment to be taught, and any other assumptions that have been made.

10.3.8 **Cost Information.** This section shall provide cost information, including overhead clearly indicated, for each line item in the Contract Data Requirements List (CDRL) or sub-item in the solicitation as indicated below:

a. Labor requirements, by labor category or skill level for each task.

b. The number of hours required to accomplish the task for each labor category or skill level.

c. The following information in separate summary forms:

1) Total labor hours and subtotals for the hours for each labor category or skill level for each year.

2) Labor hours per month by labor category or skill level for each task.

3) Total cost and hours for each task.

Information Handling Services, 1999
August 11, 1999 10:18:24

d. Travel requirements and costs by task. Travel requirements shall be listed by the number of round trips, and, for each trip, the destination, number of people traveling, and duration, including travel time, shall be provided. Travel requirements shall identify the labor categories involved and the specific work to be performed during the travel.

e. Training equipment and costs. All training equipment, documentation, and software required to develop and/or deliver the training shall be listed for each task with the costs for each item.

f. Subcontracted items and costs. All the subcontracted items or activities shall be listed and the cost shall be stated for each.

g. Printing, reproduction, and miscellaneous costs. All printing, reproduction, and miscellaneous costs shall be stated. The number of pages or copies to be made shall be estimated and stated.

h. Costs of the contractor-furnished parts, equipment, tools, and test equipment.

i. Costs of special leased equipment or services; for example, leased lines and terminals.

j. The general and administrative overhead cost, profit or fee, cost of money, and any other associated costs.

k. The total loaded cost for each CDRL line-item.

l. The total loaded cost for the sum of all the contract training items.

m. The assumptions or conditions for the estimates. The special conditions, outside the control of the contractor, that must be met to accomplish the work quoted shall be identified.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -2

1. Title:

Milestone Chart

3. Description/Purpose:

The Milestone Chart DID contains instructions for the preparation of a time-based chart which shows the start and end points for the development and review of each training deliverable specified in the contract. It is used as a management tool by the FAA. The milestone chart reflects the current status of the training deliverable schedule. It is updated whenever an approved change to the deliverable schedule occurs.

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains the preparation instructions for the format and content of a Milestone chart.

7.2 This DID is applicable to all contract training development and/or delivery efforts.

10. Preparation Instructions:

10.1 Reference Documents. The Milestone Chart shall be prepared in accordance with the FAA's solicitation for contractor training.

10.2 Format. The Milestone Chart shall be prepared in accordance with the following format requirements, unless otherwise specified by the solicitation:

10.2.1 The Milestone Chart shall be delivered on 8.5" x 11" bond paper and shall be in landscape orientation and shall be organized as shown in Figure 2-1. A foldout may be used as required.

10.2.2 The Milestone Chart shall have a cover sheet displaying the following information:

a. Document title.

Information Handling Services, 1999
August 11, 1999 10:18:24

b. Solicitation reference number and/or course identification number/course title.

c. Contract number, when submitted after contract award.

d. Contractor name and address.

e. Submission date.

10.3 Content Requirements. Each Milestone Chart shall be prepared in accordance with the descriptions below:

10.3.1 The Milestone Chart shall show the days after contract award and the calendar months for the project on the horizontal axis. The training deliverables, as specified in the solicitation or contract, shall be listed on the vertical axis.

10.3.2 The Milestone Chart shall indicate, for each deliverable, the time allowed for:

a. Contractor development.

b. FAA review, which shall be estimated at 45 working days.

c. Revision of the material by the contractor, which shall be estimated at 30 working days.

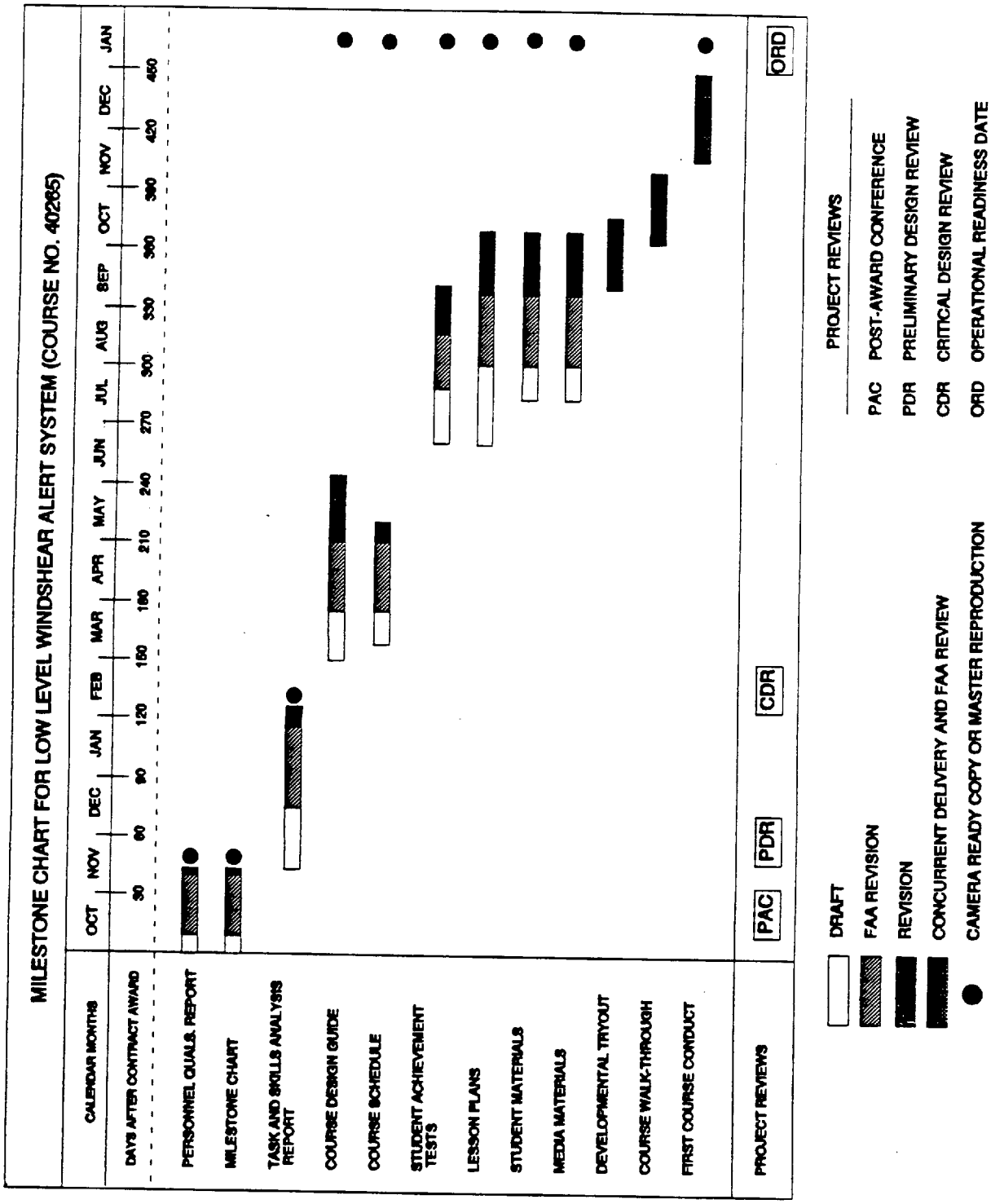
d. Submission of the final form of the deliverable.

10.3.3 The Milestone Chart shall indicate when scheduled project review meetings will occur.

10.3.4 The Milestone Chart shall be titled with the course title and number.

Information Handling Services, 1999
August 11, 1999 10:18:24

DID 2, FIGURE 1. SAMPLE MILESTONE CHART



Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -11

1. Title:

Media Materials

3. Description/Purpose:

This DID establishes the minimum requirements for contractor-developed media materials which will support and enhance the instructional presentation by supplying the students with various formats from which to gather information.

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains the preparation instructions for the format of different types of media materials.

7.2 This DID is applicable to all contract training development efforts in which the contract specifies media materials as a deliverable.

10. Preparation Instructions:

10.1 **Reference Documents**. Media materials shall be prepared in accordance with the documents referenced in the contract.

10.2 **Format**. Media materials shall be prepared and delivered in accordance with the following format requirements or in the form best suited for their use, as defined by the contract.

10.2.1 **Print Materials.** Print materials shall be delivered in the form best suited for their use and with consideration as to the type of material, as defined by the contract, and in accordance with the following:

10.2.1.1 Books shall be bound. Foldout pages may be used as required.

10.2.1.2 Periodicals shall be intact and without missing pages.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.2.1.3 Pamphlets with multiple pages shall be either bound or stapled. Tri-fold pamphlets and other formats shall be acceptable if agreed upon by the FAA prior to the pamphlet's production and/or distribution.

10.2.1.4 Maps shall be supplied intact and shall be of a magnification appropriate to supporting the instruction, as defined either by the contract or the FAA COTR.

10.2.1.5 The format for other print materials shall be determined on a case-by-case basis by the FAA, and shall be specified in the contract.

10.2.2 **Still Visuals.** Still visuals shall conform to the following format:

10.2.2.1 Still visuals shall have information on the portion of the slide or overhead that permits viewing by all students within a classroom. The portion of the slide or overhead that permits viewing shall be an area 4.625" x 6.5" in the center of a 6" x 9" projected grid. The area surrounding the designated center portion of the grid shall be used only for the overflow of artwork and other information not essential to the message being presented.

10.2.2.2 All background in still visuals shall be soft, non-obtrusive colors, with the exception of response items. Response items shall be in the negative state (white letters on black or royal blue background). Backgrounds shall not interfere with the message of the visual. When artwork appears on the visual, the background shall contrast, rather than blend in, with the letter information of the artwork.

10.2.2.3 The leading, or space between lines on a still visual shall be two points, unless otherwise specified by the FAA.

10.2.2.4 All information on a still visual shall be in typeface 7 or 8, using upper and lower case letters, except for titles, labels, phraseology, and flight progress strips which shall be in all capital letters.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.2.2.5 Italics may be used on a still visual in any typeface or size to indicate emphasis.

10.2.2.6 Fourteen point character size shall be used for slide numbers, audiovisual control numbers, and flight strip typewritten data, all of which are normally displayed in all capital letters.

10.2.2.7 Eighteen point size shall be used on still visuals for narrative data which is normally displayed in upper and lower case letters.

10.2.2.8 Twenty-four point size shall be used on still visuals for titles which are normally displayed in all capital letters.

10.2.2.9 All edges of a contact print shall be taped down with clear, cellophane tape when inserted in the visual position in the master lesson plan. A contact print is the black and white print (3" x 4") reproduced from the technistat which is the black and white printed copy of artwork used for producing a master copy or contact print.

10.2.3 **Audio Materials.** The format requirements for audio materials shall be determined by the FAA on a case-by-case basis and shall be specified in the contract.

10.2.4 **Motion Visuals.** The format requirements for motion visuals shall be determined by the FAA on a case-by-case basis, and shall be specified in the contract. When a video tape is to be developed, deliverables shall be prepared in accordance with DID-24, Video Courseware.

10.2.5 **Actual Objects.** The format requirements for actual objects shall be determined by the FAA on a case-by-case basis, and shall be specified in the contract.

10.3 <u>Content Requirements</u>. The following types of media materials shall be developed, as specified by the contract:

10.3.1 **Print Materials.** Print materials, which included printed or duplicated aids to support the instruction, shall include, but are not limited to:

Information Handling Services, 1999
August 11, 1999 10:18:24

a. Books.

b. Periodicals.

c. Pamphlets.

d. Maps.

10.3.2 **Still Visuals.** Still visuals, which are graphic aids displayed as slides, overheads, or on a flipchart, communicate facts and ideas through a combination of pictures, drawings, symbols, and words. The types of still visuals to be developed shall be agreed upon by the FAA prior to their development. The types of still visuals that may be required include, but are not limited to:

a. Illustrations.

b. Figures.

c. Schematic diagrams.

d. Tables.

e. Flowcharts.

10.3.3 **Audio.** Types of audio include disc and tape recordings and their associated equipment. The types of audio shall be specified by the contract or agreed upon by the FAA prior to development. The types of audio that may be required include, but are not limited to:

a. Magnetic cassettes.

b. Reel-to-reel tape.

c. Compact discs.

10.3.4 **Motion Visuals.** Motion visuals supply the student with information via the sight of dynamic motion. Types of motion visuals shall be specified by the contract, or otherwise agreed to by the FAA prior to development. When a video tape is to be developed, deliverables shall be prepared in accordance with DID-24, Video Courseware. Types of motion visuals include, but are not limited to:

a. Black and white films.

Information Handling Services, 1999
August 11, 1999 10:18:24

b. Color films.

c. Videotape.

d. Computer-based instruction (CBI) graphic animation or motion video segments.

10.3.4.1 When computer-based instruction is used to present motion visuals, these visuals shall be developed in accordance with the CBI DIDs.

10.3.5 **Actual Objects.** Actual objects are either the real object or scale models, mock-ups, cutaways, or simulators. The type of actual object to be developed shall be agreed upon by the FAA prior to its development, or else specified in the contract.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -12

1. Title:

Commercial Off-the-Shelf Training Materials Report

3. Description/Purpose:

This DID specifies the minimum requirements for the content of the Commercial Off-the-Shelf Training Materials Report. The Commercial Off-the-Shelf Training Materials documents the:

a. Contractor's assessment of the suitability of the commercial off-the-shelf (COTS) training materials for a specific FAA application.

b. Contractor's development and validation procedure for COTS materials.

c. Objectives, content, and any supporting materials for the COTS materials.

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains the preparation instructions for the format and content of the Commercial Off-the-Shelf Training Materials Report.

7.2 This DID is applicable to all contract training development and/or delivery efforts for which the contractor has determined that COTS materials are suitable for use in support of either the development or delivery of the instruction.

10. Preparation Instructions:

10.1 Reference Documents. The Commercial Off-the-Shelf Training Materials Report shall be prepared in accordance with the documents referenced in the contract and the CDG.

10.2 Format. The Commercial Off-the-Shelf Training Materials Report shall be prepared in accordance with the following format requirements:

Information Handling Services, 1999
August 11, 1999 10:18:24

10.2.1 The Commercial Off-the-Shelf Training Materials Report shall be delivered on 8.5" x 11" bond paper and bound following the contractor's commercial practice. Foldout pages may be used as required. All pages shall be numbered at the bottom center. Copies of all materials referenced in the Commercial Off-the-Shelf Training Materials Report shall be delivered concurrently with the report to the FAA for review.

10.2.2 The Commercial Off-the-Shelf Training Materials Report shall have a cover sheet displaying the following information:

a. Document title.

b. Course identification number/course title.

c. Contract number.

d. Contractor name and address.

e. Submission date.

10.2.3 A Table of Contents shall follow the cover sheet, specifying the page numbers. The Table of Contents shall include:

a. Proposed COTS Training Materials.

b. Target Population.

c. Tailoring Requirements.

d. Content Overview.

e. COTS Course Outline.

f. Materials List.

g. Special Equipment.

h. References.

i. COTS Course Validation Procedures.

10.2.4 Each of the Commercial Off-the-Shelf Training Materials Report sections named above shall be initiated on a separate page displaying a centered all-caps heading.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.3 Content Requirements. The Commercial Off-the-Shelf Training Materials Report shall be prepared in accordance with the descriptions provided below:

10.3.1 **Proposed COTS Training Materials.** This section of the report shall indicate the name of the proposed COTS training materials and their function, and shall contain information that validates the ability of the proposed COTS training materials to satisfy the required training need.

10.3.2 **Target Population.** The target population for whom the COTS materials were designed, its characteristics with regard to reading and experience levels, and other relevant factors shall be included in this section of the report. This section of the report shall also include descriptions of other populations with whom the materials have been successfully used.

10.3.3 **Tailoring Requirements.** All modifications to the proposed COTS training materials, to maintain consistency with the specifications of the CDG and to meet the training requirement, shall be stated in this section. This section shall also include the proposed timeframe for all modifications to the COTS training materials.

10.3.4 **Content Overview.** The content of the training materials and the methods and media used for delivery shall be briefly described in this section of the report.

10.3.5 **COTS Course Outline.** This section of the report shall contain the outline of the course, including each lesson or module, the objectives, methods and media, and time required to conduct each segment, if these have been previously determined at the time of report submission.

10.3.6 **Materials List.** Each component associated with the COTS training materials shall be listed in this section by title. The list shall also indicate the duration of use of each component. The instructor materials and the student materials shall be separately identified and shall appear on separate pages of the section.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.3.7 **Special Equipment.** Each piece of special equipment needed to conduct the training shall be listed in this section.

10.3.8 **References.** The Reference section shall include at least the names of two users of the materials, their organization(s), and their telephone numbers.

10.3.9 **COTS Course Validation Procedures.** The course validation procedures and expected results shall be contained in this section, if such procedures have been determined at the time of report submission.

10.4 **Testing.** Knowledge and performance tests shall be in accordance with the requirements of DID-8, Student Achievement Tests, unless formal approval for deviation is received from the FAA COTR.

10.5 **Copyrights.** The FAA shall have the right to reproduce the COTS materials, which the FAA has approved for use during training, without additional fees or licensing. Permission to copy shall apply to all COTS materials, regardless of format.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -13

1. Title:

On-the-Job Training Instructor Handbook

3. Description/Purpose:

This DID establishes the minimum requirements for the content of the On-the-Job Training (OJT) Instructor Handbook. The OJT Instructor Handbook documents the:

a. Instructions for the OJT instructor.

b. Subject outline for the OJT.

c. Performance evaluation criteria for assessing student performance.

d. Student achievement tests to be used with the OJT.

e. Instructional materials to be used with the OJT.

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains the preparation instructions for the format and content of the On-the-Job Training Instructor Handbook.

7.2 This DID is applicable to any contractor-developed training effort for which there is an on-the-job instructional component.

10. Preparation Instructions:

10.1 Reference Documents. The On-the-Job Training Instructor Handbook shall be prepared in accordance with the documents referenced in the contract and the Course Design Guide (CDG).

10.2 Format. The On-the-Job Training Instructor Handbook shall be prepared in accordance with the following format requirements:

10.2.1 A camera-ready or master reproducible copy of the On-the-Job Training Instructor Handbook shall be delivered on 8.5" x 11" bond paper. An electronic

Information Handling Services, 1999
August 11, 1999 10:18:24

version shall be delivered,if so required by the contract. The handbook shall be labeled in accordance with the labeling system determined by the FAA organization for which the training was developed. Foldout pages may be used as required. All pages shall be numbered at the bottom center. Each section of the On-the-Job Training Instructor handbook shall start on a new page, with the section title as the heading on the page. The materials in the On-the-Job Training Instructor Handbook shall be organized into lessons based on the objectives stated in the CDG. The OJT lessons shall be sequenced in the order that will promote the most effective learning. The FAA COTR shall specify the format for the OJT lessons. The OJT lessons shall be formatted in either lesson plan format as specified in DID-9 or in job sheet format as specified in DID-10.

10.2.2 The On-the-Job Training Instructor Handbook shall have a cover sheet displaying the following information:

a. Document title.

b. Course identification number/course title.

c. Lesson title(s).

d. Submission date of handbook.

e. Statement that the document is for training purposes only.

10.2.3 The On-the-Job Training Instructor Handbook shall have a Table of Contents following the cover sheet, specifying the page numbers. The Table of Contents shall include:

a. Reference Materials.

b. Figures and Tables List.

c. Lesson(s).

d. Post-Test.

e. Glossary.

f. Acronyms.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.2.4 Each of the On-the-Job Training Instructor Handbook sections named above shall be initiated on a separate page displaying a centered all-caps heading.

10.3 **Content Requirements.** The On-the-Job Training Instructor Handbook shall be prepared in accordance with the descriptions provided below:

10.3.1 **Reference Materials.** All reference materials used in the handbook shall be listed by title.

10.3.2 **Figures and Tables List.** All figures appearing in the handbook shall be listed by title.

10.3.3 **Lessons.** Each lesson shall be comprised of the following sections:

a. Objectives.

b. Required Tools and Test Equipment.

c. Special Instructions.

d. Precautions.

e. Pretest.

f. Body of Lesson.

g. Performance Evaluation Criteria.

h. Progress Test(s).

10.3.3.1 **Objectives.** All terminal objectives and enabling objectives, as stated in the CDG, related to the lesson shall be listed.

10.3.3.2 **Required Tools and Test Equipment.** All tools and test equipment required to perform the activities specified in the lesson shall be listed.

10.3.3.3 **Special Instructions.** Any special instructions for conducting OJT activities specified in the lesson shall be stated.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.3.3.4 **Precautions.** Any precautions that are to be taken during the OJT activities specified by the lesson shall be stated.

10.3.3.5 **Pretest.** Each lesson shall contain a Pretest and answer key. Pretests and associated answer keys shall be developed in accordance with Student Achievement Tests, DID-8.

10.3.3.6 **Body of Lesson.** Each lesson shall specify at least one student activity. The tasks and subtasks of the activity to be performed by the instructor and the tasks and subtasks of the activity to be performed by the student shall be stated in clearly written sentences which begin with action verbs. Each task name shall be proceeded by a number, beginning with the label "1" for the first task. Each subtask shall be proceeded by an alphabetic character, beginning with "a." The tasks and subtasks performed by the instructor shall be labeled "I" for instructor. The tasks and subtasks performed by the student shall be labeled "S" for student.

10.3.3.7 **Performance Evaluation Criteria.** Performance evaluation criteria shall be developed for each student activity specified in the lesson.

10.3.3.8 **Progress Test(s).** Each lesson shall contain at least one Progress Test and associated answer key. Progress Tests and answer keys shall be developed in accordance with Student Achievement Tests, DID-8.

10.3.4 **Post-Test.** Each handbook shall contain a Post-Test and associated answer key. The Post-Test and answer key shall be developed in accordance with Student Achievement Tests, DID-8.

10.3.5 **Glossary.** A glossary containing all technical words, and their definitions, presented during the training shall appear in this section of the handbook.

10.3.6 **Acronyms.** A list of all acronyms used in the handbook, and their meanings, shall appear in this section of the handbook.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -14

1. Title:

Job Aids

3. Description/Purpose:

This data item description (DID) documents the requirements for the development of job aids. Job aids are used to supplement instruction or as an alternative to instruction. They may provide information on the steps in a procedure or may guide the user in making decisions related to the performance of a job task. Examples of job aids are: checklists, procedural lists, templates, flowcharts, diagrams, and illustrations.

7. Application/Interrelationship:

7.1 This DID contains the preparation instructions for the format and content of job aids.

7.2 This DID is applicable to all contract training development that requires job aids as a deliverable.

10. Preparation Instructions:

10.1 Reference Documents. The information cited in this DID shall be prepared in accordance with FAA-STD-028B and the documents referenced in the contract.

10.1.1 The government will provide existing task analyses when these will facilitate the development of a job aid. When the task and skills analysis and/or the cognitive analysis were developed in accordance with FAA-STD-028B, the data obtained from DIDs 4 and 5 of the standard shall be used as input to the job aid.

10.2 Format. The format for a job aid will vary depending upon the environment and conditions in which it will be used, the purpose for which it is being developed, and the user population. Recommendations on the format for a job aid shall be submitted to the government for review and approval prior to

Information Handling Services, 1999
August 11, 1999 10:18:24

development. Sufficient detail shall be provided to reflect the contractor's analysis and how the recommendations were formulated. When developing recommendations on format, paragraphs 10.3.1 through 10.3.5 of this DID shall be considered.

10.2.1 A job aid that is to be automated shall require compatibility with the existing hardware and software capabilities at the site(s) where the job aid will be used. The hardware and software specifications at the site(s) will be provided by the government upon request. The contractor's specifications and approach for any automated job aids shall be submitted to the government for review and approval prior to development.

10.3 Content Requirements. The following information shall be provided:

10.3.1 **Purpose.** The purpose of the job aid, including information on whether it will be used to supplement or to decrease the need for training, shall be documented. When the job aid will be used as an alternative to training, instruction shall still be provided on the use of the job aid. The content of this instruction shall be provided to the government for review and approval prior to implementation.

10.3.2 **User Population.** A description of the user population shall be provided.

10.3.3 **User Environment.** A description of the environment in which the job aid will be used shall be provided. This description shall document any job or training conditions that will influence the design and use of each job aid.

10.3.4 **Traceability Matrix.** A matrix shall be developed that documents the tasks, subtasks, and any task elements that comprise the job aid. These job performance components shall be cross-referenced by number to the task and skills analysis and/or cognitive analysis on which each job aid is based. When the job aid will be used in a training environment, the supporting terminal and enabling learning objectives from the Course Design Guide shall also be documented.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.3.5 **Selection Criteria.** The criteria for making the decision to use a job aid shall be documented. Examples of selection criteria to be considered are frequency of task performance, task criticality, and task complexity.

10.3.6 **Prototype Development.** Pending the government's approval of the information provided in paragraphs 10.3.1 through 10.3.5 above, a prototype job aid shall be developed. The directions for use of the job aid shall be provided with the prototype. The format for the job aid shall be developed in accordance with the government-approved information provided in paragraphs 10.2. and 10.2.1 of this DID. The job aid and directions for use shall be revised, based on government review comments, prior to validation.

10.3.7 **Validation.** The plan for validation of the revised job aid and the directions for use shall be documented. The validation environment and user population shall closely resemble the actual environment, conditions, and user population for which the job aid was designed. When the job aid will be used in a training environment, applicable validation guidance in FAA-STD-028B shall be applied. The job aid and directions for use shall be revised based on the results of the validation.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -15

1. Title:

Correspondence Study Materials

3. Description/Purpose:

This DID establishes the minimum requirements for the content of correspondence study materials. The correspondence study materials document:

a. Reading assignment(s) and supporting illustrations.

b. Review exercise(s) and associated answer keys.

c. Student progress tests.

d. Post-test.

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains the preparation instructions for the format and content of correspondence study materials.

7.2 This DID is applicable to any contract training effort for which correspondence study materials are required by the contract.

10. Preparation Instructions:

10.1 Reference Documents. Correspondence study materials shall be prepared in accordance with the documents referenced in the contract and the Course Design Guide (CDG).

10.2 Format. Correspondence study materials shall be prepared in accordance with the following format requirements:

10.2.1 A camera-ready or master reproducible copy of the correspondence study materials shall be delivered on 8.5" x 11" bond paper. An electronic version shall be delivered, if so specified by the contract. Foldout pages may be used as required.

Information Handling Services, 1999
August 11, 1999 10:18:24

All pages shall be numbered at the bottom center. The study materials shall be labeled in accordance with the labeling system designated by the FAA organization for which the material is developed. The correspondence materials also shall be divided into chapters representing one lesson. Each chapter shall be sub-divided into manageable sections. Each subdivision shall be labeled. Format and style shall be in accordance with the following publication, or as specified in the contract:

a. Style Manual, Government printing Office, Washington, D. C.

10.2.2 Correspondence study materials shall have a cover sheet displaying the following information:

a. Document title.

b. Course identification number/course title.

c. Preparation date of materials.

d. Statement that the document is for training purposes only.

10.2.3 Correspondence study materials shall have a Table of Contents following the cover sheet specifying the page numbers. The first item the Table of Contents shall include is the Information Page. The Table of Contents shall include, subsequent to the Information Page, the following sections for each lesson:

a. Reading Assignment(s).

b. Review Exercise.

c. Answer Key.

d. Lesson Progress Test.

The concluding items in the Table of Contents shall include the:

Information Handling Services, 1999
August 11, 1999 10:18:24

a. Post-Test.

b. Glossary.

c. Acronyms.

10.2.4 Each of the section named above shall be initiated on a separate page displaying a centered all-caps heading.

10.3 **Content Requirements**. Correspondence study materials shall be prepared in accordance with the descriptions provided below:

10.3.1 **Information Page.** The information page shall include:

a. Brief description of the course.

b. List of the course materials.

c. Grading procedures.

d. Address to which students are to mail completed materials.

e. A statement of how to obtain assistance.

10.3.2 **Reading Assignment(s).** Reading assignments and supporting illustrations shall be developed for each lesson. Each reading assignment shall include:

a. Introduction.

b. Body of the assignment.

c. Supporting illustrations.

10.3.2.1 The introduction shall include:

a. A list of the objective(s) of the assignment as stated in the CDG.

b. Several thought-provoking questions related to the reading.

c. A tie-in to previous materials, if appropriate.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.3.2.2 The body of the assignment shall:

a. Be limited in length to 7 to 10 pages.

b. Use an active verb to begin procedures and/or instructions.

c. Emphasize key information by highlighting the text with bold face, italics, underlining, or graphics.

d. Have all illustrations referred to by number within the text.

e. Conclude with a summary of the assignment.

10.3.2.3 The supporting illustrations shall reinforce key points in the reading assignments. The supporting illustrations shall:

a. Be numbered sequentially, in accordance with the chapter/the lesson in which it is contained; for example, consecutive illustrations in chapter 5 would be labeled "Figure 5-1," "Figure 5-2."

b. Provide a caption that specifically labels the subject treated in the illustration.

c. Be located on the same page as the text for the illustration. If this is not possible, the illustration shall be placed on the next page.

d. Be sharp and clear.

10.3.3 **Review Exercise.** A review exercise which measures the accomplishment of the learning objective(s) shall be developed for each chapter/lesson. Each exercise shall have the items within it sequenced in the same order as the reading assignments to which they pertain. A variety of test item formats shall be used.

10.3.4 **Answer Key.** An answer key shall be developed for each review exercise. The answer key shall:

a Not be visible when the student is completing the review exercise.

b. Provide a comprehensive, correct answer for each review exercise item.

Information Handling Services, 1999
August 11, 1999 10:18:24

c. Provide answers in the same sequence as their respective review exercise items.

10.3.5 **Progress Test.** A progress test shall be developed for each lesson/chapter. The progress test shall measure the mastery of the learning objectives. The progress test shall be developed in accordance with Student Achievement Tests (DID-8).

10.3.6 **Post-Test.** A post-test shall be developed for the course. The post-test shall measure the mastery of each terminal objective for the course, as stated in the CDG. The post-test shall test only for information which is included in the text. The post-test shall be developed in accordance with Student Achievement Tests (DID-8).

10.3.7 **Glossary.** A glossary shall be developed which shall contain all technical and uncommon terms, and their definitions, used in the correspondence study materials.

10.3.8 **Acronyms.** A list of acronyms shall be developed which shall contain all acronyms and abbreviations, and their full written-out form, used in the correspondence study materials.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -3

1. Title:

Personnel Qualifications Report

3. Description/Purpose:

This DID establishes the minimum requirements for the content and format of the personnel qualifications report. The personnel qualifications report contains a description of the contractor personnel who will be involved in the development and/or delivery of training.

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains the preparation instructions for the format and content of the personnel qualifications report.

7.2 This DID is applicable to all contract training efforts.

10. Preparation Instructions:

10.1 Reference Documents. The personnel qualifications report shall be prepared in accordance with the documents referenced in the contract.

10.2 Format. The personnel qualifications report shall be prepared in accordance with the following format requirements:

10.2.1 The personnel qualifications report shall be delivered on 8.5" x 11" bond paper and bound following the contractor's commercial practice. Foldout pages may be used as required. All pages shall be numbered as required.

10.2.2 The personnel qualifications report shall have a cover sheet displaying the following information:

a. Document title.

b. Contract number.

Information Handling Services, 1999
August 11, 1999 10:18:24

c. Contractor name and address.

d. Submission date.

10.2.3 A Table of Contents page shall follow the cover sheet, specifying the page numbers. The Table of Contents shall include:

a. Introduction.

b. Development Team.

c. Tasks and Personnel.

d. Resumes.

10.2.4 Each of the above named sections of the personnel qualifications report shall be initiated on a separate page displaying a centered all-caps heading.

10.3 Content Requirements. The personnel qualifications report shall be prepared in accordance with the descriptions provided below:

10.3.1 **Introduction.** The introduction to the personnel qualifications report shall contain:

a. A summary of the training requirement.

b. An overview of the contract tasks for designing, developing, and delivering the training.

10.3.2 **Development Team.** The key members of the development team shall be listed by name and categorized by type. The duties listed for each position may be shared by more than one individual or divided among several individuals. One individual may serve in multiple roles. The positions for the development team are as follows:

a. Management personnel (e.g., project manager and task managers), who are responsible for the day-to-day management of the technical performance and costs of the training development effort.

b. Instructional designer, instructional technologist, or instructional developer, who is responsible for sequencing the content, providing instructional

Information Handling Services, 1999
August 11, 1999 10:18:24

strategies, and developing and documenting the lesson content as specified by the SME.

c. CBI programmer, who is responsible for implementing all training that is to be presented on a computer. this position is required only in the case in which computer-based instruction (CBI) is being procured.

d. Subject matter expert (SME), who is responsible for lesson content and for assuring the content validity and technical accuracy of the materials.

10.3.3 **Tasks and Personnel.** All contract tasks for performing analyses, designing, developing, delivering instruction shall be listed. For each task, the names of all personnel who will be involved with the task shall be listed.

10.3.4 **Resumes.** Resumes shall be provided for all project personnel. Each resume shall include:

a. Personnel category as defined in paragraph 10.3.2 of this DID.

b. Summary of experience which includes the number of years of experience in major skill areas, such as instructional design and development, user training, project management, etc.

c. Education which includes high school, college and technical schools, the year graduated, degrees, diplomas, licenses, certificates, and major fields of study.

d. Work experience which is a list of work experience beginning with the most recent and indicates the organizations' names, and year of employment with each organization.

e. Professional recognition awards and relevant publications.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -4

1. Title:

Task and Skills Analysis Report

3. Description/Purpose:

A task and skills analysis is performed to identify changes in job performance resulting from the introduction of new equipment and technology and from new workforce requirements. A task and skills analysis provides specific data which are needed to make decisions about the design, development, and delivery of both management and technical training courses.

7. Application/Interrelationship:

7.1 This data item description (DID) contains the preparation instructions for the format and content of the task and skills analysis. See DID-5 for preparation instructions for cognitive task analysis deliverables.

7.2 This DID is related to Logistics Support Analysis (LSA) data when such a data file is a contractual requirement. Existing task analyses, work load models, and other relevant data provided as government furnished information shall be used during development of the task and skills analysis so that existing data are not duplicated. Data generated by the task and skills analysis will be used to develop the course design guide. The task and skills analysis must be approved by the government prior to submission of subsequent training deliverables for government review.

7.3 The task and skills analysis shall be submitted in draft form. The contractor shall incorporate FAA comments and submit a revised draft for review. The contractor shall again revise the task and skills analysis if the FAA considers the deliverable inadequate or inconsistent with comments received during the FAA review.

Information Handling Services, 1999
August 11, 1999 10:18:24

10. **Preparation Instructions:**

10.1 **Reference Documents.** The task and skills analysis shall be prepared in accordance with chapter 5 of FAA-STD-028B and in accordance with the contract.

10.2 **Format.** The task and skills analysis shall be prepared in accordance with the following format:

10.2.1 The deliverables shall be provided on 8 1/2 by 11 inch bond paper with the date of the submission. Foldout pages may be used as required. All page numbers shall be placed at the bottom center of each page. The deliverables shall also be provided on an electronic medium when specified in the contract.

10.2.2 Task data sheets shall be developed to display all task analysis data cited in paragraphs 10.3.3 through 10.3.3.10 of this DID. The data shall be organized in columnar format for horizontal display on a single table as shown in Figure 4-1.

10.3 **Content Requirements.** The task and skills analysis shall contain the following:

10.3.1 **Front Matter.** The front matter shall contain a preface, table of contents, list of figures, and list of tables.

10.3.2 **Section I - Introduction.** This section shall contain the following information:

a. Purpose and scope of the document.

b. Organization of the document.

c. Applicable references.

d. Overview of the equipment, technology, and workforce changes which require a task and skills analysis to be conducted.

e. Overview of the procedures used to conduct the task and skills analysis and specification of the criteria used to identify tasks selected for training. Information on the sources of data, the group of employees who provided data, their occupations, the level of experience within the occupation, and

Information Handling Services, 1999
August 11, 1999 10:18:24

whether the data were obtained through observation or interview shall also be provided.

10.3.3 **Section II - Task and Skill Analysis Data.** This section shall contain the following information:

a. Introduction to the section.

b. Listing in order of performance of duties, tasks, and subtasks required to operate the equipment. Actions below the subtask level shall also be identified when lower levels of observable and measurable performance are required for course design.

c. Listing in order of performance of duties, tasks, and subtasks required for preventative and corrective maintenance and installation, as well as testing and modifying the equipment. Performance steps below the subtask level shall also be identified when lower levels of observable and measurable performance are required for course design.

d. Listing of management and supervisory duties, tasks, and subtasks when the contract requires development of management training courses.

e. Initiating cues, conditions, and standards associated with the performance of each task and subtask identified in 10.3.3. b, c, and d above.

f. Determination of knowledge and skills required for task and subtask performance.

g. Identification of data on criticality, frequency, and difficulty for each task and subtask.

h. Specification of whether each task and subtask requires training.

i. Designation of each task and subtask as "new" or "old."

j. Specification of the time required to perform each task and subtask.

k. Designation of each task and subtask as an individual performance or a team performance. For team performance, the positions which perform the task and subtask collectively shall also be specified.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.3.3.1 Task data sheets shall be developed which display the analysis data required in paragraphs 10.3.3 b through k, above. Figure 4-1 is an example of the format for a task data sheet. This format may be modified, as required, to display the data. However, no data shall be eliminated. The task data sheets shall be submitted as part of the task and skill analysis deliverables.

10.3.3.2 Duties, tasks, and subtasks shall conform to the following structure:

a. Duty. A duty shall represent a major subdivision of the work performed by one individual and shall encompass two or more related tasks in one functional area.

b. Task. A task shall represent a unit of work which: (1) is directly observable and measurable, (2) has a clear beginning and ending point, and (3) is performed independent of other tasks. A task shall be written in the form of a statement which begins with an action verb, is followed by the object acted upon, and includes any necessary qualifying information. Task statements shall not begin with the phrase "use the equipment to..." in order to preface the actual task to be performed.

c. Subtask. Tasks shall be broken out into subtasks. Each subtask shall document a single step in task performance.

d. Element. Subtasks to be trained shall be broken out into task elements when observable and measurable performance below the subtask level is required for course design.

10.3.3.3 The following numbering system shall be used to label a job and its associated duties, tasks, subtasks, and elements:

Example: 1.0 Job
1.1 Duty
1.1.1 Task
1.1.1.1 Subtask
1.1.1.1.1 Elements (as required)

10.3.3.4 For technical training, operation and maintenance tasks shall be organized in Section II by the type of facility at which the tasks will be performed.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.3.3.5 Conditions for the performance of each task and subtask shall describe the situation/environment in which the specific job behavior will be carried out. Conditions shall describe any pertinent influence upon task and subtask performance. Standards shall state the criteria for acceptable performance. Cues shall indicate the signal(s) to begin performance of each task and subtask.

10.3.3.6 Each task and subtask shall be designated as "new" or "old." The latter designation shall refer to tasks and subtasks with which job incumbents are familiar because they have been performing them on the job. When any portion of a task is new, then the entire task shall be trained. Existing knowledge and skills may be reviewed in the lesson plan; however, they shall be reviewed in a job context.

10.3.3.7 The knowledge and skills required for performance of each task and subtask shall be documented.

10.3.3.8 Data on the criticality, frequency, and difficulty of each task and subtask shall be documented to assist in the identification of tasks selected for training. Critical tasks and subtasks are defined as those which are essential to job performance, regardless of the frequency with which they are performed. Frequency refers to how often a task and subtask is performed. Difficulty refers to how hard a task and subtask is to learn and perform. A five-point scale shall be used to rate task and subtask difficulty. Maximum and minimum ratings shall be five and one, respectively. Frequency shall be coded as follows: continuous activity (CA), hourly (H), daily (D), weekly (W), monthly (M), and as required (AR). A five-point scale shall be used to rate task and subtask difficulty. Maximum and minimum ratings shall be five and one, respectively.

10.3.3.9 Each task and subtask shall be coded as individual or team performance. The code (I) shall be used to designate individual performance where interaction with another person is <u>not</u> required to carry out a task or subtask. The code (T) shall be used to designate team performance where interaction between two or more individuals is required. The positions or job categories involved in team performance shall be specified as

Information Handling Services, 1999
August 11, 1999 10:18:24

well as the percentage of time required. The performance of a team task may contain subtasks which are performed independently by an individual.

10.3.3.10 Any information listed in Section II - Task and Skill Analysis Data as "to be determined" shall be supported with a written explanation and a timeline for determining that information. The contractor shall complete this information according to the approved timeline.

10.3.4 **Section III - Manpower Summary Data.** This section shall contain the following information:

a. Introduction to the section.

b. Quantitative position requirements by personnel specialties and skill levels.

10.3.4.1 A personnel position summary table shall be developed which identifies job categories of personnel, types of tasks to be performed by job category, and number of personnel to be trained.

10.3.4.2 Any information listed in Section III - Manpower Summary Data as "to be determined" shall be supported with a written explanation and a timeline for determining that information. The contractor shall complete this information according to the approved timeline.

10.3.5 **Section IV - Appendices.** This section shall contain the following information:

a. List of acronyms.

b. List of abbreviations.

c. Glossary of terms.

d. Index.

e. Other supporting information, as required.

Information Handling Services, 1999
August 11, 1999 10:18:24

DID 4, FIGURE 1. TASK & SKILLS ANALYSIS DATA SHEET

TASK & SKILLS ANALYSIS DATA SHEET

JOB TITLE _____ DUTY _____ PAGE ____ OF ____

ANALYIST _____ DUTY _____

DESIGNATOR	TASK/SUBTASK/ ELEMENT	CUES	CONDITIONS	STANDARDS	FREQUENCY	CRITICALITY	DIFFICULTY	NEW/OLD TASK	TIME	TEAM OR INDIVIDUAL	TRAIN/ NO TRAIN	NOTES

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -5

1. Title:

Cognitive Task Analysis

3. Description/Purpose:

A cognitive task analysis is performed when a traditional task analysis indicates that some tasks have a strong cognitive component, such as those requiring the performer to exercise judgment, solve problems, and make decisions. Cognitive task analysis is a systematic process for determining the cognitive processes and strategies that support job performance.

7. Application/Interrelationship:

7.1 This data item description (DID) contains the preparation instructions for the format and content of the cognitive task analysis deliverables.

7.2 When a cognitive task analysis is required as part of curriculum development, it shall be performed after the traditional task analysis, specified in DID-4. Both traditional and cognitive task analyses provide critical information about job performance which will be used to develop the course design guide.

10. Preparation Instructions:

10.1 Deliverables. This DID contains the content and format requirements for three deliverables: a cognitive analysis plan, preliminary cognitive analysis data, and a cognitive analysis report. When specified in the contract, an automated data collection system shall be developed as a repository for cognitive analysis data. The data collection system shall be developed in accordance with contract requirements.

10.1.1 Each deliverable represents a building block in the cognitive analysis process and shall be submitted as a draft for FAA review. The contractor shall incorporate FAA comments and shall submit a revised draft of each deliverable.

Information Handling Services, 1999
August 11, 1999 10:18:24

The contractor shall revise the deliverables if the FAA considers them inadequate or inconsistent with the comments received during the FAA review.

10.2 Format. Each deliverable shall be submitted on 8.5" x 11" bond paper with the date of the submission. Foldout pages may be used as required. All page numbers shall be placed at the bottom center of each page. The deliverables shall also be provided on an electronic medium when specified in the contract.

10.2.1 The front matter of each deliverable shall contain a preface, a table of contents, a list of figures, and a list of tables.

10.3 Content Requirements.

10.3.1 **Cognitive analysis plan.** This deliverable shall contain the following information:

a. Purpose and scope of the cognitive analysis.

b. Organization of the document.

c. Applicable references.

d. Overview of the equipment, technology, and workforce changes which require a cognitive task analysis to be conducted.

e. Specification of the criteria used to select tasks for cognitive analysis. The following criteria shall be considered:

1) Complex tasks which require large amounts of knowledge to be learned during training.

2) Complex tasks which have a significant component involving judgment, problem solving, or decision-making.

3) Complex tasks which experts consider difficult to verbalize or demonstrate through overt actions.

4) Complex tasks where there are considerable differences in how individuals perform the tasks due to the number of cognitive strategies available.

Information Handling Services, 1999
August 11, 1999 10:18:24

f. Documentation of the methods proposed for conducting the cognitive task analysis. The following methods shall be considered:

1) Protocol analysis, in which individuals verbalize what they are doing or thinking about when performing a task.

2) Psychological scaling, in which individuals sort, rate, or rank task-relevant knowledge.

3) Performance modeling, in which a job or task is simulated and a model of task performance is developed and tested under varying conditions.

4) Observation of job performance and interviews to obtain information on reasoning processes of task performers.

g. Information on how data sources will be obtained, the groups of employees to provide data, their occupations, and the experience levels within the occupation.

h. Data collection instruments, for review and approval by the FAA prior to use.

i. Specification of how reliability and validity of the data will be determined.

10.3.2 **Preliminary cognitive analysis data.** This deliverable shall contain the following information:

a. The list of tasks selected for cognitive analysis, based on the approved criteria identified in the cognitive analysis plan. These tasks shall be grouped by duties. If task groupings are different than those specified in the traditional task analysis, DID-4, an explanation for the differences shall be provided.

b. Conditions and standards for task performance.

c. A sample of the results of cognitive analysis for one or more tasks.

d. A summary of the findings from the various data collection methods and instruments used during the

Information Handling Services, 1999
August 11, 1999 10:18:24

preliminary cognitive analysis and their relevance for the design of training.

e. A description of critical problems encountered and recommendations for change to the cognitive analysis plan, if required.

10.3.3 **Cognitive analysis report.** This deliverable shall contain the following information:

a. The knowledge structure, skills, knowledge, and strategies required for optimal task performance.

b. Visual representation of the knowledge structure for each task.

c. Identification of strategies, heuristics, algorithms, or aids used in job performance.

d. Discussion of the relevance of the cognitive analysis for the design of training:

1) Recommended content and organization of the instructional material.

2) Recommended instructional setting, media, and learning strategies.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -6

1. Title:

Course Design Guide

3. Description/Purpose:

The Course Design Guide contains three parts. Part I documents the overall approach to training. Part II documents the course design, including the training outcomes, terminal objectives, enabling objectives, type of learning, technical content, instructional methods, and media. Part III contains a traceability matrix which cross references the tasks selected for training with the terminal objectives and with the training outcomes. All learning objectives and training outcomes are sequenced in the CDG in the best order for learning.

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains the preparation instructions for the format and content of the Course Design Guide (CDG).

7.2 This DID is applicable to all contract training development efforts.

10. Preparation Instructions:

10.1 Reference Documents. The CDG shall be prepared in accordance with the documents referenced in the contract and the Task and Skills Analysis Report.

10.2 Format. The CDG shall be prepared in accordance with the following format requirements:

10.2.1 The CDG shall be delivered on 8.5" x 11" bond paper and bound following the contractor's commercial practice. Foldout pages may be used as required. All pages shall be numbered at the bottom center.

10.2.2 The CDG shall have a cover sheet displaying the following information:

Information Handling Services, 1999
August 11, 1999 10:18:24

a. Document title.

b. Course identification number/course title.

c. Contract number.

d. Contractor name and address.

e. Submission date.

10.2.3 A Table of Contents page shall follow the cover sheet, specifying the page numbers. The Table of Contents shall include:

Part I - Management Summary

a. Overall Approach.

1) Proposed Methods and Media.

2) Selection Criteria.

3) Course Series.

4) Analysis of Alternate Training Approaches.

b. Equipment.

c. Course Catalogue Entry.

d. Location of Training.

Part II - Course Design

a. Training outcomes.

b. Training objectives.

Part III - Cross Reference Matrix

10.2.4 Each of the CDG sections named above shall be initiated on a separate page displaying a centered all-caps heading.

10.3 Content Requirements. The CDG shall be prepared in accordance with the descriptions provided below:

10.3.1 Part I organization and content shall be as follows:

Information Handling Services, 1999
August 11, 1999 10:18:24

10.3.1.1 **Overall Approach.** This section shall provide a summary of the overall approach to the training.

a. **Proposed Methods and Media.** This section shall describe the proposed methods and media for the training and the rationale for their selection.

b. **Selection Criteria.** This section shall describe the criteria used for selection of the approach.

c. **Course Series.** This section shall indicate the existing or proposed series of courses which include the course described in the CDG, if applicable.

d. **Analysis of Alternate Training Approaches.** This section shall present an analysis of alternate training approaches to the one described in the CDG. The analysis shall include discussions of state-of-the-art technology, and the rationale for their recommendation or non-recommendation.

10.3.1.2 **Equipment.** This section shall include a description of the equipment that will be used to develop or conduct the training. The section shall include for each type of equipment:

a. Type of equipment.

b. Model of equipment.

c. Number of items of equipment needed.

10.3.1.3 **Course Catalogue Entry.** This section shall contain the course catalogue entry for the course. The course catalogue entry shall include:

a. Course title, which shall be brief and self-explanatory.

b. Course Length.

c. Course description, which shall be a concise and comprehensive description of the course, not to exceed 750 characters, including spaces and punctuation. The course description shall include:

1) For whom the course is designed.

2) How the course will be delivered; for example, classroom, computer-based instruction (CBI),

Information Handling Services, 1999
August 11, 1999 10:18:24

simulator, laboratory, workshop, flight training, independent study.

3) Purpose and description of the subject matter of the course.

4) Course titles for all the courses in a series, if applicable.

d. Course prerequisite(s), which must be successfully completed prior to enrollment, or for which the student must pass an approved screening examination measuring a level of knowledge/skill equivalent to that which could have been achieved in the prerequisite courses.

e. Other requirements, such as certificates, licenses, and flight hours, which are required before course enrollment.

10.3.1.4 **Location of Training.** This section shall specify the location(s) of the facilities where the training will be presented.

10.3.2 An example of Part II is shown in figure 6-1. Part II shall contain the following:

10.3.2.1 **Training Outcomes.** Training outcomes are written at the duty level of the task and skills analysis. Each page of Part II of the CDG shall have one training outcome on it. The training outcomes shall be sequenced in one or more logical training segments. For the purposes of identification and traceability, each training outcome shall be labeled with consecutive upper case letters, beginning with "A."

10.3.2.2 **Terminal Objectives.** This section of Part II of the CDG shall contain the terminal objectives for each training outcome. The terminal objectives and their supporting data shall conform to the following requirements.

a. The terminal objectives shall be derived from the tasks selected for training in the task analysis. At least one terminal objective shall be written for each task selected for training.

b. Each terminal objective shall have three parts: condition(s), performance, and standards.

Information Handling Services, 1999
August 11, 1999 10:18:24

c. The terminal objectives shall be sequenced in the best order for learning and shall be numbered consecutively, beginning with "1."

d. The time for reaching each terminal objective shall be estimated and placed in the appropriate column of Part II of the CDG.

e. The type of learning represented by each terminal objective shall be indicated in the appropriate column of Part II of the CDG using the following labels:

1) A terminal objective requiring performance to emphasize major physical skills and abilities, including affective and attitudinal behaviors, shall be labeled "P."

2) A terminal objective requiring primarily cognitive skills, such as knowledge, comprehension, or judgement, shall be shall be labeled "CG." A terminal objective that requires cognitive skills should be analyzed to determine whether it is actually an enabling objective which supports a terminal performance objective. In most cases, cognitive objectives are enabling objectives.

10.3.2.3 **Enabling Objectives.** This section of Part II of the CDG shall contain the enabling objectives developed to support the terminal objectives. The enabling objectives and their supporting data shall conform to the following requirements.

a. The enabling objectives shall be derived from the subtasks which support each task selected for training in the task analysis.

b. Each enabling objective shall have three parts: condition(s), performance, and standards.

c. The enabling objectives shall be sequenced in the best order for learning and shall be labeled with lower case letters, beginning with "a."

d. The type of learning represented by each enabling objective associated with a cognitive terminal objective shall be indicated in the appropriate column of Part II of the CDG using the following labels:

Information Handling Services, 1999
August 11, 1999 10:18:24

1) An enabling objective requiring the student to recall specific and general information, recall a pattern, sequence, or condition, or require the process of remembering, shall be labeled "K," for "Knowledge."

2) An enabling objective requiring the student to know how and why a procedure or action should be performed (i.e., describing function and fact), shall be labeled "C," for "Comprehension."

3) An enabling objective requiring the use of ideas, rules, procedures, methods, theories, and concepts in appropriate situations shall be labeled "AP," for "Application."

4) An enabling objective requiring the separating of a unit, such as a problem, policy, directive, technical material, schematic, or flow diagram, into its parts and showing the relationship between the parts, shall be labeled "AN," for "Analysis."

5) An enabling objective requiring putting elements together to form a whole, make a pattern, or form an approach, shall be labeled "S," for "Synthesis."

6) An enabling objective requiring a judgement or appraisal as to the value, or extent, to which materials or methods satisfy recognized criteria, shall be labeled "E," for "Evaluation."

e. In the case of enabling objectives supporting a performance terminal objective, at least one of the enabling objectives shall also reflect a performance requirement.

10.3.2.4 Content Outline. This section of Part II of the CDG shall contain an outline of the content to be taught for each terminal and enabling objective. This section shall meet the following requirements:

a. The content shall be organized into logical training segments, and the segments shall be identified in the technical content outline.

Information Handling Services, 1999
August 11, 1999 10:18:24

b. The training segments appearing in the technical content outline shall be organized in a logical way that best supports training.

10.3.2.5 **Instructional Methods and Media.** This section of Part II of the CDG shall contain an instructional method and supporting media for attaining each terminal objective and each enabling objective. Selection of methods and media shall be based on:

a. Type of learning to be supported.

b. Ability to simulate actual job performance conditions and requirements.

c. Variety of media or delivery systems needed to maintain an interactive learning environment.

d. Variety of situations which may be encountered on the job.

e. Other factors, such as cost, maintainability, ease of operation, and transportability.

10.3.2.6 **Tests.** This section of Part II of the CDG shall contain an indicator for the test type appropriate for each terminal objective and enabling objective. Selection of test type shall be consistent with the type of learning associated with each objective. At least one sample test item shall be developed for each terminal objective and its enabling objectives. These shall be labeled with a number. The items shall be referenced by number in the tests section. The developed test items shall be attached to the CDG.

10.3.2.7 **Notes.** This section of Part II of the CDG shall provide guidance, notes, and references for developing the courseware. References to technical manuals and other written documentation shall be stated at the paragraph level, at a minimum.

10.3.3 An example of Part III is shown in figure 6-2. Part III shall contain the following:

10.3.3.1 **Cross Reference Matrix.** The Cross Reference Matrix shall trace between the training outcomes, the tasks selected for training in the Task and Skills Analysis, and the terminal objectives. The

Information Handling Services, 1999
August 11, 1999 10:18:24

Cross Reference Matrix shall be comprised of four columns with the following information included:

a. In column 1, the training outcomes developed for Part II of the CDG shall be recorded.

b. In column 2, the task numbers from the Task and Skills Analysis which are associated with each training outcome shall be recorded.

c. In column 3, the terminal objective number that is associated with each task selected for training shall be recorded.

d. In column 4, the letter label for each training outcome as indicated in Part II of the CDG shall be recorded.

Information Handling Services, 1999
August 11, 1999 10:18:24

9003329 0020757 8T8

DID 6, FIGURE 1. SAMPLE COURSE DESIGN GUIDE, PART II
COURSE DESIGN

Course Number: 40265
Course Title: LOW LEVEL WINDSHEAR ALERT SYSTEM (LLWAS) FA9980

Block/Module Number:
Block/Module Title:

Page B1
Date

B. TRAINING OUTCOME: *Given a Low Level Windshear Alert System (LLWAS) with a malfunction, the Manufacturer's Instruction Book (MIB), appropriate test equipment and diagnostics tapes, the student will be able to restore the system to normal operation in accordance with (IAW) MIB T.I.-8690-1.*

EST. TIME (HRS.)	TERMINAL OBJECTIVES AND ENABLING OBJECTIVES	TYPE OF LEARNING	TEST TYPE	TECHNICAL CONTENT OUTLINE	INSTRUCTIONAL STRATEGY & MEDIA	DEVELOPMENTAL NOTES
				SYSTEM OPERATION		
2	1. Given the block diagram of the central station memory backup power supply, the student will analyze the operational characteristics IAW MIB T.I.-8690-1.	CG	W	1. Central Station Memory Backup Power Supply	Lecture/Discussion Text Transparencies Equipment Modules Questioning	Include glossary of common terms and definitions
	a. Given the block diagram of the central station memory backup power supply, the student will identify the function and purpose of the central station memory backup power supply IAW MIB T.I.-8690-1.	K	W 1	a. Function and Purpose Converting Line Voltages to Necessary dc Voltages Supplying ± 15 Volts, 10 Volts, 5 Volts		
	b. Given the block diagram of the central station memory backup power supply, the student will identify the inputs and outputs IAW MIB T.I.-8690-1.	K	W 2	b. Power Supply Interfaces Voltage Inputs Voltage Outputs		Diagrams of Inputs/Outputs Illustrate voltage paths
	c. Given the block diagram of the central station memory backup power supply, the student will trace the voltage path IAW the MIB T.I.-8690-1.	AN	W 3	c. Functional Block Diagram of Power Supply Description of Components Voltage Path		MIB Sections 4, 5, 6
7.	3. Given an operating LLWAS central station, the student will perform the normal system performance measurements IAW MIB T.I.-8690-1.	P	P	3. Central Station Laboratory	Demonstration/ Performance	Illustrate Voltage Levels Illustrate Signal Levels Safety Precautions
	a. Given an operating central station master controller and modem, the student will measure the voltage levels during "scan" and "down" and test the unit in test mode IAW MIB T.I.-8690-1.	P	P 4	a. Master Controller and Modem Voltage Level Measurements Scan Down Test Mode	Laboratory Actual Equipment Individualized Instruction	
	b. Given an operating central station master radio and power supply, the student will measure voltage and signal levels and align the receiver IAW MIB T.I.-8690-1.	P	P 5	b. Master Radio and Power Supply Voltage Level Measurement Signal Level Measurement Receiver Tuning		
	c. Given an operating LLWAS, the student will check the system operation by varying system parameters using the CRT and keyboard IAW MIB T.I.-8690-1.	P	P 6	c. CRT/Keyboard Vary System Parameters Gust Threshold Windshear Threshold		
	d. Given an operating LLWAS central station, the student will measure the voltage levels of the memory backup power supply and the computer power supply IAW MIB T.I.-8690-1.	P	P 7	d. Power Supplies Measure Voltage Levels Memory Backup Power Supply, Computer Power Supply		

NOTE: For the purposes of this sample, all the instructional objectives which support the training outcome have not been shown.

Information Handling Services, 1999
August 11, 1999 10:18:24

9003329 0020758 734

DID 6, FIGURE 2. SAMPLE COURSE DESIGN GUIDE, PART III, CROSS REFERENCE MATRIX

Course Number: 40265	Block/Module Number:	Page B2
Course Title: Low Level Windshear Alert System (LLWAS) FA9980	Block/Module Title:	Date

COLUMN 1 TRAINING OUTCOME	COLUMN 2 TASK NUMBER	COLUMN 3 TERMINAL OBJECTIVE NUMBER	COLUMN 4 TRAINING OUTCOME
Given a Low Level Windshear Alert system, the student will be able to evaluate the CRT displays to determining program operation in accordance with (IAW) the Manufacturer's Instruction Book (MIB) T.I.-8690-1.	1.1.1		A
	1.1.2		A
	1.1.3		A
	1.1.4		A
	1.1.5		A
	1.1.6		A
Given a Low Level Windshear Alert System and the MIB, the student will be able to perform preventive (periodic) maintenance procedures IAW Sections 4, 5, and 6 of the MIB T.I.-8690-1.	1.2.1		C
	1.2.2		
Given a Low Level Windshear Alert System with a malfunction, the MIB, appropriate test equipment and diagnostic tapes, the student will be able to restor the system to normal IAW at the current FAA standards and tolerance MIB T.I.-8690-1.	1.3.1		B
	1.3.2		B

Note: For the purposes of this sample, all the tasks which support each training outcome have not been shown.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -7

1. Title:

Course Schedule

3. Description/Purpose:

This DID establishes the minimum requirements for the content of the contractor's course schedule. The course schedule documents the:

a. Starting and ending dates of the course.

b. Time allocations for major topics and lessons in the course.

c. Major course topics and lessons, arranged in chronological order.

d. Points at which tests are administered.

e. Number of instructors.

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains the preparation instructions for the format and content of the Course Schedule.

7.2 This DID is applicable to all contract training development and delivery efforts.

10. Preparation Instructions:

10.1 **Reference Documents**. The Course Schedule shall be prepared in accordance with the documents referenced in the contract and the Course Design Guide (CDG).

10.2 **Format**. The Course Schedule shall be prepared in accordance with the following format requirements:

10.2.1 A camera-ready or master reproducible copy of the Course Schedule shall be delivered on 8.5" x 11" bond paper. An electronic version shall be

Information Handling Services, 1999
August 11, 1999 10:18:24

delivered, if so specified by the contract. Foldout pages may be used as required. All pages shall be numbered at the bottom center.

10.2.2 The Course Schedule shall have a cover sheet displaying the following information:

a. Document title.

b. Course identification number/course title.

c. Contract number.

d. Contractor name and address.

e. Submission date.

10.2.3 If the schedule for more than one class appears in the Course Schedule, a Table of Contents page shall follow the cover sheet, specifying the page numbers on which each class schedule appears.

10.2.4 If the schedule for more than one class appears in the Course Schedule, each class shall be initiated on a separate page displaying a centered all-caps heading.

10.3 Content Requirements. The Course Schedule shall be prepared in accordance with the descriptions provided below:

10.3.1 **Grid.** The Course Schedule shall be set up as a grid with the days of the week on one axis and the daily hours or periods per day on the other axis. If the contract specifies the day of the week on which the course begins, the week block shall begin with that day. Figures 7-1 and 7-2 of this DID provide examples of the specified arrangement.

10.3.2 **Other Information.** The following information shall be indicated on the Course Schedule:

a. Major course topics, as stated in the technical content outline of Part II of the CDG, and as shown in Figure 1 of this DID.

b. Estimated time, as stated in Part II of the CDG, for each course topic.

Information Handling Services, 1999
August 11, 1999 10:18:24

c. Periods devoted to performance exercises.

d. Type of test(s) associated with a specific course topic block.

e. Number of instructors for each instructional segment. This number shall appear in the lower right corner of the block.

Information Handling Services, 1999
August 11, 1999 10:18:24

9003329 0020762 165

DID 7, FIGURE 1. SAMPLE COURSE SCHEDULE WITH MAJOR COURSE TOPICS

COURSE LOADS ANALYSIS FOR SMALL AIRPLANES
COURSE NO. 22521 (88001)
WEEK: 1
DATES: 5/14/90 - 5/18/90

	MONDAY	TUESDAY	WENSDAY	THURSDAY	FRIDAY
8:00	REGISTRATION AND INTRODUCTION 2		AIRFOIL CHARACTERISTICS 1	V-N DIAGRAMS 1	AIRPLANE BALANCING 1
9:00	INTRODUCTION TO LOADS ANALYSIS 1				
10:00					
11:00		PROGRESS TEST			
12:30	BASIC AERODYNAMICS REVIEW 1	DESIGN DATA 1		V-N DIAGRAMS PROBLEM SESSION 1	
1:30					
2:30					
3:30					PROGRESS TEST

Information Handling Services, 1999
August 11, 1999 10:18:24

9003329 0020763 0T1

DID 7, FIGURE 2. SAMPLE COURSE SCHEDULE WITH LESSON TITLES

COURSE ARTS IIIE SYSTEM
WEEK: 1
DATES: 8/7/90 - 8/13/90

	FIRST PERIOD	SECOND PERIOD	THIRD PERIOD	FOURTH PERIOD
TUESDAY	ADMINISTRATION	ATRS IIIE System Introduction	ATRS IIIE System Introduction Laboratory Group 1	ATRS IIIE System Introduction Laboratory Group 2
WEDNESDAY	VMEbus Specification and Data Transfer Bus (DTB)	VMEbus Specification and Data Transfer Bus (DTB) DTB Arbitration Bus	DTB Arbitration Bus Priority Interrupt Bus	Priority Interrupt Bus Utility Bus MC68010 Microprocessor Architecture
THURSDAY	MC68010 Microprocessor Data Organization MC68010 Addressing Capabilities	MC68010 Addressing Capabilities MC68010 Instruction Set	MC68010 Instruction Set MC68010 Exception Processing	MC68010 Exception Processing Download Functional Operation
FRIDAY	Download Functional Operation Download Procedure	Download Procedure Download Procedure Lab Group 1	Download Procedure Lab Group 2 Progress Test One	Progress Test One FDAD Functional Sections: Console, DSU, PEC
MONDAY	FDAD External and Internal Interfaces FDAD Operator Assemblies, Modes, and Operation	FDAD Operator Assemblies, Modes, and Operation SDU Deflection Correction	SDU Deflection Amplifiers SDU Video Amplifier	SDU Assemblies and Power Supplies SDC Central Processing Unit: Functional Operation

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -8

1. Title:

Student Achievement Tests

3. Description/Purpose:

This DID establishes the minimum requirements for the content and format of contractor-provided, criterion-referenced student achievement tests. This DID contains preparation guidance for both student and instructor versions of the test(s).

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains the preparation instructions for the format and content of Student Achievement Tests.

7.2 This DID is applicable to all contract training development efforts, other than computer-based instruction (CBI).

7.3 See DID-17 for guidance on the preparation of CBI tests for all FAA organizations.

10. Preparation Instructions:

10.1 **Reference Documents**. Student Achievement Tests shall be prepared in accordance with the documents referenced in the contract and the Course Design Guide (CDG).

10.2 **Format**. The Student Achievement Tests shall be prepared in accordance with the following format requirements:

10.2.1 Camera-ready or master reproducible copies of Student Achievement Tests shall be delivered on 8.5" x 11" bond paper. Electronic versions of the Student Achievement Tests shall be delivered, if so specified in the contract. Foldout pages may be used as required. All pages shall be numbered at the bottom center. The submission date of the test shall be placed next to each page number.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.2.2 Each Student Achievement Test shall have a cover sheet displaying the following information:

a. Document title which identifies the type of test (pretest, progress test, or post-test), course title, and test user (student or instructor).

b. Course Identification number.

c. Label or number of the test, which shall be consistent with the labeling system of the FAA organization for which the test has been developed.

d. A statement as to subject matter area of the test and the associated lesson title(s) and number(s).

e. Contract number.

f. Contractor name and address.

g. Submission date.

10.2.3 For the student version of the Student Achievement Test, a Table of Contents page shall follow the cover sheet, specifying the page numbers. The Table of Contents for the student version of a post-test shall include:

a. Student Achievement Test.

b. Alternate Test.

10.2.4 For the instructor version of the Student Achievement Test, a Table of Contents page shall follow the cover sheet, specifying the page numbers. The Table of Contents for the instructor version of the Student Achievement Test shall include, in the following order:

a. Instructions.

b. Answer Key.

c. Student Achievement Test.

d. Alternate Test.

e. Alternate Test Answer Key.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.2.5 Each of the sections named above shall be initiated on a separate page displaying a centered all-caps heading.

10.3 Content Requirements. Student Achievement Tests shall be prepared in accordance with the descriptions provided below:

10.3.1 **Student Achievement Test.** Each Student Achievement Test shall include:

10.3.1.1 **Test Instructions.** Each Student Achievement Test shall include clear, concise, written test instructions which include the following information:

a. Time allowance for completing test.

b. List of allowed reference materials, if appropriate.

c. Required manner for indicating response.

d. Method for grading test, if appropriate.

e. A statement as to contribution of the test score to the student's final grade for the course.

f. Specification of assistance to be made available for the student.

g. For performance tests include the following:

1) Description of the simulated situation.

2) Tools and supplies to be used.

3) Student Activities.

4) Explanation of performance recording and scoring.

5) Statement as to the type of performance being evaluated (process, product, or both).

10.3.1.2 **Test Items on Student Version.** Each student version of the Student Achievement Test shall include test items which correspond to the terminal and enabling objectives specified in the CDG. The number of test items shall be sufficient to adequately measure student mastery of each

Information Handling Services, 1999
August 11, 1999 10:18:24

training outcome, terminal objective, and enabling objective. Allowable types of items include:

a. For written tests:

1) Multiple choice.

2) True-false.

3) Completion/Short answer.

4) Matching.

b. For performance tests:

1) Demonstrations of actual, and observable, performance.

2) Performance checklists.

10.3.1.3 **Alternate Written Test.** An alternate written test shall be provided. The contents of the alternate written test shall be as follows:

a. Test instructions as specified in 10.3.1.1.

b. Test items such that each test item on the alternate test and its corresponding original test item shall measure the same objective. However, the alternate test item shall not be identical to that of the original test item. Each test item and its alternate shall be identified by the same label. For example, if the original test item is labeled "1," its alternate form shall also be labeled "1."

10.3.2 **Instructor Version.** The instructor version of the student achievement test shall contain the following:

10.3.2.1 **Instructor Instructions.** The instructor version of the Student Achievement Test shall include instructions to the instructor directing him/her in the procedure for test administration. The instructions shall include:

a. Heading, with the course number and title, lesson title, and the type of test (pretest, progress test, or post-test).

b. Description of student activities during the test.

Information Handling Services, 1999
August 11, 1999 10:18:24

c. Instructor responsibilities, such as:

1) Ensuring satisfactory test area conditions (for example, minimal distractions; adequate working space; and sufficient materials).

2) Ensuring the simulator/test equipment is operable for performance tests.

d. Emergency procedures for accidents, illnesses, equipment failure, power failure, severe weather, and fire drills.

10.3.2.2 **Answer Key.** The instructor version of the Student Achievement Test shall include an answer key which contains the following items:

a. Correct answer for each test item in the order in which the items appear on the student test copy.

b. Acceptable responses and acceptable variations of the answer for completion/short answer test items.

c. Checklist of the procedures to be performed by the student for performance tests, sequenced in the order in which the procedures should be performed. Standardized checklists shall be developed to assist the instructor in assessing mastery of performance behaviors. Sufficient detail shall be provided to enable an instructor to make "go/no-go" decisions and to determine whether further training is required.

d. Directions for recording and scoring student test performances.

10.3.2.3 **Student Achievement Test.** Each instructor version of the Student Achievement Test shall include all test items appearing on the student version of the test. Each test item shall have the alphanumeric label, from Part II of the CDG, for the corresponding terminal or enabling objective in parentheses next to the test item.

10.3.2.4 **Alternate Test.** A copy of the alternate test shall be provide. Each alternate test item shall be labeled in accordance with 10.3.1.3 above.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.3.2.5 **Alternate Test Key.** The alternate test answer key shall be provided in accordance with 10.3.2.2 above.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -9

1. Title:

Lesson Plan

3. Description/Purpose:

This DID establishes the minimum requirements for the content of contractor-developed Lesson Plans. For each lesson or practice exercise of a course, the associated Lesson Plan documents the:

a. Course number, course title, preparation date, lesson duration, lesson title, exams and workshop material, other student support material, lesson overview, references, visuals, handouts, and other pertinent information.

b. Subject outline, which includes the introduction, body, and summary sections.

c. Instructional materials, overheads, carousel slide positions, notes, and response items to be used during the lesson.

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains the preparation instructions for the format and content of Lesson Plans.

7.2 This DID is applicable to all contract training efforts for developing instructor-presented training (IPT).

10. Preparation Instructions:

10.1 <u>Reference Documents</u>. The Lesson Plans shall be prepared in accordance with the documents referenced in the contract and the Course Design Guide (CDG).

10.2 <u>Format</u>. The Lesson Plans shall be prepared in accordance with the following format requirements:

Information Handling Services, 1999
August 11, 1999 10:18:24

10.2.1 A camera-ready or master reproducible copy of the Lesson Plan shall be delivered on 8.5" x 11" bond paper. An electronic version shall be delivered, if so specified by the contract. The cover page of the Lesson Plan shall not be numbered. All other pages of the Lesson Plan shall be numbered on a line in the page heading. Lesson Plans shall be constructed using double spacing.

10.2.2 The Lesson Plan shall have a cover sheet displaying the following information. An example of a cover sheet for a Lesson Plan appears in Figure 9-1 of this DID.

a. Course number, as supplied by the FAA.

b. Course title, as specified in the CDG.

c. Lesson plan number, which shall be consistent with the labeling system of the FAA organization for which the lesson plan is developed.

d. Lesson title, which shall be consistent with the technical content outline of the CDG.

e. Date on which the instructor lesson plan is prepared.

f. Duration of the lesson in hours and minutes.

g. Exams and/or performance exercise used within the lesson.

h. Reference list, which shall include source materials from which the instructor shall gather information to support the lesson objectives. (Identify each document by title, page, paragraph number, and publication date, as applicable).

i. Visuals, including overhead transparencies, listed by label/number which shall be consistent with the labeling system of the FAA organization for which the lessons are developed.

j. Handouts, listed by label/number which shall be consistent with the labeling system of the FAA organization for which the lessons are developed.

k. Other pertinent information; for example, advisory circulars or a change of status.

Information Handling Services, 1999
August 11, 1999 10:18:24

l. Document number (to be left blank).

m. Developer's name and address.

n. Name of the FAA COTR.

10.2.3 An example of a Lesson Plan appears in Figure 9-2. The Lesson Plan page shall consist of:

a. A heading area at the top of the page.

b. Four columns labeled, with upper case letters, as follows:

1) AIDS.

2) POS.

3) SUBJECT OUTLINE.

4) NOTES.

10.2.4 Answers, and references for answers, for all study questions and self-test items appearing in the Student Guide and Student Workbook shall be attached to the end of their corresponding Lesson Plan.

10.3 Content Requirements. Each Lesson Plan shall be prepared in accordance with the descriptions provided below:

10.3.1 **Heading.** There shall be two types of headings on Lesson Plan pages:

a. The first page of the Lesson Plan shall contain the following information:

1) Lesson Plan title.

2) Course title and number.

3) Lesson number.

4) Preparation date.

5) Subject covered in lesson.

Information Handling Services, 1999
August 11, 1999 10:18:24

6) Document number, if it has been assigned; if the number has not been assigned, this area shall be left blank.

7) Lesson duration.

8) Page number.

b. Subsequent pages of the Lesson Plan shall contain the following information:

1) Document number if it has been assigned; if the number has not been assigned, this area shall be left blank.

2) Lesson number.

3) Preparation date.

4) Page number.

10.3.2 **AIDS.** References to the appropriate instructional materials to be used in conjunction with the information in the subject outline shall be placed in the AIDS column. References shall be consistent with the labeling system of the FAA organization for which the lessons are developed. Appropriate instructional materials shall include, but not be limited to, all:

a. Visual aids.

b. Audiovisual aids.

c. Handouts.

d. Reference documents, including the Student Guide, the Student Workbook, and all supplemental materials.

e. Tests.

f. Response items.

10.3.3 **POS.** The POS column shall be left blank. It is for FAA use only and will eventually contain the slide position number of the carousel.

10.3.4 **SUBJECT OUTLINE.** The subject outline shall be placed in the column labeled SUBJECT OUTLINE. The

Information Handling Services, 1999
August 11, 1999 10:18:24

subject outline shall contain the following information:

a. For non-performance exercise lesson plans:

1) Introduction.

2) Body of lesson.

3) Summary.

4) Response Items.

b. For performance exercise lesson plans, which shall correspond to the job sheets in the Student Guide, described in Student Materials (DID-9):

1) Time allocation for preparation of materials or equipment for the performance of the exercise.

2) Steps for instructor demonstration of the activity.

3) Step-by-step procedures for the students to follow when performing the activity.

4) Explanation of how the performance exercise relates to the lesson.

5) Specification of safety procedures and precautions related to the performance exercise.

6) Performance evaluation criteria.

10.3.4.1 The Introduction shall be the first section of the subject outline. The Introduction shall be written such that it will promote student interest in the lesson topic. When supplemental training is being developed, the introduction shall establish a bridge between management and technical procedures and processes as currently performed and how they will be performed as the result of new equipment or workforce changes. Relevant knowledge of students in relation to the current work environment shall be recalled to help the students learn new knowledge and skills. At a minimum, the Introduction shall include the following:

Information Handling Services, 1999
August 11, 1999 10:18:24

a. Review of the knowledge and skills from previous lessons which tie in with the current lesson.

b. Overview of the learning activities and organization of the lesson.

c. Examples of real world applications of the lesson content.

d. A statement as to the benefits of the lesson.

e. Objective(s) of the lesson, as specified in the CDG.

10.3.4.2 The Body of the lesson shall be the second section of the subject outline. The Body of the lesson shall communicate the key points of the lesson. The body of the lesson shall be task based and shall build from the known to the unknown, simple to complex,and concrete to abstract. At a minimum, the body shall include the following:

a. Expansion of the information contained in Part II of CDG with sufficient detail to ensure achievement of the terminal and enabling learning objectives.

b. Student-instructor interaction, such as practice and participation activities.

c. Exact wording of response items, blocked in by horizontal lines above and below.

d. Interim summary, which recaps the key points of the body in outline form (approximately one interim summary for each 2-hour class session).

e. Titles of handouts and/or other reference material.

f. Black and white depiction (this may be a photograph, if specified in the contract) of all slides and transparencies, appropriately placed in the lesson plan, and blocked in by horizontal lines above and below. This shall be accomplished with print if the slide is strictly text.

10.3.4.3 The Summary section shall follow the Body of the lesson in the subject outline. The Summary shall present a review of the objectives and the key points of the Body of the lesson. At a minimum, the summary shall include:

Information Handling Services, 1999
August 11, 1999 10:18:24

a. Review of the main points of the lesson and the lesson objectives.

b. Evaluation, including instructions for administering and grading an end-of-lesson (progress) test. The contractor shall provide an end-of-lesson test for each lesson. Student Achievement Tests (DID-8) specifies the content and format for progress tests.

c. Assignment, including a brief preview of the next lesson and/or an assignment which shall prepare students for upcoming material. If study questions are used in the assignment, the answers shall be provided and shall be attached to the end of the lesson plan they support.

10.3.4.4 Response Items shall be placed throughout the Lesson Plan at points where they are best suited during the lesson. There shall be response items for all sections of the Lesson Plan. Use of response items shall include, but not be limited to, learning reinforcement, summarization, and drawing attention to the material. Types of response items include:

a. Oral questions, such as:

1) Rhetorical questions directed to the entire group of students to stimulate covert group response. No verbal response is expected.

2) Factual questions requiring the student(s) to give "when," "where," and "what" responses.

3) Leading questions used to assist the student(s) in thinking through to the answer. When a student is seeking the answer, the instructor may ask another question to direct attention to information known but not being used.

4) Problem questions which challenge the student(s) to apply knowledge to specific problems.

b. Written questions.

c. Role playing.

d. Work sheets.

Information Handling Services, 1999
August 11, 1999 10:18:24

e. Push button response items, known as responder items, if specified by the contract.

10.3.5 **NOTES.** All the instructor activities designed to enhance the instruction outlined in the presentation shall be placed in the NOTES column. The information in the NOTES column shall be placed at the point(s) in the Lesson Plan where it will provide the greatest benefit to the instructor. The following types of information shall be recorded in the NOTES column:

a. References to governmental and industry documents pertaining to the lesson.

b. Notes from the developer to the instructor.

c. Answers to response items, placed opposite the items to which they pertain.

d. Specification of how optional material shall be used.

e. Other pertinent information.

10.3.5.1 Whenever an instructional aid is identified in the AIDS column, the NOTES column shall contain corresponding information, including the title (or description) of the instructional aid and the associated instructor activities.

Information Handling Services, 1999
August 11, 1999 10:18:24

DID 9, FIGURE 1. SAMPLE LESSON PLAN COVER SHEET

COURSE NO. AND NAME 50255 MODEL-1 AFSS SUPERVISOR TRAINING	
LESSON TITLE FLIGHT SERVICE AUTOMATION SYSTEM (FSAS) COMMUNICATION PROCESS, F-12-11	
DATE REQUIRED DECEMBER 1985	**DURATION** 4+00
EXAMS AND /OR PERFORMANCE EXERCISE MATERIAL END-OF-LESSON TEST, F-12-11	
REFERENCE LIST SUPERVISOR'S SUPPLEMENT	
VISUALS F-12-11-1 AND F-12-11-6 THROUGH F-12-11-10	
HANDOUTS FW-12-2 SUPERVISOR'S SUPPLEMENT	
OTHER PERTINENT INFORMATION END OF LESSON TEST AND PERTINENT SLIDES ARE INCLUDED IN THE STUDENT WORKBOOK	
DOCUMENT NO.	
DEVELOPER'S NAME AND ADDRESS ABC TRAINING 5000 C ST., N.W. WASHINGTON, D.C. 20001	**FAA COTR** JOHN W. JONES

Information Handling Services, 1999
August 11, 1999 10:18:24

9003329 0020779 469

DID 9, FIGURE 2. SAMPLE LESSON PLAN

Lesson Plan Title

Course _____ Lesson No. _____ Date _____

Subject _____

Document No. _____ Duration _____ Page _____

AIDS	POS	SUBJECT OUTLINE	NOTES
Use this column for: Training Aids (use codes)	List slide position no. in carousel in this column	Use this column for: I. Introduction A. Review/Tie-in 1. Give a brief review of past lesson(s), background knowledge, or skills that are important to this lesson. 2. Relate new learning to the job, and prepare students to learn new knowledge and skills. 3. Transition from known to unknown. B. Define key terms and introduce new acronyms.	Use this column for: 1. References 2. Descriptions of visuals 3. Developer-to-instructor notes 4. Answers to questions 5. Instructor's personal teaching information 6. Optional material

Information Handling Services, 1999
August 11, 1999 10:18:24

9003329 0020780 180

Lesson Plan Continuation

Document No. _____ Duration _____ Page _____

AIDS	POS	SUBJECT OUTLINE	NOTES
		C. Overview 1. Give an overview of the lesson. Explain what is to be learned, and how it will be accomplished. 2. Mention the use of lab exercises and testing, as appropriate. D. Motivation 1. State the benefits of learning the new knowledge and skills. 2. Create interest and prepare students to learn.	Include any notes for the instructor.

Information Handling Services, 1999
August 11, 1999 10:18:24

9003329 0020781 017

Lesson Plan Continuation

Document No. _____ Duration _____ Page _____

AIDS	POS	SUBJECT OUTLINE	NOTES
		E. Objectives 1. Explain the terminal and enabling objectives for the lesson. 2. Make students aware of what they will know and be able to do upon completion of the lesson.	Use a visual which lists the objectives.
		II. Body (use detailed outline format)	Provide content information references.
		A. Body of lesson should convey information in a logical learning sequence: - Simple to complex, - Known to unknown, - Job performance sequence.	Use additional visuals, as required.
		B. Teach to the objectives.	
		C. Specify safety precautions.	

Information Handling Services, 1999
August 11, 1999 10:18:24

9003329 0020782 T53

Lesson Plan Continuation

Document No. _____ **Duration** _____ **Page** _____

AIDS	POS	SUBJECT OUTLINE	NOTES
		III. Summary A. Review the objectives, as required. B. Review key terms and definitions. C. Review main points. D. Review safety precautions. E. Provide review questions for reinforcement of content. Discuss answers as a group.	Provide guidance on how to connect the review.
		IV. Practice Exercises A. Explain any lab or other practical application exercises that are part of lesson. B. Brief students on any safety precautions and procedures to be followed for hands-on performance.	List any lab or practice application guidance.

Information Handling Services, 1999
August 11, 1999 10:18:24

9003329 0020783 99T

Lesson Plan Continuation

Document No. _____ Duration _____ Page _____

AIDS	POS	SUBJECT OUTLINE	NOTES
		V. Conduct End-of-Lesson Tests	
		A. Make sure students understand the test directions and test conditions.	
		B. After testing and scoring have been complete, review written and performance test items. Make sure students understand their mistakes.	Make answer keys and performance checklists part of lesson plan.
		C. Provide additional training, as required.	
		VI. Present any assignments for the following lesson and preview the next learning activity.	

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -10

1. Title:

Student Materials

3. Description/Purpose:

This DID specifies the minimum requirements for the content of student materials developed to support training. Student Materials shall include:

a. Student guide.

b. Student workbook.

c. Supplementary materials.

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains the preparation instructions for the format and content of the student materials specified in paragraph 10.3 of this DID.

7.2 This DID is applicable to all contract training development efforts.

10. Preparation Instructions:

10.1 **Reference Documents**. The student materials shall be prepared in accordance with the documents referenced in the contract and the Course Design Guide (CDG).

10.2 **Format**. Student materials shall be prepared in accordance with the following format requirements:

10.2.1 **Student Guide.** A camera-ready or master reproducible copy of the Student Guide shall be delivered on 8.5" x 11" bond paper. An electronic version shall be delivered, if so specified by the contract. Foldout pages may be used as required. All pages shall be numbered at the bottom center. The materials in the Student Guide shall be separated into logical segments; for example, by lesson, topic, or day of class. Separation of

Information Handling Services, 1999
August 11, 1999 10:18:24

logical segments shall be made with tabs, dividers, or colored paper. The Student Guide contents shall be labeled/numbered in a manner which is consistent with the labeling system of the FAA organization for which the guide is developed. The cover of the Student Guide shall be labeled with the title(s) of the lessons it supports.

10.2.1.1 The Student Guide shall have a cover sheet displaying the following information:

a. Heading identifying the lesson title(s) and number(s) covered in the guide.

b. Course title and number the guide supports.

c. Preparation date of the guide.

d. Statement that the document is for training purposes only.

10.2.1.2 The Student Guide shall have a Table of Contents following the cover sheet, specifying the page numbers. The Table of Contents shall include:

a. References.

b. Administrative information.

c. Introduction.

d. Information sheets.

e. Assignment sheets.

10.2.2 **Student Workbook.** A camera-ready copy of the Student Workbook shall be delivered on 8.5" x 11" bond paper. An electronic version shall be delivered, if so specified by the contract. Foldout pages may be used as required. All pages shall be numbered at the bottom center. The Student workbook shall be organized by lesson, with each lesson separated from other lessons by tabs, dividers, or colored paper. The Student Workbook contents shall be labeled/numbered in a manner which is consistent with the labeling system of the FAA organization for which the guide is developed. The cover of the Student Workbook

Information Handling Services, 1999
August 11, 1999 10:18:24

shall be labeled with the title(s) of the lessons it supports.

10.2.2.1 The Student Workbook shall have a cover sheet displaying the following information:

a. Heading identifying the lesson title(s) and number(s) covered in the guide.

b. Course title and number the guide supports.

c. Preparation date of the guide.

d. Statement that the document is for training purposes only.

10.2.2.2 The Student Workbook shall have a Table of Contents following the cover sheet, specifying the page numbers. The Table of Contents shall include:

a. References.

b. Instructions for workbook use.

c. For each lesson covered by the workbook:

1) Learning activities.

2) Job sheets to support the learning activities.

10.2.3 Each section of the student materials described above shall be initiated on a separate page displaying a centered all-caps heading.

10.2.4 **Supplementary Materials.** Supplementary materials shall be bound separate from other materials following the contractor's commercial practice. All supplementary materials shall be labeled "For Student Use Only."

10.3 <u>Content Requirements</u>. Student materials shall be prepared in accordance with the descriptions provided below:

10.3.1 **Student Guide.** The Student Guide organization and contents shall be as follows:

10.3.1.1 **References.** The reference page shall list all:

Information Handling Services, 1999
August 11, 1999 10:18:24

a. Training outcome(s) from the CDG covered by the Student Guide.

b. Reference materials required for the course.

10.3.1.2 Administrative Information. The administrative information section of the Student Guide shall contain, but not be limited to:

a. Course schedule in the format specified in Course Schedule (DID-7).

b. Any safety precautions to be observed during the course.

c. Guidelines for using the material in the Student Guide.

d. Orientation information which includes a list of lodging facilities, restaurants, and transportation services for students.

10.3.1.3 Introduction. The introduction for each lesson shall list all objectives for the lesson.

10.3.1.4 Information Sheets. Information sheets shall be included to aid the student by supporting important information contained in the instruction and presenting information from documents which are not readily available to the students. Each information sheet shall have a heading which identifies the lesson to which it pertains. Each type of information presented on an information sheet shall be titled. Information sheets shall be sequenced to correspond with the sequence in which the information is presented. All visuals included on an information sheet shall have conventional labeling and format (e.g, call-outs), and shall be clear and uncluttered. All call-outs on a visual shall be explained in the accompanying text. When text and a visual appear on the same information sheet, the text shall be placed to the left or above the visual, or in the case of double-sided printed pages, the text may appear on the left-hand page. Information sheets may include the following types of data:

a. Narrative descriptions, which shall be written at the appropriate reading level for the class.

Information Handling Services, 1999
August 11, 1999 10:18:24

b. Diagrams, which shall be labeled in accordance with documents referenced in the contract.

c. Sketches.

d. Charts, which shall be labeled in accordance with documents referenced in the contract and shall be drawn so as to convey the greatest amount of information in the most accurate way.

e. Graphs, which shall be labeled in accordance with documents referenced in the contract and shall be drawn so as to convey the greatest amount of information in the most accurate way.

f. Pictures, which shall be printed in such a way as to convey the fullest amount of information possible.

h. Tables, which shall be labeled in accordance with documents referenced in the contract and shall be drawn so as to convey the greatest amount of information in the most accurate way.

i. Flowcharts, which shall be labeled in accordance with documents referenced in the contract.

j. Excerpts from or references to other documents or original material prepared by the contractor.

10.3.1.5 **Assignment Sheets.** An assignment sheet shall be placed at the end of each lesson or class day segment. The assignment sheet shall support the instruction by preparing the students for upcoming material. Assignment sheets shall contain the following:

a. Introduction, which states the purpose or the scope of the assignment.

b. Study assignment, which provides instructions for completing the assignment and identifies the paragraphs, pages, and publications assigned for reading. Study assignments shall be:

1) Reasonable in length and not require more than two hours to complete.

2) Sequenced in the best learning order.

Information Handling Services, 1999
August 11, 1999 10:18:24

c. Study questions, which are thought-provoking and related to the assignment. Study questions shall:

1) Require decisions similar to those made on the job.

2) Measure the student's accomplishment of the objectives.

10.3.2 **Student Workbook.** The Student Workbook shall present learning activities which are applications of the principles learned in the classroom to practical, job-relevant situations. The Student Workbook shall contain:

10.3.2.1 **Reference Page.** The reference page(s) shall list all:

a. Training outcome(s) from the CDG covered by the Student Guide.

b. Reference materials required for the course.

c. Reference materials needed to complete any learning activity included in the workbook.

10.3.2.2 **Learning Activities.** Learning activities shall consist of a list of questions and/or one or more projects to complete. The learning activities shall require the student to use only the reference material available during the course and the knowledge acquired through the instruction to complete the activity. Each learning activity shall include the:

a. Topic title.

b. Terminal Objective(s) addressed by the activity.

c. Enabling Objective(s) addressed by the activity.

D. Activity.

10.3.2.3 **Job Sheets.** Job sheets shall support performance exercises in the lesson. Each performance exercise shall require at least one job sheet. An example of a job sheet appears in Figure 10-1 of this DID. Each job sheet shall include:

a. Performance exercise title.

Information Handling Services, 1999
August 11, 1999 10:18:24

b. Time of performance.

c. Job sheet number.

d. Introduction, which gives a brief statement of the topic, purpose, scope, and value of the performance exercise and a suggested completion time.

e. Terminal and enabling objective(s), which specify what the student will accomplish through completion of the performance exercise.

f. References, which identify the publications referenced in the performance exercise.

g. List of all equipment, tools, and materials necessary for the performance exercise.

h. Precautions to be observed during the performance exercise, including personnel safety and equipment care.

i. Job steps for properly performing assigned tasks in a step-by-step manner; if the job steps contained in the technical documentation used in the course are sufficiently detailed, the applicable section and page shall be referenced rather than reproducing them as job steps.

j. Space for the instructor's initials and date, indicating satisfactory student performance of the job steps.

k. Self-test items, which provide questions on the performance exercise and are designed to measure student understanding of the procedures. The students shall be permitted to use information in the technical manual and the course materials, as appropriate, in solving the questions.

10.3.3 **Supplementary Materials.** Any necessary supplementary materials shall be provided to the student. Examples of supplementary materials may include, but are not limited to:

a. System or equipment publications.

b. Operator's manuals.

c. Computer documentation.

Information Handling Services, 1999
August 11, 1999 10:18:24

d. Schematics or block diagrams (a draft or final copy of a set of schematic and block diagrams, if prepared as a deliverable engineering item).

e. Books.

f. Periodicals.

g. Pamphlets.

h. Maps.

i. Photographs.

j. Reference manuals.

Information Handling Services, 1999
August 11, 1999 10:18:24

a. Contractor personnel with responsibility for the design and development of the course shall be available during the walk-through to answer questions about the course. Available contractor personnel shall include:

1) Instructor(s).

2) Developer(s).

3) Appropriate subject matter experts.

b. FAA representatives shall include:

1) The FAA COTR.

2) Subject matter expert(s).

3) Instructional Systems Design Specialist(s).

10.3.2 **Agenda.** The contractor shall draw up an agenda for the Course Walk-Through. The agenda shall be submitted to the FAA for approval prior to the Course Walk-Through.

10.3.3 **Availability of Materials.** Revised draft versions of all materials associated with the course, including, but not limited to, the course schedule, lesson plans, tests, student materials, and media material, shall be made available to the FAA for approval prior to the Course Walk-Through.

10.3.4 **Presentations.** The contractor shall present a shortened version of each lesson during the Course Walk-Through. Each lesson shall be presented in enough detail and depth so that the integration and effectiveness of the instructional materials, learning sequence, performance exercises, tests, and the time allocations can be fully assessed by the FAA.

10.3.5 **Minutes.** The contractor shall record the minutes during the Course Walk-Through. The minutes shall include, but not be limited to:

a. The date of the Course Walk-Through.

b. The course identification number/course title.

c. Titles of lessons in the course.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -16

1. Title:

CBI Lesson Specifications

3. Description/Purpose:

The CBI Lesson Specifications DID contains two parts. Part I documents the design of each computer-based instruction (CBI) lesson. Part II documents the hardware, authoring system, and conventions to be used to produce each lesson. This DID provides the transition from analysis to the design and production of draft CBI courseware. The CBI Lesson Specifications are prepared following the Course Design Guide (CDG).

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains the preparation instructions for the format and content of CBI Lesson Specifications.

7.2 This DID is applicable to all contract training developments which will produce electronically-delivered instruction. The term computer-based instruction (CBI) shall include computer-based instruction, computer assisted or managed instruction, interactive videodisc (IVD), compact disc interactive (CD-I), and other advanced training technologies.

10. Prepararion Instructions:

10.1 Reference Documents. CBI Lesson Specifications shall be prepared in accordance with the documents referenced in the contract and to the approved Course Design Guide (CDG).

10.2 Format. CBI Lesson Specifications shall be prepared in accordance with the following format requirements:

10.2.1 Each CBI Lesson Specification shall be delivered on 8.5" x 11" bond paper and bound following the contractor's commercial practice. Foldout pages

Information Handling Services, 1999
August 11, 1999 10:18:24

may be used as required. All pages shall be numbered at the bottom center.

10.2.2 The CBI Lesson Specifications document shall have a cover sheet displaying the following information:

a. Document title.

b. Course identification number/course title.

c. Lesson number(s)/lesson title(s). (When more than one Lesson Specifications document must be provided because of the length of the course)

d. Contract number.

e. Contractor name and address.

f. Submission date.

10.2.3 A Table of Contents page shall follow the cover sheet, specifying the page numbers. The Table of Contents shall include:

Part I

a. Introduction to the Course.

b. Course Prerequisites.

c. Course Organization.

d. Lesson Elements.

1) Lesson Introduction.

2) Lesson Objectives.

3) Lesson Flow.

4) Content (by Segment).

5) Graphics.

6) Lesson Summary.

e. Instructional Techniques.

1) Presentation.

Information Handling Services, 1999
August 11, 1999 10:18:24

2) Practice.

3) Branching.

4) Interactions.

5) Feedback.

6) Help Sequence.

f. Testing.

1) Pretest.

2) Progress Test.

3) Post-test.

g. Remediation.

h. Supporting Student Materials.

Part II

a. Presentation System/Hardware.

b. Authoring System Description.

c. Conventions.

d. Developer's Notes.

10.2.4 Each of the Lesson Specification segments named above shall be initiated on a separate page displaying a centered all-caps heading.

Part I organization and content shall be as follows:

10.3 <u>Content Requirements</u>. Each CBI Lesson Specification for a course shall be prepared in accordance with the descriptions provided below:

10.3.1 **Introduction to the Course.** This section shall provide a brief overview of the purpose and expected application of the course.

10.3.2 **Course Prerequisites.** This section shall list the necessary prerequisite experience/training which a student should have prior to taking the course.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.3.3 **Course Structure.** Overall course structure shall be shown by means of a Course Flowchart. Figure 1 is an example of a Course Flowchart.

10.3.4 **Lesson Elements.** This section shall describe each aspect of the lesson: the objectives to be achieved, the content to be included, the lesson flow, and the tests associated with the lesson. The time estimate for each lesson shall be documented.

10.3.4.1 **Lesson Introduction.** This section shall provide a brief overview of the purpose and expected application of the lesson, and how it is related to other lessons in the course.

Information Handling Services, 1999
August 11, 1999 10:18:24

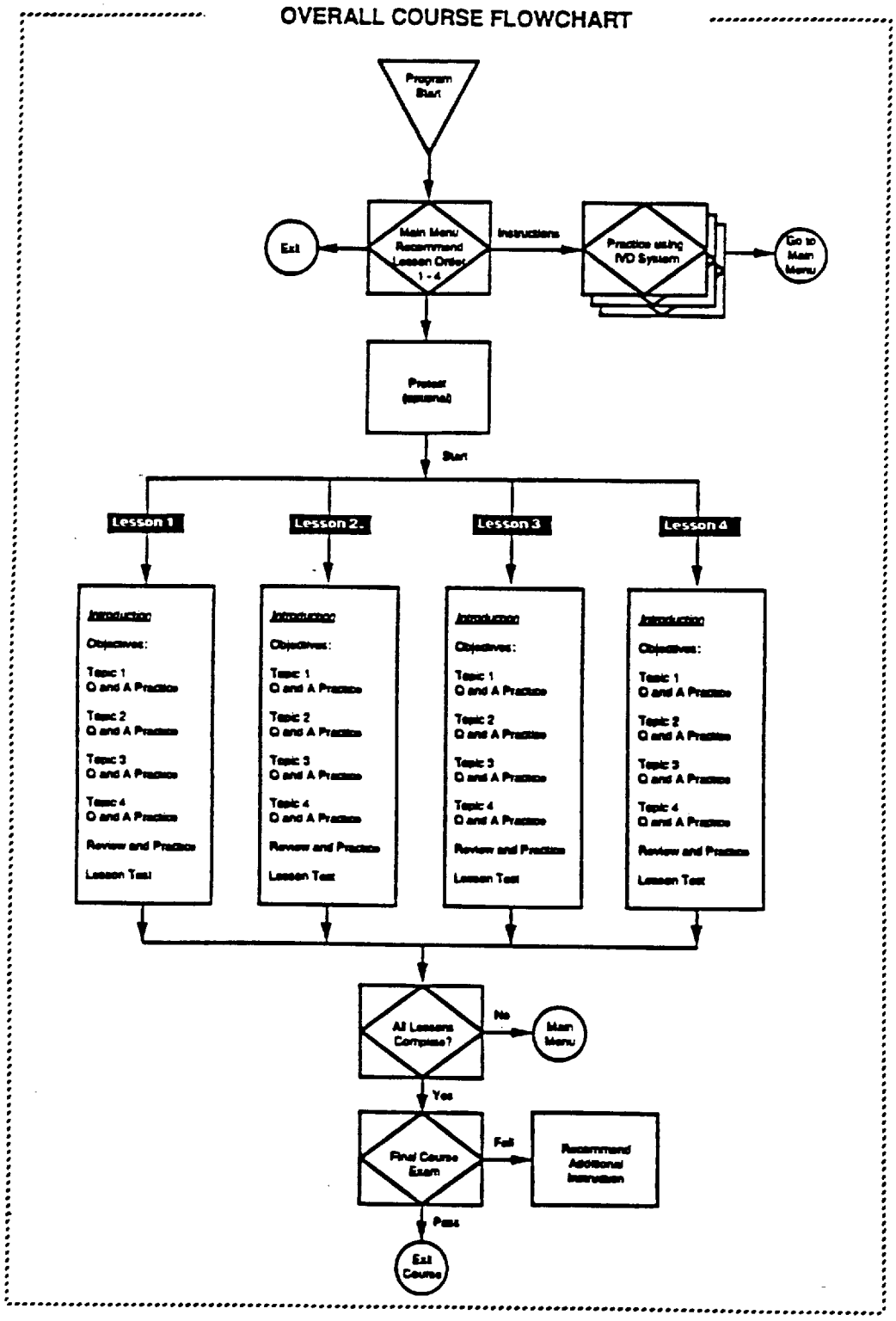


Figure 1: Example of Course Flowchart
DID 16-5

10.3.4.2 **Learning Objectives.** This section lists the terminal objectives and their associated enabling objectives as they are specified in the Course Design Guide (CDG). This listing is as follows:

a. Each relevant terminal objective listed in optimum learning sequence.

b. The associated enabling objectives listed under the terminal objective from which they were derived and arranged in optimum learning sequence.

c. Each terminal and enabling objective shall be written in the three-part form prescribed in the CDG (conditions, performance, and standards).

d. All objectives shall be labeled in accordance with the instructions in the CDG.

10.3.4.3 **Lesson Flow.** This flowchart shall depict the details of the lesson design using standard flowchart procedures, to include the following:

a. The sequence of lesson segments. Each segment shall be labeled with the topic or content to be covered.

b. The location of all test events. Each event shall be labeled to indicate the type and content of the test.

c. Branching between lessons and within lessons.

10.3.4.4 **Content (by Segment).** A topical outline of each lesson shall be provided which relates knowledge and skill areas to the terminal and enabling objectives.

10.3.4.5 **Graphics.** (For non-IVD lessons; IVD lessons will require use of the Video Shot List DID.) All graphics intended to be part of a frame shall be described in sufficient detail (with references for source material wherever possible) so that the lesson author who will implement this Lesson Specification can accurately interpret the designer's intent.

10.3.4.6 **Lesson Summary.** A description of how the key points will be summarized and tied together shall be provided.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.3.5 **Instructional Techniques.** This section shall describe the instructional techniques to be incorporated into the lesson to maximize the effectiveness of the training medium. These techniques include presentation, practice, branching, interaction, feedback, and help sequence.

10.3.5.1 **Presentation.** The presentation for each lesson shall be described. Presentation strategies for CBI include drill and practice, tutorial, case studies, and simulation. Presentation of instruction is based on the type of learning objective in accordance with the Course Design Guide (CDG).

10.3.5.2 **Practice.** Practice exercises shall permit the application of material learned in the earlier portion of the lesson. These exercises shall be designed to require decision-making and/or the application of procedures to solve realistic problems. This section shall describe the practice to be provided for each learning objective, and specify what cues, prompts, and memory aids shall be provided for the student.

10.3.5.3 **Branching.** This section shall describe how branching will be used within the lesson. All branching points and the basis for branching shall be described.

10.3.5.4 **Interactions.** This section shall describe how interactions between the student and the training system will be used within the lesson. The description shall include the purpose of each interaction and the means by which it is to be accomplished--for example, touch screen or keystrokes.

10.3.5.5 **Feedback.** This section shall describe how feedback will be provided to responses made by the student. Feedback may be given in an auditory mode or in the form of text and/or graphics as appropriate. A note shall be provided to the student that another response is needed, when an unanticipated response is given.

10.3.5.6 **Help Sequence.** This section shall describe the on-line help features available to the student. Such help may provide procedural instructions on

Information Handling Services, 1999
August 11, 1999 10:18:24

the training system hardware and software, or it may provide supplemental or explanatory information on the content of the lesson.

10.3.6 **Testing.** This section shall present an overview of the tests to be developed for a course. Three types of test shall be developed: pretests, progress tests, and post-tests. The following information shall be provided for each type:

a. The method of test presentation.

b. Test content, such as "procedures for data entry simulated by screen graphics", or "knowledge of the sequence of steps required to. . . by fill in the blank test."

c. Pass/fail criteria.

d. Remediation to be available for students who do not meet the specified proficiency levels.

1) Nature of the failure.

2) Purpose of the remediation.

10.3.6.1 **Pretest.** A detailed specification of the intended performances shall be provided. On pretests, feedback shall be provided only after all test items have been completed.

10.3.6.2 **Progress Test.** A detailed specification of the intended performance of each progress test shall be provided. On progress tests, feedback shall be provided to the student after each item, with a general summary feedback after all items have been completed.

10.3.6.3 **Post-test.** A detailed specification for the intended performance test situation shall be provided. On post-tests, feedback shall be provided only after all test items have been completed. At least two alternate versions of each post-test item shall be provided for each terminal and enabling objective.

10.3.7 **Remediation.** This section shall describe how remedial instruction is to be provided to students who fail to achieve the specified criteria on a progress test or on a post-test. The remediation

Information Handling Services, 1999
August 11, 1999 10:18:24

may be in the form of re-exposure to the original training material, re-exposure to the original material but with different examples, or new material which uses a different approach to the same content.

10.3.8 **Supporting Student Materials.** A listing of any supplementary materials needed to support the course lessons shall be provided.

Part II organization and content shall be as follows:

10.3.9 **Presentation System/Hardware.** A brief description of the functional characteristics of the delivery system shall be provided. This section shall include:

a. Number and display capabilities of screens.

b. Characteristics of all input devices.

c. Availability of color, audio, graphic animation, etc.

d. Unique operating characteristics which could influence the way in which an author or programmer elects to design the training.

10.3.10 **Authoring System Description.** The name and version of the authoring system to be used in building the training material shall be provided. In addition, a brief description shall be provided of any specific authoring system capability or limitation which could influence the lesson material design or its programming.

10.3.11 **Conventions.** This section shall describe the text and graphics conventions which will be used in the production of the CBI courseware:

a. Type - style, size, and use of capitalization.

b. Format - locations, spacing, and amount of text per frame.

c. Color - background, text, headings, and graphics.

d. Punctuation.

e. Use and placement of logos and icons.

Information Handling Services, 1999
August 11, 1999 10:18:24

f. Use of highlighting and flashing.

g. Placement on the screen of program control selections, such as arrows to step ahead or back in the program.

h. Use of touch-sensitive screens.

10.3.12 **Developer's Notes.** The contractor shall list in this section information which will be of importance to the lesson author, including:

a. References to source material for the lesson.

b. Special instructions to the author about the integration of other student material (e.g. Student Workbook) with the CBI material.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -17

1. Title:

Plan for Computer-Based Instruction Testing

3. Description/Purpose:

This DID provides the minimum requirements for a plan for computer based instruction (CBI) testing which describes how students will be tested and how test information will be managed for use by the instructor and/or student. The Plan for Computer-Based Instruction testing is prepared following the CBI Lessons Specifications.

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains the preparation instructions for the content and format of the plan for CBI testing.

7.2 This DID is applicable to all contract training development efforts for which computer based instruction (CBI) is a component of the instruction.

10. Preparation Instructions:

10.1 Reference Documents. The plan for CBI testing shall be prepared in accordance with the documents referenced in the contract, the CBI lesson specifications, and the CBI testing policy of the FAA organization which is contracting for CBI tests or courseware.

10.2 Format. The plan for CBI testing shall be prepared in accordance with the following format requirements, unless otherwise specified in the contract.

10.2.1 The plan for CBI testing shall be delivered on 8.5" x 11" bond paper and bound following the contractor's commercial practice. Foldout pages may be used as required. All pages shall be numbered at the bottom center.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.2.2 The plan for CBI testing shall have a cover sheet displaying the following information:

a. Document title.

b. Course identification number/course title.

c. Contract number.

d. Contractor name and address.

e. Submission date.

10.2.3 A Table of Contents shall follow the cover sheet, specifying the page numbers. The Table of Contents shall include:

a. Introduction

b. Test Item Descriptions.

c. Displaying of Scores.

d. Test Management Facilities.

e. Glossary.

f. Acronyms.

10.2.4 Each section of the plan for CBI testing named above shall be initiated on a separate page displaying a centered all-caps heading.

10.3 Content Requirements. The plan for CBI testing shall be prepared in accordance with the descriptions provided below:

10.3.1 **Introduction.** The introduction section of the plan for CBI testing shall briefly describe the testing strategies and rationale for their use.

10.3.2 **Test Item Descriptions.** This section of the plan for CBI testing shall include the following for each terminal and enabling objective to be tested:

a. The objective.

b. Test item description(s), including:

Information Handling Services, 1999
August 11, 1999 10:18:24

1) The wording of the item.

2) How the item will be displayed (for example, as an overlay on video, straight text, via icons or other graphics).

3) The test type represented by the item (e.g., text-based or practical application).

4) The number of times the student will be allowed to respond in the event of an initial incorrect answer.

c. Method by which the student will respond to the item, for example by touching the correct answer on the touch screen.

d. How the item will be scored (for example, if the student will be given credit for a partially correct answer).

e. The feedback that will be given to the student upon responding to the item, for each possible response, each time the student is presented with the item.

f. If relevant, the branching that will occur based on each possible response each time the student is presented with the item.

g. Whether test item randomization capabilities will be used and a description of these capabilities.

10.3.3 **Displaying of Scores.** This section of the plan for CBI testing shall contain a description of the test score information that will be available to the student and the test score information that will be available to the instructor. The procedures that the students and instructors will use to display the test score information shall be described. There shall also be an example of each type of score display screen that will be presented to either the student or the instructor.

10.3.4 **Test Management Utilities.** The test management utilities section of the plan for CBI testing shall contain descriptions of each test management aid available for instructor use. These aids may include utilities such as test item modification, feedback modification, or test type modification. For each utility, the description shall include:

Information Handling Services, 1999
August 11, 1999 10:18:24

a. A descriptive name for the utility.

b. A description of the function of the utility.

c. A statement of the rationale for including the utility.

d. The procedures to be performed by the instructor in order to access and use the utility.

e. Examples of all the screens and system responses presented during the use of the utility.

10.3.5 **Glossary.** The glossary shall contain technical words, and their definitions, used in the plan for CBI testing.

10.3.6 **Acronyms.** The acronyms section shall contain a list of acronyms, and their meanings, used in the plan for CBI testing.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -18

1. Title:

CBI Validation Plan and Validation Report

3. Description/Purpose:

The CBI Validation Plan documents the validation activities which will be used to assess the effectiveness and efficiency of CBI courseware. Validation occurs after the CBI courseware has been completed in its initial form. The purpose of validation is to: 1)confirm that all segments of the courseware "play" together, and 2) determine whether the courseware will enable students to achieve the prescribed learning objectives.

The CBI Validation Plan specifies the schedule, processes, and resources to be employed in testing, analyzing, and refining the CBI courseware. The Validation Plan shall be prepared immediately following the Lesson Specifications and the Plan for Computer-Based Instruction Testing.

The results of CBI validation activities shall be documented in a CBI Validation Report. The Validation Report shall be prepared immediately following the pilot test of the CBI courseware.

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains the preparation instructions for the format and content of a CBI Validation Plan and Validation Report. This DID consists of two separate deliverables, the Validation Plan and the Validation Report. Each deliverable must be documented separately on the Contract Data Requirements List (CDRL).

7.2 This DID is applicable to all contract training developments which will produce electronically-delivered instruction. The term computer-based instruction (CBI) includes computer-based instruction, computer assisted or managed instruction, interactive videodisc (IVD), compact

Information Handling Services, 1999
August 11, 1999 10:18:24

disc interactive (CD-I), and other advanced training technologies.

10. Preparation Instructions:

10.1 **Reference Documents**. The CBI Validation Plan and Validation Report shall be prepared in accordance with the documents referenced in the contract.

10.2 **Format**. The CBI Validation Plan shall be prepared in accordance with the following requirements:

10.2.1 The Plan shall be printed on 8.5" x 11" paper, single or double sided, bound following the contractor's commercial practice. All pages shall be numbered at the bottom center.

10.2.2 Each CBI Validation Plan and Validation Report shall have a cover sheet displaying the following information:

a. Document title.

b. Course identification number/course title.

c. Lesson number(s)/lesson title(s), if applicable.

d. Contract number.

e. Contractor name and address.

f. Submission date.

10.2.3 A Table of Contents page shall follow the cover sheet. The Table of Contents shall list all significant headings used in the report along with their page numbers. Sufficient detail shall be included to permit direct location of any segment of the report.

The Table of Contents for the Validation Plan shall include:

a. Introduction.

b. Validation Schedule.

c. Methodology.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.3 **Validation Plan Contents**. The CBI Validation Plan shall be prepared in accordance with the descriptions provided below:

10.3.1 **Introduction.** The Introduction section shall briefly discuss the overall validation process and the procedures to be used to determine the effectiveness of the courseware. The Introduction shall describe all significant limitations and constraints which have influenced the Plan or which will influence the ultimate results.

10.3.2 **Validation Schedule.** The schedule for validation shall cover tryouts of the courseware under instructional conditions that are as close as possible to the conditions under which the final courseware will be implemented. An overall schedule of validation events shall be presented. This schedule shall establish the time frame and locations for the validation.

10.3.3 **Methodology.** Each tryout identified on the validation schedule shall be described in terms of:

a. Course component, including objective(s) and frames and/or sequence identification.

b. Tryout purpose.

c. Resources required, including equipment, subjects, observers/data collectors, facilities, and time.

d. Test materials required, including training software, instructions for all participants, and data collection forms. Drafts of all data collection instruments shall be provided.

e. Procedures for conducting the study and collecting required data.

f. Procedures for data analysis and interpretation.

g. Procedures for reporting results.

10.4 **CBI Validation Report**. The Validation Report shall document the results of the validation activities. It shall include a discussion of the extent to which students achieved the terminal and enabling objectives, deficiencies in the instruction, and the

Information Handling Services, 1999
August 11, 1999 10:18:24

accuracy of the time allocations. In the Validation Report, the contractor shall recommend revisions to the instruction and a timeline for completion of the revisions.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -19

1. Title:

Video Treatments

3. Description/Purpose:

Video Treatments shall be prepared as a narrative description of the proposed content of all video sequences identified to support the CBI Lesson Specifications. These descriptions document the images, time, personnel, location, and facility requirements needed to produce the video segment, whether original production or existing material. The video treatments are prepared following the Lesson Specifications and the Plan for CBI Testing for those courses/lessons requiring video.

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains the preparation instructions for the format and content of Video Treatment documents.

7.2 This DID is applicable to all contractor-developed CBI training which involves the production of video sequences.

10. Preparation Instructions:

10.1 **Reference Documents**. CBI Video Treatments shall be prepared in accordance with the documents referenced in the contract.

10.2 **Format**. Video Treatments shall be prepared in accordance with the following format requirements:

10.2.1 A separate Video Treatment (description) shall be prepared for each terminal and enabling objective identified in the Lesson Specifications which involve a video sequence.

10.2.2 All Video Treatments for a CBI course shall be bound together as a single document. The document

Information Handling Services, 1999
August 11, 1999 10:18:24

shall be delivered on 8.5" x 11" bond paper and bound following the contractor's commercial practice. Foldout pages may be used as required. All pages shall be numbered at the bottom center.

10.2.3 The Video Treatment document shall have a cover sheet displaying the following information:

a. Document title.

b. Course identification number/course title.

c. Contract number.

d. Contractor name and address.

e. Submission date.

10.2.4 A Table of Contents page shall follow the cover sheet, specifying the page numbers. The Table of Contents shall include:

a. Introduction.

b. Concept and Approach.

c. Video Treatments.

10.3 Content Requirements. Each Video Treatment document shall be prepared in accordance with the descriptions provided below:

10.3.1 **Introduction.** The overall treatment of the course shall be described with annotations to indicate each of the video sequences needed for the terminal and enabling objectives. A matrix showing which sequences have various factors in common shall be provided, if applicable.

10.3.2 **Concept and Approach.** The overall approach to the video sequences and how continuity will be achieved shall be described. For example, will an off-camera narrator be used throughout? Will an on-camera instructor demonstrate the procedures? Will animation be used to show a process flow?

10.3.3 **Video Treatments.** Each Video Treatment shall include:

a. Terminal and enabling learning objectives.

Information Handling Services, 1999
August 11, 1999 10:18:24

b. Summary discussion of the theme of each video event.

c. Narrative description of the set and/or location.

d. Casting requirements.

e. Equipment/facilities required.

f. Special effects anticipated.

g. Narrative description of the action.

h. Estimated running time.

i. Probable interaction with ongoing operations while taping.

j. Source (if existing footage is to be used).

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -20

1. Title:

Storyboards/Scripts

3. Description/Purpose:

Storyboards, for computer-based instruction (CBI), build upon the information in the CBI Lesson Specifications DID and provide a detailed picture of each frame in the course. These storyboards constitute the output from the instructional design process and the input to programmers who produce the final training software.

Scripts detail the actions, dialogue, and image by image directions for all of the still and motion video requirements of the storyboard.

The storyboards and scripts are prepared following the Lesson Specifications, the Plan for CBI Testing, and Video Treatments.

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains the preparation instructions for the format and content of storyboards and scripts.

7.2 This DID is applicable to all contract training developments which will produce electronically-delivered instruction. The term computer-based instruction (CBI) includes computer-based instruction, computer assisted or managed instruction, interactive videodisc (IVD), compact disc interactive (CD-I), and other advanced training technologies.

10. Preparation Instructions:

10.1 <u>Reference Documents</u>. CBI Storyboards and Scripts shall be prepared in accordance with the documents referenced in the contract.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.2 **Format**. CBI Storyboards and Scripts shall be prepared in accordance with the following format requirements:

10.2.1 Storyboards and scripts shall be delivered in paper-based form and/or electronically, with the approval of the government. Storyboards and scripts delivered in an electronic format shall be compatible with government computer-based systems and software.

10.2.2 Each Storyboard/Script document shall have a cover sheet displaying the following information:

a. Document title.

b. Course identification number/course title.

c. Lesson number(s)/lesson title(s). (When more than one Storyboard/Script document must be provided because of the length of the course).

d. Contract number.

e. Contractor name and address.

f. Submission date.

10.2.3 A Table of Contents page shall follow the cover sheet. The Table of Contents shall list each storyboard and script included in the document, identified by lesson number, along with their respective page numbers.

10.2.4 All storyboards and scripts shall conform to the conventions for media development that were agreed upon by the contractor and the government in Part II of the Lesson Specifications document.

10.3 **Storyboards**. A standard storyboard format approved by the government shall be used to specify the content and configuration of each CBI frame, and to position and lead into a video still or sequence. Once approved, the format shall remain constant for the complete course. Approved formats shall have the characteristics listed below.

10.3.1 **Content Requirements.** Storyboard pages/screens shall meet the following content requirements:

Information Handling Services, 1999
August 11, 1999 10:18:24

a. Each storyboard page/screen shall contain the following information:

1) Course name and number.

2) Lesson Specification identification.

3) Lesson Specification objective number.

4) Lesson number and Segment number

5) Instructional component; the type or purpose of the material on each storyboard, such as instructional presentation, pretest, practice exercise, etc.

6) Coded references for:

a) The NEXT frame.

b) The BACK frame.

c) The HELP frame.

d) QUIT.

7) Completion date.

b. The storyboard page/screen shall contain spaces for the programmer to enter, as the programming is accomplished, the following types of information as part of the programming documentation:

1) Frame identification.

2) Authoring system file/block.

3) Graphic file(s) identification.

4) Program identification for NEXT, BACK, HELP, and QUIT, as appropriate.

5) Programmer identification.

6) Completion date.

c. The information entered on the storyboards shall be sufficient to insure that the content and configuration of all frames meets the lesson author's intent and shall adhere to the conventions document.

Information Handling Services, 1999
August 11, 1999 10:18:24

d. The center portion of the storyboard page/screen shall be a rectangle of generally the same proportions as a CRT screen. Within the rectangle shall be exactly what the lesson author wants to display for each particular frame.

e. Each frame shall contain a representation of the icon panel. Placement shall be standardized to the extent feasible.

10.3.2 **Production Notes.** The bottom area of the storyboard page shall provide space for Production Notes. The Production Notes shall provide all appropriate instructions to programmers. Classes of instructions shall include:

a. Very specific and detailed animation instructions for graphics simulations, (e.g. starting and ending configurations, timing, color changes, etc.).

b. Announcements of the specific additions being sequentially made to graphics that are built frame by frame.

c. Specific areas of each screen which must be touch sensitive, and the necessary screen response for each.

10.4 **Scripts.** For every storyboard which specifies a video sequence, with or without audio, a script shall be prepared. Scripts shall describe the required process and product to meet a video requirement as established by the storyboard sequence. Scripts shall be identified with the specific storyboard they support, and shall be attached to it. They shall be written in a form which the contractor has found to be effective with the production process, and which meets the approval of the FAA client.

10.4.1 **Content.** The script shall provide the spoken word and a description of the scene, camera directions, and audio requirements. It shall meet the information needs of production functions, such as locations, sets, casting, wardrobe, stage directions, stage properties, artwork, stock footage, and special effects.

a. Minimum requirements for video shall include:

Information Handling Services, 1999
August 11, 1999 10:18:24

1) Description of all shots, including the objectives for the sequence and the action to be photographed.

2) Details of each shot, such as close up and view from above.

3) Stage directions.

4) Editing instructions, including transitions such as fades, special effects, dissolves, and wipes.

5) Resource tapes.

6) Finished time requirements.

b. Minimum requirements for audio shall include all necessary information on the:

1) Audio track.

2) Music cuts.

3) Ambient sound.

4) Sound effects.

5) Written scripts for all narration/dialogue.

6) Narration/dialogue voice requirements.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -21

1. Title:

Video Shot List

3. Descriptio/Purpose:

The Video Shot List is a listing of video motion and still frame shots. Its purpose is to assist in the efficient organization of the required video production for computer-based instruction (CBI) training development. The descriptive information for each shot included in the Video Shot List is taken directly from the approved script; this information is then organized and sequenced in a way that will maximize production efficiency. The Video Shot List is prepared following the Storyboards/Scripts documentation.

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains the preparation instructions for the format and content of the Video Shot List.

7.2 This DID is applicable to all contract CBI course development in which still or motion video must be produced and integrated into the training material.

10. Preparation Instructions:

10.1 Reference Documents. The Video Shot List shall be prepared in accordance with the documents referenced in the contract.

10.2 Format. The Video Shot List shall be prepared in accordance with the following format requirements:

10.2.1 The Video Shot List shall be printed on 8.5" x 11" paper in either single or double page layout and bound following the contractor's commercial practice. Foldout pages may be used as required. All pages shall be numbered at the bottom center.

10.2.2 Cover. The Video Shot List shall have a cover sheet displaying the following information:

Information Handling Services, 1999
August 11, 1999 10:18:24

a. Document title.

b. Course identification number/course title.

c. Lesson number(s)/lesson title(s). (When more than one Video Shot List must be provided because of the length of the course)

d. Contract number.

e. Contractor name and address.

f. Submission date.

10.2.3 **Table of Contents.** A Table of Contents page shall follow the cover page, specifying the page number for each section of the Video Shot List. The Table of Contents shall include:

a. Introduction.

b. Summary Matrix.

c. Shot Sequences, including:

1) Shot location.

2) Shot description.

3) Audio track information.

4) Audiovisual resource material reference.

5) Graphic artwork reference.

6) Required support services and resources.

10.3 <u>Content Requirements</u>. The Video Shot List shall be prepared in accordance with the descriptions provided below:

10.3.1 **Introduction.** This section shall provide an overview of Video Shot List procedures to be used to accomplish a CBI video production. The specific content areas of the report shall be summarized, and instructions provided to facilitate effective use of the document.

10.3.2 **Summary Matrix.** A matrix or series of matrices shall be used to relate video shots to descriptive

Information Handling Services, 1999
August 11, 1999 10:18:24

and/or identification parameters which permit grouping for production efficiency, including:

a. Storyboard references.

b. Location/set.

c. Shot sequence numbers.

d. Page numbers of specific shot descriptions.

10.3.3 **Shot Sequences.** This section shall contain brief descriptive material, in storyboard reference number sequence, for each video event to be shot. The descriptive material shall be taken directly from the final script and sequenced into a concise workable document. Each sequence shall be described in terms of:

a. Shot location and/or set required.

b. Shot description, including:

1) Stills and motion sequences.

2) Angle and distance of view.

3) Stage directions.

4) Transitions.

5) Character generation requirements.

c. Audio track information. This section shall identify the audio requirements for each scene.

d. Audiovisual resource material reference. This section shall identify existing audiovisual materials to be used, including titles, control numbers, reel numbers, and Society of Motion Picture and Television Engineers (SMPTE) time codes.

e. Graphic artwork reference. This section shall identify and reference all graphic artwork to be used in the training sequences.

f. Required support services and resources. This section shall specify all special support required to accomplish shooting each video sequence.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -22

1. Title:

CBI Program Documentation

3. Description/Purpose:

Computer-Based Instruction (CBI) Program Documentation provides a detailed record of the software programming which produces the on-screen training material for each CBI training course. Its purpose is to permit programming personnel to understand the software configuration and to be able to interpret the code sufficiently so that routine maintenance and minor program modifications can be made efficiently. CBI Program Documentation pulls together some key information for programmers from other CBI material. Existing material is referenced where applicable. CBI Program Documentation is prepared at the completion of a CBI courseware project.

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains preparation instructions for the format and content of CBI Program Documentation.

7.2 This DID is applicable to all contract training developments which will produce electronically-delivered instruction. The term computer-based instruction (CBI) includes computer-based instruction, computer assisted or managed instruction, interactive videodisc (IVD), compact disc interactive (CD-I), and other advanced training technologies.

10. Preparation Instructions:

10.1 <u>Reference Documents</u>. In the preparation of CBI Program Documentation, the contractor shall adhere to the documents referenced in the contract.

10.2 <u>Format</u>. CBI Program Documentation shall be prepared in a specific format judged by the contractor to most

Information Handling Services, 1999
August 11, 1999 10:18:24

effectively facilitate understanding and usability during program maintenance and/or modification.

10.2.1 Each CBI training course shall have an individual program document which is printed on 8.5" x 11" bond paper and bound following the contractor's commercial practice. Foldout pages may be used as required. All pages shall be numbered at the bottom center.

10.2.2 All flowcharts, tables, and figures shall be drawn and reproduced so that all labels and notations are clearly readable.

10.2.3 The CBI Program Documentation shall have a cover sheet displaying the following information:

a. Document title.

b. Course identification number/course title.

c. Lesson number(s)/lesson title(s), if applicable

d. Contract number.

e. Contractor name and address.

f. Submission date.

10.2.4 A Table of Contents page shall follow the cover sheet, specifying the page numbers for all sections and for all tables and figures. The Table of Contents shall include:

a. Introduction.

b. Training System Description.

1) Hardware.

2) Authoring Language/System.

c. Program Functionality.

1) General.

2) Utilities.

3) Menu Frames.

Information Handling Services, 1999
August 11, 1999 10:18:24

4) Instructional Frames.

5) Test Frames.

6) Graphics Library.

d. Data Files.

e. Appendices.

1) Lesson Flowcharts.

2) Source Code.

10.3 Content Requirements. Each CBI training course Program Documentation shall be prepared so that a competent programmer, who is familiar with the training system hardware and with the authoring language/system, can understand all of the program functionality, and can accomplish all required program maintenance and modifications. Each document shall contain at least the following information:

10.3.1 **Introduction.** The introduction shall establish the purpose and scope of the training, and the content areas of the CBI Program Documentation.

10.3.2 **Training System Description.** This segment of the CBI Program Documentation shall describe the operating characteristics of the hardware and software with which the programmer will interact in maintaining and modifying the program. This description shall be based on the training system characteristics described in Part II of the CBI Lesson Specifications document.

10.3.2.1 Hardware. Each equipment component of the training system shall be specified and described. The descriptions shall list all of the operational features of the equipment which interact with the authoring software and/or the training program.

10.3.2.2 Authoring Language/System. The specific tool(s) used to assemble the training program shall be named and described. An authoring system which is used in its standard (unmodified) form to write the training materials need only be named or otherwise identified as to source and version. Sufficient description of a customized authoring

Information Handling Services, 1999
August 11, 1999 10:18:24

system or language shall be included to permit complete programmer understanding. If necessary for ease of reference, this material may be contained in a separate volume.

10.3.3 **Program Functionality.** This section of the document shall detail the ways in which the various components of the training program work, and how changes, if necessary, can be made to the original courseware. Program functionality shall be systematically organized to clearly portray the relationships between and among program components, and shall use verbal descriptions, flowcharts, tables, and other graphics as appropriate. Training program components shall include:

10.3.3.1 General. An overview of the complete course shall be presented. This description shall center around the Course Flowchart, and shall specify the overall configuration of the course, its inter-lesson branch points, and all sequence options. This overview shall be compiled from the CBI Lesson Specifications document and shall not require additional development.

10.3.3.2 Utilities. A detailed functional description shall be provided of each utility or subroutine. A verbal description and flowcharts shall cover at least the following topics:

a. Access - How to get to, and out of, each utility from all appropriate portions of the program.

b. Input and output parameters.

c. Applications - The ways in which each subroutine is/can be used in the training program, including a cross reference matrix of frames by utility.

d. Interrelationships - The ways in which applications of each subroutine can affect or cause a need for further modification in other portions of the program. Included here shall be all applicable conditional statements.

e. Notes - Hints and warnings, along with a description of all known bugs and the procedures for circumventing them.

Information Handling Services, 1999
August 11, 1999 10:18:24

f. Maintenance - Procedures for accomplishing all of the different modifications which may become appropriate over the life of the training materials, to include:

1) Text changes.

2) Graphics changes.

3) Menu changes.

4) Frame changes.

5) File changes.

6) Changes in the training system operation.

10.3.3.3 Menu Frames. A detailed description of all of the different menu frames utilized in the training program. All frame or screen descriptions shall include at least the following parameters:

a. Access.

b. Inputs/Outputs.

c. Applications.

d. Interrelationships.

e. Permissible responses/system responses.

f. Notes.

g. Maintenance.

10.3.3.4 Instructional Frames. A detailed description of the format and functionality of each type of instructional frame. All frame or screen descriptions shall include at least the parameters listed under Menu Frames (10.3.3.3).

10.3.3.5 Test Frames. A detailed description of the format and functionality of each type of test frame. All frame or screen descriptions shall include at least the parameters listed under Menu Frames (10.3.3.3).

10.3.3.6 Graphics Library. This section shall contain a complete listing of all the stored graphics

Information Handling Services, 1999
August 11, 1999 10:18:24

images, with instructions for retrieval and storage.

10.3.4 **Data Files.** This section shall present a comprehensive listing and description of all data files used in or with the training program. Each file shall be identified and summarized in terms of:

a. Functional description.

b. Source(s) of input data.

c. Users--the specific data called by individual routines.

d. File structure.

10.3.5 **Appendices.** The following appendices shall be included in the CBI Program Documentation:

10.3.5.1 Lesson Flowcharts. This section shall contain all of the individual lesson flowcharts in the sequence of presentation. These flowcharts, along with the Course Flowchart referenced in 10.3.3.1, shall be sufficient to depict all program components, branch points, and conditions for the development and the conduct of training. The flow chart information shall be compiled from the CBI Lesson Specifications, and shall not require additional development.

10.3.5.2 Source Code. This section shall list all global and local variables, with a description of what they do or mean. Parameters of description shall include, but not be limited to:

a. Environmental or pre-course conditions.

b. Initialization/set up procedures.

c. Inputs and outputs.

d. Conditional events.

e. Any out-of-the-ordinary situation.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -23

1. Title:

Interactive Courseware for Training Devices

3. Description/Purpose:

This data item description (DID) documents the requirements for deliverables that are developed as part of the interactive courseware for a training device. A series of deliverables are described in this DID: lesson specifications, testing, validation plan and report, video treatments, storyboards and scripts, video shot list, interactive courseware, and courseware documentation. The contents of this DID will be used to monitor the development process for the interactive courseware, to assess its instructional effectiveness, and to determine the adequacy with which the government's requirements have been met.

7. Application/Interrelationship:

7.1 This DID contains the preparation instructions for the format and content of interactive courseware for training devices.

7.2 This DID is applicable to all supporting documentation and electronically delivered courseware, for a training device, that is developed by a contractor. The term "electronically delivered" shall include computer-aided instruction, computer-assisted instruction, computer-based instruction/training, interactive videodisc (IVD), compact disc interactive (CD-I), and other advanced technologies.

10. Preparation Instructions:

10.1 Reference Documents. The deliverables cited in this DID shall be prepared in accordance with the documents referenced in the contract. This DID is related to Computer-Based Instruction (CBI) DIDs 16 through 22.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.2 Format. The interactive courseware deliverables for a training device shall be prepared in accordance with the following format guidelines:

10.2.1 **Lesson Specifications.** Paragraphs 10.2.1, 10.2.2 10.2.3, and 10.2.4 of DID 16 shall apply.

10.2.2 **Testing.** Paragraphs 10.2.1, 10.2.2, 10.2.3, and 10.2.4 of DID 17 shall apply.

10.2.3 **Validation Plan and Report.** Paragraphs 10.2.1, 10.2.2, and 10.2.3 of DID 18 shall apply.

10.2.4 **Video Treatments.** Paragraphs 10.2.1, 10.2.2, 10.2.3, and 10.2.4 of DID 19 shall apply for interactive courseware that requires video sequences.

10.2.5 **Storyboard and Scripts.** Paragraphs 10.2.1, 10.2.2, 10.2.3, and 10.2.4 of DID 20 shall apply. Storyboards shall be developed for all interactive courseware. Scripts shall be developed for interactive courseware that requires video sequences.

10.2.6 **Video Shot List.** Paragraphs 10.2.1, 10.2.2, and 10.2.3 of DID 21 shall apply for interactive courseware that requires video sequences.

10.2.7 **Program Documentation.** Paragraphs 10.2.1, 10.2.2, 10.2.3, and 10.2.4 of DID 22 shall apply.

10.3 Content. The interactive courseware deliverables for a training device shall be prepared in accordance with the following content guidance:

10.3.1 **Lesson Specifications:** Paragraphs 10.3.1 through 10.3.12 of DID 16 shall apply. In addition, the following specifications shall be followed:

10.3.1.1 The presentation of content shall progress from the known to the unknown and from the simple to the complex. Relevant learning must be recalled.

10.3.1.2 The presentation of content shall be consistent with the course design guide (CDG) sequence of training, when a CDG was developed as training deliverable for a contract. If any deviation from the CDG sequence is proposed, then the rationale

Information Handling Services, 1999
August 11, 1999 10:18:24

shall be provided to the FAA for review and approval.

10.3.1.3 Content shall be presented in segments that are a reasonable size for recall and application.

10.3.1.4 Learning and application shall be integrated. Training shall emphasize immediate application of new skills and build on skills that were previously learned.

10.3.1.5 The courseware shall be task based. Performance scenarios shall permit application and integration of skills in job relevant scenarios.

10.3.1.6 The instructional management capabilities of the training device software to track student use and performance shall be documented. At a minimum, the instructional management capabilities shall include the ability to track and record performance for each student, by name, on a single test item and for each component of a scenario.

10.3.1.7 Any hardware, software, or authoring system characteristics that may impact the ability of a site to update courseware shall be documented when site-specific training capabilities are a contract requirement.

10.3.1.8 Any supporting materials such as student materials, instructor guides, and quick reference cards shall be identified and their use explained. The proposed format, structure, and content of the supporting materials shall be submitted for government review and approval. Draft and final copies of supporting materials shall be delivered in a format that can be reproduced cost-effectively by the government. The proposed number of copies to be provided per student and training device shall be submitted to the government for approval.

10.3.2 **Testing.** Paragraphs 10.3.1, 10.3.2, 10.3.3, 10.3.4, 10.3.5, and 10.3.6 of DID 17 shall apply.

10.3.3 **Validation Plan and Report.** Paragraphs 10.3.1, 10.3.2, and 10.3.3, and 10.4 of DID 18 shall apply.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.3.4 **Video Treatments.** Paragraphs 10.3.1, 10.3.2, and 10.3.3 of DID 19 shall apply for interactive courseware that requires video sequences.

10.3.5 **Storyboard and Scripts.** Paragraphs 10.3.1, 10.3.2, 10.4, and 10.4.1 of DID 20 shall apply. Storyboards shall be developed for all interactive courseware. Scripts shall be developed for interactive courseware that requires video sequences.

10.3.6 **Video Shot List.** Paragraphs 10.3.1, 10.3.2, and 10.3.3 of DID 21 shall apply for interactive courseware that requires video sequences.

10.3.7 **Program Documentation.** Paragraphs 10.3.1 through 10.3.5.2 of DID 22 shall apply.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -24

1. Title:

Video Courseware

3. Description/Purpose:

The Video Courseware data item description (DID) documents the information that the government needs to evaluate the contractor's decisions concerning the content, treatment, and organization of video courseware. This DID contains the documentation for the following deliverables: video lesson specifications, video treatments, video scripts and storyboards, video shot list, and draft and final copies of the video courseware. Each deliverable represents a building block in the process of developing the final video courseware. Guidance is also provided in this DID for the development of written material, such as an information booklet, to support a video tape.

7. Application/Purpose:

7.1 This DID contains the preparation instructions for the format and content of Video Courseware deliverables.

7.2 This DID is applicable to all contract training development that will use video tape as a delivery medium for instruction. A methods and media analysis shall be conducted prior to making the decision to use video during training. For guidance on the preparation of interactive video disc courseware, see DIDs 16 through 22 of FAA-STD 028B.

10. Preparation Instructions:

10.1 Reference Documents. Video courseware deliverables shall be prepared in accordance with the documents referenced in the contract and the approved Course Design Guide (CDG).

10.2 Format. Text-based, Video Courseware deliverables shall be prepared in accordance with the following format requirements:

Information Handling Services, 1999
August 11, 1999 10:18:24

10.2.1 Each of the text-based deliverables shall be provided on 8.5" x 11" bond paper and bound following the contractor's commercial practice. Foldout pages may be used as required. All pages shall be numbered at the bottom center.

10.2.2 All text-based, Video Courseware deliverables shall have a cover sheet displaying the following information:

a. Document title.

b. Course identification number/course title.

c. Lesson number(s)/lesson title(s).

d. Contract number.

e. Contractor name and address.

f. Submission date.

10.2.3 Table of Contents page shall follow the cover sheet. For each text-based deliverable, the Table of Contents shall specify the major paragraphs and page numbers that correspond to the Content Requirements in paragraph 10.3 of this DID. Any supporting figures and tables shall also be listed.

10.2.4 One inch beta cam, or its equivalent, shall be used for production of the master video tape. The production format for final copies and the number of copies required shall be in accordance with the specifications of the contract. Draft and final video tapes shall be labeled with the following information:

a. Video title.

b. Course title.

c. Lesson numbers(s).

d. Contractor name.

e. Submission date.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.3 Content Requirements. Each deliverable shall be prepared in accordance with the following requirements:

10.3.1 **Lesson Specifications.** The Lesson Specifications shall provide the transition from the analysis phase to the design and production of the draft video courseware. The following information shall be provided:

a. Introduction to the Courseware. A brief overview of the purpose and expected application of the courseware for both the video tape, and any supporting materials, shall be provided.

b. Course/Lesson Prerequisites. The prerequisite experience or training of the target audience shall be documented.

c. Lesson Content. The terminal and enabling objectives to be achieved for each video courseware lesson or topic shall be provided. These objectives shall also be documented in the course design guide.

1) A brief overview of the purpose, key points, expected application of each lesson or topic area, and how it is related to other lessons and topics shall be provided. The estimated time requirements for each lesson or topic, and the video tape as a whole, shall also be provided.

2) Each video tape lesson or topic shall teach from the known to the unknown, and from the simple to the complex. Key points shall be summarized at the end of each lesson or topic. Visual material shall accompany and expand upon each key point. Video segments shall be short as possible while still achieving the terminal and enabling learning objectives.

d. Supporting Instructional Material. Information on any supplementary material needed to support the video tape, such as an information booklet or manual, shall be documented. The purpose and structure of the supporting material shall be explained and the content shall be discussed. A sample shall be made available for government review and comment which illustrates the level of detail and layout of the supporting material. Complete draft and final supporting material shall be delivered in a format

Information Handling Services, 1999
August 11, 1999 10:18:24

that can be reproduced cost-effectively by the government. The supporting instructional material shall provide, at a minimum, the following information for the student.

1) The relationship of the supporting material to the video tape and how the supporting material will be used.

2) Definition of key words and acronyms used in the video tape and supporting material.

3) An outline of key points for each lesson or topic covered in the video tape.

4) Self-checks to assess retention of key points.

5) Diagrams, charts, and illustrations needed to facilitate comprehension and retention of key information.

6) Information on any academic test procedures. See paragraph 10.3.1.e, below.

7) The individual to contact for further information or assistance.

e. Testing. An overview of any hands-on or written tests to be developed as part of the Video Courseware shall be provided. These may include pretests, progress tests, and posttests. All tests shall be developed in accordance with DID-8.

f. Presentation System Software or Hardware. The type of equipment needed to play the overview courseware shall be documented.

g. Validation. The contractor's plan for validating the draft video tape and supporting material shall be documented. Any key milestones at which the contractor requires feedback from the government shall be provided. These milestones shall include information as to expected government participation and responsibilities during shooting, off-line editing, and on-line editing.

10.3.2 **Video Treatments.** The video treatments shall describe the approach to be taken for each lesson or topic containing video. Each treatment shall describe the "look and feel" of a single video

Information Handling Services, 1999
August 11, 1999 10:18:24

segment and shall focus on a central theme which is consistent throughout the video tape. The following information shall be provided:

a. A description of the visual content and theme of each video segment for each lesson or topic to be covered. This description shall include the overall approach to each video segment and how continuity shall be maintained.

b. A narrative description of the set and/or location to be used and the equipment/facilities required.

c. A narrative description of the action.

d. Any special effects anticipated.

e. Estimated running time.

f. Video source, if existing footage is to be used.

10.3.3 **Video Storyboards and Scripts.** The storyboards shall provide a complete description of the visual content, often in the form of sketches of the video scenes. The storyboards also document any production notes or special instructions. The scripts shall document all narration and dialogue as well as the audio requirements. The following information shall be provided:

a. A list of any conventions to be followed throughout the video courseware, e.g., natural breaks and transitions between lessons and topics.

b. A visual and/or narrative description of each video segment. The information provided shall be adequate to ensure that the content and organization of each video sequence meets the purpose of the terminal and enabling objectives.

c. Any production notes such as the locations, sets, casting, stage directions, stock footage, and special effects; the details of each shot, such as close-up and view from above; and the editing instructions, including transitions such as fades and dissolves.

d. Special support required to accomplish shooting each video segment.

e. Written scripts for all narration and/or dialogue.

Information Handling Services, 1999
August 11, 1999 10:18:24

f. Narration and dialogue voice requirements.

g. Information on music cuts, ambient sound, and sound effects.

10.3.4 **Video Shot List.** The video shot list shall document all video motion and still frame shots. The descriptive information for each shot shall be taken directly from the approved storyboard and scripts deliverable. In the video shot list deliverable, this information shall be organized and sequenced in a way that will maximize production efficiency. The video shot list shall be prepared in accordance with the information provided below:

a. Introduction. An overview of the video shot list procedures to be used to accomplish the video production shall be documented.

b. Summary Matrix. A matrix or series of matrices shall be provided which relates video shots to descriptive and/or identification parameters and which permits grouping for production efficiency, including:

1) Storyboard references.

2) Location/set.

3) Shot sequence numbers.

4) Page numbers of specific shot descriptions.

c. Shot Sequences. Brief descriptive material shall be provided, in storyboard reference number sequence, for each video segment to be shot. The descriptive material shall be taken from the final storyboard and script deliverable and sequenced into a concise workable document. Each segment shall be described in terms of:

1) Shot location and/or set required.

2) Shot description, including:

a) Stills and motion sequences.

b) Angle and distance of view.

c) Stage directions.

Information Handling Services, 1999
August 11, 1999 10:18:24

d) Transitions.

3) Audio track information. The audio requirements for each scene shall be identified.

4) Audiovisual resource material. Existing audiovisual materials to be used, including titles, control numbers, reel numbers, and Society of Motion Picture and Television Engineers (SMPTE) time codes shall be documented.

5) Graphic artwork reference. All graphic artwork to be used in the training sequences shall be documented.

6) Required support services and resources. All special support required to accomplish shooting each video sequence shall be documented.

10.3.5 **Video Courseware.** The video courseware, including all supplementary instructional material, shall be provided as a draft for government review and comment. The government's recommendations for improvement shall be incorporated into the final copies of the video tape and supporting material. The video tape and supporting material shall be further revised when any changes to training materials, during training development for a contract, impact the instructional content.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -25

1. Title:

Developmental Tryout

3. Description/Purpose:

This DID provides the minimum requirements for the materials to be used and the procedures to be followed during the developmental tryout(s) of a course. A development tryout is an assessment of the effectiveness of the instructional materials when they are in a semi-finished or draft form. The materials are presented to representatives of the target population, in a training environment, for their use and comment. Information obtained from the developmental tryout(s) is used to improve the instructional effectiveness of the materials prior to the operational tryout of a course.

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains the instructions for preparing for and performing the developmental tryout.

7.2 This DID is applicable to all contract training development efforts.

10. Preparation Instructions:

10.1 Reference Documents. The developmental tryout shall be prepared and conducted in accordance with the documents referenced in the contract and the Course Design Guide (CDG).

10.2 Format. All course materials developed for the developmental tryout shall meet the minimum format requirements specified in the DIDs associated with these materials. All other materials developed for, or as a result of, the developmental tryout shall be delivered on 8.5" x 11" bond paper. Foldout pages may be used as necessary. All pages shall be numbered at the bottom center.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.3 Content Requirements. The developmental tryout shall be prepared and conducted in accordance with the following descriptions:

10.3.1 **Participants.** The following personnel shall attend the developmental tryout:

a. Contractor personnel with responsibility for the design and development of the course shall be available during the developmental tryout to answer questions about the course. Available contractor personnel shall include:

1) Instructor(s).

2) Developer(s).

3) Appropriate subject matter experts.

b. FAA representatives shall include:

1) The FAA COTR.

2) Subject matter expert(s).

3) Instructional Systems Design Specialist(s).

4) Members of the target population.

10.3.2 **Agenda.** The contractor shall draw up an agenda for the developmental tryout. The agenda shall be submitted to the FAA for approval prior to the developmental tryout.

10.3.3 **Availability of Materials.** Draft versions of course materials to be used during the developmental tryout shall be made available to the FAA for prior review and approval. These course materials may include, but are not limited to, the course schedule, lesson plans, tests, student materials, and media material.

10.3.4 **Materials Tryout.** The contractor shall present to the representatives of the target population the course materials as they would be used in the course.

10.3.5 **Materials Review.** A review of draft materials developed for a course shall be conducted following the developmental tryout. Each review

Information Handling Services, 1999
August 11, 1999 10:18:24

shall be presented in enough detail and depth so that the integration and effectiveness of the instructional materials, learning sequence, performance exercises, tests, and the time allocations can be fully assessed by the FAA.

10.3.6 **Minutes.** The contractor shall record the minutes during the developmental tryout. The minutes shall include, but not be limited to:

a. The date of the developmental tryout.

b. The course identification number/course title.

c. Titles of lessons in the course.

d. Titles of the presented course materials.

e. Names, organizations, and phone numbers of all participants.

f. All activities that took place during the developmental tryout.

g. All comments made by the FAA and contractor personnel.

10.3.7 **Materials Evaluation.** Once the developmental tryout has occurred, the contractor shall score any tests given during the tryout and assess the effectiveness of the course materials based on student performance and comments made by the other attending FAA representatives.

10.3.8 **Follow-up Activities.** Following the developmental tryout, the contractor shall submit a letter to the FAA with the:

a. Agenda and minutes of the developmental tryout.

b. Results of the developmental tryout and the follow-up review of materials.

c. Proposed revisions to the course based on the FAA's comments, student performance during the developmental tryout, and the follow-up review of materials.

d. Schedule for accomplishing each proposed revision, with an indication of which revisions shall be

Information Handling Services, 1999
August 11, 1999 10:18:24

completed before the next developmental tryout or the Course Walk-Through.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -26

1. Title:

Course Walk-Through

3. Description/Purpose:

This DID provides the minimum requirements for the materials for, and the procedures to follow during, the Course Walk Through. The Course Walk-Through is an overview of each component of a course.

7. Application/Interrelationship:

7.1 This Data Item Description (DID) contains the instructions for preparing for and performing the Course Walk-Through.

7.2 This DID is applicable to all contract training development efforts.

10. Preparation Instructions:

10.1 **Reference Documents.** The Course Walk-Through shall be prepared and conducted in accordance with the documents referenced in the contract and the Course Design Guide (CDG).

10.2 **Format.** All course materials developed for the Course Walk-Through shall meet the minimum format requirements specified in the DIDs associated with these materials. All other materials developed for, or as a result of, the Course Walk-Through shall be delivered on 8.5" x 11" bond paper. Foldout pages may be used as necessary. All pages shall be numbered at the bottom center.

10.3 **Content Requirements.** The Course Walk-Through shall be prepared and conducted in accordance with the following descriptions:

10.3.1 **Participants.** The following personnel shall attend the Course Walk-Through:

Information Handling Services, 1999
August 11, 1999 10:18:24

a. Contractor personnel with responsibility for the design and development of the course shall be available during the walk-through to answer questions about the course. Available contractor personnel shall include:

1) Instructor(s).

2) Developer(s).

3) Appropriate subject matter experts.

b. FAA representatives shall include:

1) The FAA COTR.

2) Subject matter expert(s).

3) Instructional Systems Design Specialist(s).

10.3.2 **Agenda.** The contractor shall draw up an agenda for the Course Walk-Through. The agenda shall be submitted to the FAA for approval prior to the Course Walk-Through.

10.3.3 **Availability of Materials.** Revised draft versions of all materials associated with the course, including, but not limited to, the course schedule, lesson plans, tests, student materials, and media material, shall be made available to the FAA for approval prior to the Course Walk-Through.

10.3.4 **Presentations.** The contractor shall present a shortened version of each lesson during the Course Walk-Through. Each lesson shall be presented in enough detail and depth so that the integration and effectiveness of the instructional materials, learning sequence, performance exercises, tests, and the time allocations can be fully assessed by the FAA.

10.3.5 **Minutes.** The contractor shall record the minutes during the Course Walk-Through. The minutes shall include, but not be limited to:

a. The date of the Course Walk-Through.

b. The course identification number/course title.

c. Titles of lessons in the course.

Information Handling Services, 1999
August 11, 1999 10:18:24

d. Names, organizations, and phone numbers of all participants.

e. All activities that took place during the Course Walk-Through.

f. All comments made by the FAA and contractor personnel.

10.3.6 **Follow-up Activities.** Following the course walk-through, the contractor shall submit a letter to the FAA with the:

a. Agenda and minutes of the course walk-through.

b. Proposed revisions to the course based on the FAA's comments during the course walk-through.

c. Schedule for accomplishing each proposed revision, with an indication of which revisions shall be completed before validation of the course.

Information Handling Services, 1999
August 11, 1999 10:18:24

DATA ITEM DESCRIPTION (DID) -27

1. Title:

First Course Conduct and Course Report

3. Description/Purpose:

This DID establishes the minimum requirements for the Course Validation Plan, first course conduct, and the Course Report. The Validation Plan for the first course conduct must be submitted and approved by the FAA COTR prior to validation. Developmental tryouts prior to the first course conduct are also recommended. The results of the first course conduct are documented in the Course Report.

7. Application/Interrelationship:

7.1 This Data Item Description (DID) documents the format and content requirements for validation deliverables.

7.2 This DID is applicable to all contract training development efforts except validation of stand-alone, Computer-Based Instruction (CBI) courseware. Validation of CBI courseware shall be conducted in accordance with DID-18.

10. Preparation Instructions:

10.1 **Reference Documents**. The instructional materials to be used during the conduct of the validation shall be prepared in accordance with the documents referenced by the contract and the Course Design Guide (CDG).

10.2 **Format**. The validation materials shall be prepared in accordance with the following format requirements:

10.2.1 The Validation Plan shall conform to the following format requirements:

10.2.1.1 The Validation Plan shall be delivered on 8.5" x 11" bond paper and bound following the contractor's commercial practice. Foldout pages may be used as required. All pages shall be numbered at the bottom center.

Information Handling Services, 1999
August 11, 1999 10:18:24

10.2.1.2 The Validation Plan shall have a cover sheet displaying the following information:

a. Document title.

b. Course identification number/course title.

c. Contract number.

d. Contractor name and address.

e. Submission date.

10.2.1.3 A Table of Contents for the Validation Plan shall follow the cover sheet. The Table of Contents shall list all significant headings used in the plan and the page numbers. Sufficient detail shall be included to permit direct location of any segment of the plan. The Table of Contents shall include:

a. Introduction.

b. Validation Schedule.

c. Methodology.

d. Examples of data collection forms.

10.2.1.4 The data collection forms shall each contain heading information to be filled in. The heading information shall allow for the identification of the course and identification of the individual filling out the form. All data collection forms shall be delivered to the FAA COTR, for approval prior to use, on 8.5" x 11" bond paper and bound following the contractor's commercial practice.

10.2.2 **Conduct of the Course.** All instructor and student materials used during the first course conduct shall conform to the formats specified in the associated DID's and the contract.

10.2.3 **Course Report.** A Table of Contents for the Course Report shall follow the cover sheet. The Table of Contents shall include the:

a. Introduction.

b. Training outcomes.

Information Handling Services, 1999
August 11, 1999 10:18:24

c. Class data.

d. Comments.

e. Test data.

f. Recommended revisions.

g. Supporting documentation.

h. Official roster.

10.3 Content Requirements. The contents of validation materials shall be prepared in accordance with the descriptions provided below:

10.3.1 **Validation Plan.** The contents of the Validation Plan shall be as follows:

10.3.1.1 **Introduction.** The Introduction section shall briefly discuss the overall validation process and the procedures to be used to determine the effectiveness of the course. The Introduction shall describe all significant limitations and constraints which have influenced the Plan or which will impact the validation results.

10.3.1.2 **Validation Schedule.** The schedule for validation shall cover tryouts of the course under instructional conditions that are as close as possible to the conditions under which the actual course will be conducted. An overall schedule of validation events shall be presented. This schedule shall establish the timeframe and location(s) for the validation.

10.3.1.3 **Methodology.** Each tryout identified on the validation schedule shall be described in terms of the:

a. Purpose of the validation.

b. Expected training outcomes.

c. Validation process to be used.

d. Resources required including equipment, subjects, observers/data collectors, facilities, and time.

Information Handling Services, 1999
August 11, 1999 10:18:24

e. Evaluation materials required, including instructions for all participants.

10.3.1.4 **Data Collection Forms.** Examples of all data collection forms and instruments shall be provided for FAA review and approval prior to use.

10.3.2 **Conduct of the Course.** The following materials shall be provided and used during the first course conduct:

a. Student Materials.

b. Lesson Plans.

c. Instructor Checklists.

d. Lesson Evaluation Checklists.

e. Student Critique Sheets.

f. End-of-Course Evaluation Questionnaires.

10.3.2.1 **Student Materials.** The contractor shall provide copies of all student materials to each student in the course.

10.3.2.2 **Lesson Plans.** The contractor shall supply the FAA representatives attending the first course conduct with copies of the lesson plans for the course. FAA representatives attending the first course conduct will include:

a. The FAA COTR.

b. Subject matter specialist(s).

c. Instructional systems design specialists.

10.3.2.3 **Instructor Checklists.** The Instructor Checklists shall allow the course instructors to evaluate the course lesson-by-lesson. The Instructor Checklists shall be completed by the course instructors at the completion of each lesson. The Instructor Checklists shall contain items which address instructor concerns. An example of an Instructor Checklist appears in Figure 27-1 of this DID.

10.3.2.4 **Lesson Evaluation Checklists.** The contractor shall provide the FAA representatives attending

Information Handling Services, 1999
August 11, 1999 10:18:24

the course with lesson evaluation checklists. The Lesson Evaluation Checklists shall allow the FAA representatives attending the course to evaluate each lesson as it is presented. An example of a Lesson Evaluation Checklist appears in Figure 27-2 of this DID.

10.3.2.5 **Student Critique Sheets.** The Student Critique Sheets shall allow the students participating in the first course conduct to evaluate each lesson after it is presented. The contractor shall fill in the administrative information on the critique sheet for the students. The administrative information shall include the instructor name, course title and number, lesson title and number, and the date of the validation. An example of a Student Critique Sheet appears in Figure 27-3 of this DID.

10.3.2.6 **End-of-Course Evaluation Questionnaires.** The End-of-Course Evaluation Questionnaires shall allow the students to evaluate the course overall. Each student shall fill out a questionnaire. Figure 27-4 of this DID shows a sample questionnaire that is appropriate for an equipment-oriented course. A sample questionnaire for a non-equipment oriented course is shown in Figure 27-5 of this DID.

10.3.3 **Course Report.** The sections of the Course Report shall be prepared in accordance with the descriptions provided below:

10.3.3.1 **Introduction.** The Introduction shall include:

a. Course number and title.

b. Class number.

c. Course description, including:

1) Brief overview of the course.

2) Total time scheduled for the new course.

3) Course prerequisites by course number and title.

10.3.3.2 **Training Outcomes.** The training outcomes section, an example of which appears in Figure 27-6, shall include:

Information Handling Services, 1999
August 11, 1999 10:18:24

a. Training outcomes for the course.

b. Lesson plan title(s) and number(s) supporting each enabling objective.

c. Estimated and actual times for completing each training outcome, terminal objective, and lesson plan.

10.3.3.3 Class Data. The class data section shall contain:

a. Beginning and ending dates of the course.

b. Class Roster (names of students in attendance).

c. Number of students in attendance.

d. Number of students meeting course prerequisites.

e. Daily class schedule for resident classes.

10.3.3.4 Comments. The Comments section shall include summaries of comments of students, instructors, and FAA representatives attending the course. These summaries shall include:

a. Summary of the information in the completed lesson Evaluation Checklists completed by the FAA representatives.

b. Summary of the information in the completed Instructor(s) Checklists.

c. Summary of the information in the completed Student Critiques.

d. Summary of the information in the End-of-Course Questionnaires completed by students who meet course prerequisites.

e. Summary of the information in the End-of-Course Questionnaires completed by students who do not meet course prerequisites.

10.3.3.5 Test Data. The Test Data section shall include information about each graded test presented in the course. The Test Data section shall be subdivided into two subsections:

Information Handling Services, 1999
August 11, 1999 10:18:24

a. Test Data Listing (Figure 27-7 of this DID shows an appropriate format for this subsection), in which each graded test is listed by name, with information concerning the:

1) Type of test (pretest, progress test, and post-test) for both written and performance tests.

2) Class average (mean in percent) for students who meet course prerequisites and for students who do not meet prerequisites.

3) Range of scores (in percent) for students who meet course prerequisites and for students who do not meet prerequisites.

4) Number of students meeting the passing criteria, if applicable.

b. Ease Index (Figure 27-8 of this DID shows an appropriate format for this subsection), for each tested item for two categories of students, those who meet course prerequisites and those who do not meet prerequisites. The Ease Index of an item is the number of correct responses for the item divided by the number of students responding to the item.

10.3.3.6 **Recommended Revisions.** The Recommended Revisions section shall contain a list of recommended revisions to the course, listed by lesson title and number and in the order in which the lessons were presented. The Recommended Revisions section shall also contain a timeline for accomplishing each recommended revision. The recommended revisions shall address, but are not limited to, the following areas:

a. Course organization and content.

b. Instructional methods and media.

c. Instructor capabilities.

d. Instructional materials, including instructor and student materials.

e. Facilities and equipment.

10.3.3.7 **Supporting Documentation.** All supporting documentation shall be turned over to the FAA, in

Information Handling Services, 1999
August 11, 1999 10:18:24

its original form, as part of the Course Report. Supporting documentation shall include all completed:

a. Instructor Checklists.

b. Lesson Evaluation Checklists.

c. Student Critiques.

d. End-of-Course Evaluation Questionnaires.

e. Original Student Achievement Tests.

10.3.3.8 Official Roster. The Official Roster shall contain the names of the students attending the course and a grade for each student. The Official Roster is generated by the Consolidated Personnel Management Information System (CPMIS) and shall be supplied by the FAA.

Information Handling Services, 1999
August 11, 1999 10:18:24

DID 27, FIGURE 1, SAMPLE INSTRUCTOR CHECKLIST

INSTRUCTOR CHECKLIST (FOR CONTRACTOR USE)

INSTRUCTOR _____ COURSE _____ COURSE NO. _____

LESSON TITLE _____ LESSON NO. _____ DATE _____

The instructor checks "Yes" or "No" for each item during the first course conduct. Use "Comments" column for notes which prove useful if revision to the lesson is necessary. Recommend appropriate revision for any item marked "No".

	YES	NO	COMMENTS
Is the subject outline in the lesson plan easy to follow?	☐	☐	
Are the instructions for conducting performance exercises clear and complete?	☐	☐	
Are the instructions for administering the tests clear and complete?	☐	☐	
Does the lesson plan reference all materials and equipment needed to conduct the lesson?	☐	☐	
Is the equipment for the lesson available and accessible?	☐	☐	
Are the training aids –	☐	☐	
• readable and easy to understand?	☐	☐	
• easy to use?	☐	☐	
Do visuals correspond with the numbers in the lesson plan?	☐	☐	
Do the response items challenge the students?	☐	☐	
Are the instructional materials –	☐	☐	
• adequate to support the objectives?	☐	☐	
• written at an appropriate level for the students?	☐	☐	
Do the instructional strategies –	☐	☐	
• encourage student participation?	☐	☐	
• make effective use of the media?	☐	☐	
Are the learning activities safe?	☐	☐	
Is the sequence of the lesson logical?	☐	☐	
Is the time for conducting the lesson adequate?	☐	☐	
Is the lesson objective(s) achieved?	☐	☐	

Information Handling Services, 1999
August 11, 1999 10:18:24

DID 27, FIGURE 2, SAMPLE VALIDATION CHECKLIST

LESSON EVALUATION CHECKLIST (FOR FAA USE)

REVIEWER _____ POSITION TITLE _____

INSTRUCTOR _____ COURSE _____ COURSE NO. _____

LESSON TITLE _____ LESSON NO. _____ DATE _____

FAA representative in attendance at the first course conduct checks "Yes" or "No" for each item. Use "Comments" column for notes which prove useful if revision to the lesson is necessary. Recommend appropriate revision for any item marked "No".

	YES	NO	COMMENTS
Does each student have a copy of the materials?	☐	☐	
Are reference materials available?	☐	☐	
Is equipment available and accessible?	☐	☐	
Is the space for student adequate?	☐	☐	
Does the instructor –			
• show enthusiasm?	☐	☐	
• demonstrate mastery of the subject?	☐	☐	
• use training aids/equipment effectively?	☐	☐	
• ask timely questions?	☐	☐	
• use positive reinforcement?	☐	☐	
Do the visuals match the presentation?	☐	☐	
Are visuals readable and easy to understand?	☐	☐	
Are safety precautions observed?	☐	☐	
Are test stored securely?	☐	☐	
Do the majority of students participate?	☐	☐	
Is the sequence of the lesson logical?	☐	☐	
Is the lesson well paced?	☐	☐	
Is the lesson objective(s) achieved?	☐	☐	

Information Handling Services, 1999
August 11, 1999 10:18:24

DID 27, FIGURE 3, SAMPLE STUDENT CRITIQUE SHEET

STUDENT CRITIQUE SHEET

INSTRUCTOR _____ **COURSE** _____ **COURSE NO.** _____

LESSON TITLE _____ **LESSON NO.** _____ **DATE** _____

- Students complete this questionnaire for each lesson in the first course conduct.
- Please comment on each of the items below. Your feedback is important for determining the effectiveness of the lesson.

Is this lesson relevant to your job? Will this lesson help you perform your job better?

Is there a balance between theory and practice in this lesson?

Are the training aids in this lesson effective? (Readable? Understandable? Appropriate to the presentation?)

Is there enough opportunity in this lesson to participate? (Discussion, questioning, student-student interaction, small group work, hands-on exercises, etc.)

Is there anything in this lesson that you would like changed? How would you change it?

Is this lesson objective(s) achieved?

Information Handling Services, 1999
August 11, 1999 10:18:24

DID 27, FIGURE 4, SAMPLE END-OF-COURSE EVALUATION QUESTIONNAIRE (EQUIPMENT)

Employee's Name	Period of Training
Out-of-Agency Course	Contractor

In order that we may use your experience, we would appreciate your comments on the above training. These will assist us in evaluating contractor performance and the validity of contract specifications.

If sufficient space is not provided for your comments, please attach a separate sheet. Your responses will in no way affect or be reflected on your training record.

ELEMENTS	Yes A	No B	See Remarks C	Does Not Apply D
TRAINING OUTCOMES:				
1. Were you given training outcomes or objectives at the course introduction?				
2. Were you given objectives with each lesson/module?				
3. Were you given objectives with the hands-on exercises?				
CONCEPTS TRAINING:				
4. Were you given general equipment concepts?				
5. Were you taught specific equipment concepts?				
6. Were you taught normal equipment operation?				
7. Were you taught abnormal equipment operation?				
8. Were you taught the use of technical manuals?				
9. Were you taught the use of Operator manuals?				
10. Were you taught concepts of built-in test equipment?				
11. Did concept training teach off-line test equipment?				
12. Did the concept training teach diagnostic routines?				
13. Did the concept training teach operational program?				
14. Did the concept training teach preventive maintenance requirements?				
15. Did the concept training teach corrective maintenance?				
TRAINING MATERIALS:				
16. Were training materials job related?				
17. Were training materials useful for self-study?				
18. Were training materials sequenced or in order of the topics?				
19. Were training materials useful to class work?				
20. Were training materials useful in lab/hands-on?				
21. Were training materials free of errors?				
22. Were training materials closely related to subject being taught?				

Information Handling Services, 1999
August 11, 1999 10:18:24

DID 27, FIGURE 4, SAMPLE END-OF-COURSE EVALUATION QUESTIONNAIRE (EQUIPMENT) (CONTINUED)

ELEMENTS	Yes A	No B	See Remarks C	Does Not Apply D
HANDS-ON TRAINING:				
23. Did hands-on training teach System power-up/start?				
24. Did hands-on training teach System power-down/stop?				
25. Did hands-on training teach preventive maintenance tasks?				
26. Did hands-on training teach use of built-in test equipment?				
27. Did hands-on training teach use of off-line test equipment?				
28. Did hands-on training teach fault isolation to board/module level?				
29. Did hands-on training teach fault isolation to software/firmware level?				
30. Did hands-on training teach fault isolation to piece/part level?				
31. Can you now (with references), do preventive tasks?				
32. Can you now (with references), make essential adjustments?				
33. Can you now (with references), set up test equipment?				
34. Can you now (with references), use diagnostic routines?				
35. Can you now (with references), power-up/start system?				
36. Can you now (with references), power-down/stop system?				
37. Can you correctly determine that system operation is normal?				
38. Can you correctly identify controls?				
39. Can you correctly identify indicators?				
40. Can you correctly interpret monitor/indicator readouts?				
41. Can you isolate malfunctions?				
42. Were hands-on exercises tied into concepts training?				
43. Were hands-on exercises supervised?				
44. Were hands-on exercises derived from tech. manual content?				
45. Were hands-on exercises individually performed?				
46. Were hands-on exercises directly related to the job task?				
47. Were hands-on exercises graded or evaluated?				
48. Did hands-on exercises reinforce a concept or job task?				
TIME ALLOCATION:				
49. Was there sufficient time allotted to concepts?				
50. Was sufficient time allotted to hands-on?				
51. Was excessive time allotted to concepts?				
52. Was excessive time allotted to hands-on?				
TESTS:				
53. Were the tests based on the training lesson objectives?				
54. Did the tests include performance testing?				
55. Did the tests include fault isolation?				

Information Handling Services, 1999
August 11, 1999 10:18:24

DID 27, FIGURE 4, SAMPLE END-OF-COURSE EVALUATION QUESTIONNAIRE (EQUIPMENT) (CONTINUED)

ELEMENTS	Yes A	No B	See Remarks C	Does Not Apply D
ENVIRONMENT:				
56. Was the lighting adequate in the classroom?				
57. Was the ventilation adequate in the classroom?				
58. Was the noise level kept low in the classroom?				
59. Was the classroom kept clean?				
60. Was laboratory lighting adequate?				
61. Was laboratory ventilation adequate?				
62. Was laboratory noise level controlled?				
63. Was the equipment in the lab in good condition?				
64. Were good safety practices used in the laboratory?				
INSTRUCTOR PERFORMANCE:				
65. Was the instructor prepared for the lesson/module?				
66. Did the instructor cover all topics?				
67. Did the instructor direct learning activities?				
68. Did the instructor control the class?				
69. Did the instructor provide feedback to you on your progress?				
70. Did the instructor provide you with the supervised study?				
71. Did the instructor answer all questions?				
72. Did the instructor explain training outcomes/objectives?				
Was the instructor knowledgeable in the subject matter?				
Was the instructor available full time?				

75. Would you recommend continuing training with this contractor? Yes___ No___
If not, why?

_____

_____

_____

_____

76. Would you recommend using the same instructor(s) in future training? Yes___
If not, why?

_____

_____

Information Handling Services, 1999
August 11, 1999 10:18:24

DID 27, FIGURE 4, SAMPLE END-OF-COURSE EVALUATION QUESTIONNAIRE (EQUIPMENT) (CONTINUED)

77. Please provide any suggestions that you feel would improve this training program or future contract training programs.

_____

_____

_____

_____

78. Comments on lodging, transportation and food availability, convenience, quality and cost.

_____

_____

_____

_____

Information Handling Services, 1999
August 11, 1999 10:18:24

DID 27, FIGURE 5, SAMPLE END-OF-COURSE EVALUATION QUESTIONNAIRE (NON-EQUIPMENT ORIENTED)

COURSE TITLE _____

COURSE NO. _____

DIRECTIONS

- In Section A of the questionnaire, rate each item as:
  - Almost Never
  - Some of the Time
  - Half of the Time
  - Most of the Time
  - Almost Always
- In Section B, indicate the extent to which this course prepared you with the skills and knowledge to fulfill each training outcome of the course.

Information Handling Services, 1999
August 11, 1999 10:18:24

DID 27, FIGURE 5, SAMPLE END-OF-COURSE EVALUATION QUESTIONNAIRE (SECTION A)

END-OF-COURSE EVALUATION QUESTIONNAIRE FOR STUDENTS

COURSE: _____
NUMBER: _____
DATES: _____

	ALMOST NEVER	SOME OF THE TIME	HALF OF THE TIME	MOST OF THE TIME	ALMOST ALWAYS
1. The objective(s) for each lesson in the course was presented and clearly indicated what you needed to learn.	A	B	C	D	E
2. The course instruction provided enough information to accomplish the objectives.	A	B	C	D	E
3. Course materials did not seem to duplicate or overlap.	A	B	C	D	E
4. Course materials were available at the start of the course or were provided at the appropriate time during the course.	A	B	C	D	E
5. The instruction allowed for student involvement and participation.	A	B	C	D	E
6. Classes started and ended on time.	A	B	C	D	E
7. Breaks were provided and not abused.	A	B	C	D	E
8. Time was not wasted in the course to set up training aids, equipment, or demonstrations.	A	B	C	D	E
9. Written and oral questions were used.	A	B	C	D	E
10. The procedures/processes taught in the classroom were consistent with what was required in lab.	A	B	C	D	E
11. Sufficient practice time was given before being evaluated on a performance test.	A	B	C	D	E
12. Questions were answered professionally and promptly by the instruction(s).	A	B	C	D	E
13. Training aids, handouts, texts, and audiovisuals made the instruction more understandable.	A	B	C	D	E
14. The time devoted to each lesson of the course was sufficient to understand the basic concepts.	A	B	C	D	E
15. The instruction received in the classroom allowed me to perform effectively in the lab.	A	B	C	D	E
16. The class/lab was adequately equipped.	A	B	C	D	E
17. The class/lab equipment was reliable.	A	B	C	D	E
18. The class/lab was adequately lighted.	A	B	C	D	E
19. The class/lab was adequately ventilated.	A	B	C	D	E
20. The test instructions were clear.	A	B	C	D	E
21. The test items seemed to be taken from the material covered in the classroom/lab.	A	B	C	D	E
22. Test items were clearly written and understandable.	A	B	C	D	E
23. Test feedback was sufficient to clarify any problem areas.	A	B	C	D	E
24. The time allotted for taking tests was sufficient.	A	B	C	D	E

Information Handling Services, 1999
August 11, 1999 10:18:24

DID 27, FIGURE 5, SAMPLE END-OF-COURSE EVALUATION QUESTIONNAIRE (SECTION B)

END-OF-COURSE EVALUATION QUESTIONNAIRE FOR STUDENTS

COURSE: _____
NUMBER: _____
DATES: _____

	ALMOST NEVER	SOME OF THE TIME	HALF OF THE TIME	MOST OF THE TIME	ALMOST ALWAYS
25. (List Training Outcomes Here)	A	B	C	D	E
26.	A	B	C	D	E
27.	A	B	C	D	E
28.	A	B	C	D	E
29.	A	B	C	D	E
30.	A	B	C	D	E
31.	A	B	C	D	E
32.	A	B	C	D	E
33.	A	B	C	D	E

Information Handling Services, 1999
August 11, 1999 10:18:24

DID 27, FIGURE 6, SAMPLE TRAINING OUTCOMES SECTION OF THE VALIDATION REPORT

	ESTIMATED TIME (In hours)	ACTUAL TIME (In hours)
TRAINING OUTCOME B.		
Given a Low Level Windshear Alert System (LLWAS) with a malfunction, the Manufacturer's Instruction Book (MIB), and appropriate test equipment and diagnostic tapes, the student will be able to restore the system to normal operation in accordance with (IAW) MIB T.I.-8690-1.	11	14
TERMINAL OBJECTIVE 1.	2	2.5
Given the block diagram of the central station memory backup power supply, the student will analyze the operational characteristics IAW MIB T.I.-8690-1.		
Lesson B1a. Function and Purpose	.5	.75
Lesson B1b. Power Supply Interfaces	.5	.75
Lesson B1c. Functional Block Diagram of Power Supply	1	1

Information Handling Services, 1999
August 11, 1999 10:18:24

9003329 0020865 855

DID 27, FIGURE 7, SAMPLE TEST DATA LISTING

COURSE: LOW LEVEL WINDSHEAR ALERT SYSTEM (LLWAS) FA9980, FA9981 COURSE NO. 40268

WRITTEN TESTS	TYPE			CLASS AVERAGE		RANGE OF SCORES		NO. OF STUDENTS PASSING	
	PRE	PROGRESS	POST	P	NP	P	NP	P	NP
FUNDAMENTALS	X			85	81	56-89	60-85	5	6
PDP II COMPUTER		X		79	72	65-89	60-79	7	4
REMOTE WIND UNITS		X		81	79	61-94	68-88	6	4

PERFORMANCE TESTS	TYPE			CLASS AVERAGE		RANGE OF SCORES		NO. OF STUDENTS PASSING	
	PRE	PROGRESS	POST	P	NP	P	NP	P	NP
CS MASTER CONTROLLER/ MODEM		X		83	80	60-88	60-90	7	4
CS MASTER RADIO		X		79	77	56-84	65-80	7	4
CORRECTIVE MAINTENANCE			X	86	84	74-96	70-92	6	4

P Number of Students Meeting the Course Prerequisites

NP Number of Students Not Meeting the Course Prerequisites

Information Handling Services, 1999
August 11, 1999 10:18:24

DID 27, FIGURE 8, SAMPLE EASE INDEX FOR TEST ITEMS

COURSE: LOW LEVEL WINDSHEAR ALERT SYSTEM (LLWAS)
FA9980, FA9981 COURSE NO. 40268

TEST: SYSTEM OPERATIONS - PERFORMANCE MEASURE

TYPE OF TEST: POST-TEST

ITEM	OBJECTIVE NO.	EASE P	INDEX NP
1	B2c	.93	.90
2	B2e	.82	.79
3	B2b	.69	.54
4	B2f	.78	.75
5	B2g	.35	.37
6	B2c	.70	.71
7	B2a	.84	.80
8	B2e	.81	.82
9	B2d	.89	.87
10	B2e	.60	.59
11	B2d	.22	.23
12	B2a	.21	.31
13	B2b	.92	.89
14	B2a	.80	.80
15	B2e	.91	89

P Number of Students Meeting the Course Prerequisites

NP Number of Students Not Meeting the Course Prerequisites

Information Handling Services, 1999
August 11, 1999 10:18:24

9003329 0020867 628

APPENDIX 2

GLOSSARY

Information Handling Services, 1999
August 11, 1999 10:18:24

APPENDIX 2

GLOSSARY

Behavior. The part of a learning objective which describes the action to be performed.

Block Test. A test (written or performance) designed to measure the accomplishment of the objectives of a block or module of instruction.

Block (or module) of Instruction. A group of related instructional units covering a major subject area. Logical training segments.

Camera Ready Copy. Format, as stated in Specification 2494, for the final submission of materials, which allows for high quality reproduction, as specified in the contract for training.

Cognition. The process of knowing, including both awareness and judgment.

Cognitive Task Analysis. A systematic process for determining the cognitive processes and strategies that support job performance.

Commercial Off-the-shelf Training Materials. Commercially available training materials which are already developed and produced.

Computer Based Instruction (CBI). An overall term which refers to any generalized use of computers in the training process. CBI consists of a management component, Computer Managed Instruction (CMI) and a delivery component, Computer Assisted Instruction (CAI).

Concurrence. Written consent which signifies agreement.

Condition (of Performance). What is provided or restricted from use in the work environment (for example, tools, equipment, time). The "condition" is generally stated at the beginning of a three-part objective.

Contract Data Requirements List (CDRL). List included in a contract which states the deliverables to be submitted, the submission date for each, and to whom the contractor shall submit them.

Contracting Officer's Technical Representative (COTR). An individual in the FAA designated by the FAA Contracting Officer,

Information Handling Services, 1999
August 11, 1999 10:18:24

who provides the technical training oversight of a contractor's effort.

Contracting Officer. An individual in the FAA who provides legal expertise in a contracting situation and has the authority to approve deliverables.

Correspondence Study Materials. Correspondence study materials are individualized self-paced study materials used in a correspondence course. Correspondence study materials include reading assignment(s) and supporting illustrations, review exercises and associated answer keys, student progress tests, and a post-test.

Course Design Guide (CDG). The course design guide consists of three parts. Part I is the management summary and contains information for resource decisions. Part II contains the training outcomes, terminal objectives, and enabling objectives and the types of learning, test types, technical content, and instructional methods and media for each objective. Part III cross-references the sequenced training outcomes, the tasks selected for training in the task and skills analysis, and the terminal objectives contained in Part II of the CDG.

Course Report. A document containing information about the results of course validation, such as the extent to which the objectives are achieved, deficiencies exist in the instruction, and accuracy of time allocations occurs. Recommended revisions to the instruction and a timeline for their completion are included in the report.

Course Schedule. Depicts, in a grid format, the time allocated for each major course topic and for each lesson for each week of the course.

Course Walk-through. An overview of a course, given by a contractor to FAA representatives, in which the integration and traceability of the components of the instruction are assessed.

Criterion Referenced Test. A type of test which compares a student's performance against a fixed standard rather than the performance of other students.

Criticality. A characteristic that indicates how essential it is to perform the task or subtask.

Data Item Description (DID). A specification of the content and format requirements of training deliverables, or products.

Deliverable. A product developed by the contractor which is required by a line item in the contract.

Information Handling Services, 1999
August 11, 1999 10:18:24

Developmental Tryout. A part of course validation in which the instruction or instructional materials (in draft form) are presented to peers and training experts to determine their effectiveness before being finalized.

Difficulty. A characteristic task that indicates how hard it is to perform the task or subtask.

Duty. A discrete segment of a job encompassing two or more related tasks. A duty statement starts with an action verb and includes the object of that verb. Examples: perform corrective maintenance; maintain radar separation.

Enabling Objective. A three-part statement, containing a condition(s), behavior, and standard(s). Enabling objectives support terminal objectives and are sometimes referred to as lesson objectives.

Evaluation. An ongoing process that determines the effectiveness of a program or course and identifies changes, if necessary.

First Course Conduct. The first presentation of a course developed by a contractor to the student population. Generally, the first course conduct is conducted by the contractor, however, this will be stipulated by the training contract.

Flowchart. A graphic representation of the sequence of steps and decisions that make up a task, a "roadmap" of the task.

Formative Evaluation. Process through which instructional materials are evaluated for technical accuracy and instructional soundness prior to final delivery to students.

Frequency. A characteristic of a task that indicates the number of times per work period (for example, shift, weekly, monthly) a task or subtask is performed.

Instructional Materials. Any materials which are developed or obtained to support the instruction; for example, lesson plans, tests, videotapes, and correspondence study materials.

Instructional Strategy. The combination of specific techniques, methods, and media used to achieve a particular training outcome.

Instructional Systems Personnel. Individual with expertise in all phases of the instructional systems design process, including analysis, design, development, delivery, and evaluation of training.

Instructor Presented Training. Training in which the primary method of teaching is through use of an instructor.

Information Handling Services, 1999
August 11, 1999 10:18:24

Job. A set of positions which are similar enough in the activities performed by workers or in the goals they serve for an organization to call the positions by the same job titles. Examples: Electronic Technician (Radar), Principal Operations Inspector (General Aviation).

Knowledge. The use of mental processes which enable a person to recall facts, identify concepts, apply rules or principles, solve problems, and think creatively. A person can demonstrate knowledge only through performing associated overt activities.

Learning Behavior. The part of an objective which describes the action to be performed.

Lesson. The smallest or most discrete unit of instruction for which objectives are developed, instructional strategies and materials are developed, and evaluation is conducted.

Lesson Plan. A plan for a lesson that provides detailed information and technical data necessary to assist the instructor in presenting the lesson material. It identifies at the appropriate points, the instructional aids and reference materials to be used in conjunction with the instruction.

Lockout Item. A step in a standard operating procedure, which if not performed strictly in accordance with the established procedure, precludes continuing with the operation of a task or subtask.

Master Reproducible. A high quality, single sided original of a document which permits reproduction of legible copies; first generation copy of a film or videotape that allows for high quality reproduction.

Media. The means through which the content of a learning experience is presented to the student; for example, transparencies, videotape, or a book.

Method. Procedure or process for imparting a training objective; for example, a performance exercise.

Module (of Instruction). Subdivision or a block of instruction that is complete within itself (i.e., "stands alone") and can be independently taught, measured, and evaluated.

Multimedia Approach. Coordinated use of more than one type of media as a vehicle for presenting the instructional objectives.

OJT Instructor Handbook. Provides the activities for both the OJT instructor and student to enable the student to complete the OJT objectives.

Information Handling Services, 1999
August 11, 1999 10:18:24

On-the-job Training (OJT). Method of training, usually delivered at a work site. OJT may combine several methods of instruction, including formal classroom training, reading assignments, job performance with or without supervision, self-paced instructional materials, and CBI.

Performance Exercise. Activities designed so the students can physically apply lesson information to job-like situations.

Position. Duties and tasks established as the work requirement for one individual.

Post-test. A test administered at the end of a course or block of instruction to determine the mastery level of the students. Post-tests may be written tests or performance tests.

Prerequisite. A course(s) which must be successfully completed prior to enrollment, or an approved screening examination which measures the level of knowledges and skills equivalent to that which could have been achieved in the prerequisite course(s).

Pretest. A test administered before training occurs to assess entry level skills. The pretest may be used as a baseline to measure student progress and to test out of training when the student demonstrates mastery.

Progress Test. A test given during the course to indicate individual student and class progress toward mastery of the course material. Progress tests may be written or performance tests.

Responder Item. Response item which requires using a mechanism (for example, pushing one of three buttons) to indicate the correct answer.

Response Item. Any oral or written question to which the student responds.

Skill. Physical, mental, or manipulative activity.

Standard (of Performance). A component of an objective which states the minimum level of proficiency; or how well a process must be accomplished; the acceptable quality or quantity of a product.

Subject Matter Expert (SME). Responsible for assessing the technical accuracy of the instructional materials.

Subtask. A step in the accomplishment of a task. Each subtask within a task is independent of all other subtasks. A subtask's statement starts with an action verb and includes the object of that verb.

Information Handling Services, 1999
August 11, 1999 10:18:24

Systematic Training Development Process. A systematic process for planning, analyzing, designing, developing, delivering, and evaluating instruction. The process ensures that personnel are trained in the knowledge and skills essential for successful job performance.

Target Population. The persons, designated in the contract, for whom instruction is developed and delivered.

Task Analysis. A systematic process for identifying, analyzing, and documenting the components of each task associated with a job. The analysis determines the characteristics, such as criticality, frequency, and difficulty of a task, and results in a hierarchy which is used to design and develop job-centered training.

Task and Skills Analysis Report. A document which contains the task analysis information by specifying the task hierarchy, sources and procedures for collecting, analyzing, and validating job information, task characteristics, and the train/no train decision for each task.

Task. A unit of work that constitutes a logical and necessary component of a duty. A duty is comprised of multiple tasks. A task is comprised of multiple subtasks, or steps.

Terminal Objective. A three-part statement, containing condition(s), behavior, and standard(s), which represents the expected behavior of a student at the end of training. Terminal objectives, also referred to as instructional objectives, support training outcomes and are, in turn, supported by enabling objectives. One or more terminal objectives are written to support each task selected for training. Terminal objectives are stated as job performance behaviors rather than training behaviors.

Traceability. A systematic process which cross-references the tasks selected for training in the task and skills analysis with the terminal objectives and training outcomes in the course design guide.

Training Outcome. A training outcome is written at the duty level of the task and skills analysis. A training outcome contains three parts: a performance, condition(s), and standard(s). Each training outcome is supported by terminal and enabling objectives.

Validation. An evaluation process which includes the developmental tryout(s), course walk-through, first course conduct, and revision to the instruction.

Information Handling Services, 1999
August 11, 1999 10:18:24

9003329 0020874 868

APPENDIX 3

ACRONYMS

Information Handling Services, 1999
August 11, 1999 10:18:24

APPENDIX 3

ACRONYM LIST

AHT	Office of Training and Higher Education
CAI	Computer Assisted Instruction
CBI	Computer Based Instruction
CDG	Course Design Guide
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CMI	Computer Managed Instruction
COTS	Commercial Off-the-shelf
COTR	Contracting Officer's Technical Representative
CPMIS	Consolidated Personnel Management Information System
DID	Data Item Description
FAA	Federal Aviation Administration
IAW	In Accordance With
IPR	In-Progress Review
IPT	Instructor-Presented Training
ISD	Instructional Systems Design
LLWAS	Low Level Windshear Alert System
LRU	Line Replaceable Unit
MIB	Manufacturer's Instruction Book
OJT	On-the-job Training
ORD	Operational Readiness Date
PCB	Printed Circuit Board
PDR	Preliminary Design Review

Information Handling Services, 1999
August 11, 1999 10:18:24

9003329 0020876 630

PR	Procurement Request
PWA	Printed Wiring Assembly
SME	Subject Matter Expert
TIM	Technical Interchange Meeting

*U.S. Government Printing Office: 1993 — 343-120/85899

Information Handling Services, 1999
August 11, 1999 10:18:24

FAA-STD-033
April 29, 1986

U.S. Department of Transportation

Federal Aviation Administration

Standard

DESIGN STANDARDS FOR ENERGY MANAGEMENT IN NAS PHYSICAL FACILITIES

Information Handling Services, 1999
August 11, 1999 10:38:37

CONTENTS

Paragraph	Title	Page
1.	SCOPE	1
1.1	Scope	1
1.2	Purpose	1
2.	APPLICABLE DOCUMENTS	1
2.1	Government documents	1
2.2	Non-government documents	2
3.	REQUIREMENTS	5
3.1	General	5
3.1.1	Air traffic control (ATC) mission impact	5
3.1.2	Current proven technology	5
3.1.3	Design objectives	5
3.1.4	Energy sources	5
3.1.5	Climatic conditions and interior environments	7
3.2	National codes and industry standards	7
3.3	Energy management and conservation measures	7
3.3.1	Building	7
3.3.2	Illumination	8
3.3.3	Electric power	10
3.3.4	Heating, ventilating and air conditioning (HVAC) systems	11
3.3.5	HVAC equipment	14
3.3.6	Service (domestic) hot water systems	14
3.3.7	Process equipment	15
3.3.8	Thermal energy recovery	15
3.3.9	Energy and load management	16
3.3.10	Other energy management and conservation measures	17
3.4	Energy consumption baseline and profile	18
3.4.1	National standard design	18
3.4.2	Site adapted design	18
3.5	Economic analyses	18
3.5.1	General	18
3.5.2	Exceptions	19
3.5.3	Standard	19
3.5.4	Analyses of multiple energy management and conservation measures	19
3.5.5	Computational requirements	20
3.6	Selection and implementation of energy management and conservation measures	20
3.7	Quality assurance requirement	20
3.7.1	Internal design review	20

Information Handling Services, 1999
August 11, 1999 10:38:37

CONTENTS

Paragraph	Title	Page
4.	QUALITY ASSURANCE PROVISIONS . . (Not Applicable). . . .	23
5.	PREPARATION FOR DELIVERY . . . . (Not Applicable). . . .	23
6.	NOTES	25
6.1	Additional data required	25
6.2	Acronyms, abbreviations and definitions	26
6.2.1	Acronyms and abbreviations	26
6.2.2	Definitions	27
6.3	Suggested computer programs	29

Information Handling Services, 1999
August 11, 1999 10:38:37

FAA-STD-033
April 29, 1986

1. SCOPE

1.1 Scope. This standard shall apply to all physical facilities and support equipment that are owned, operated or leased by the Federal Aviation Administration (FAA), or otherwise under the jurisdiction, occupancy or control of the FAA.

1.2 Purpose. This standard establishes requirements for energy management and conservation that shall be incorporated into the designs of new physical facilities and modifications to existing physical facilities in the NAS. Specific technical requirements for these facilities will be defined in subsystem or project specifications and in facility development specifications for each subsystem or project. This standard is primarily for use in the development of national standard designs and shall also be used for site adaptations by FAA Washington and Regional Offices in the development of engineering requirements and task orders. This standard is to be used by FAA Washington in preparation of the physical facilities requirements portions of the NAS subsystem or project specifications and by architects and engineers in the design and construction of new facilities and modifications to existing NAS physical facilities. This standard shall not be used to abridge any federal safety, health, or environmental code requirements.

2. APPLICABLE DOCUMENTS

2.1 Government documents. The following documents of the issue in effect on the date of invitation for bids or request for proposal, form a part of this standard to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this standard, the contents of this standard shall be considered a superseding requirement.

STANDARDS:

FAA

FAA-STD-032	Design Standards for National Airspace System Physical Facilities

OTHER PUBLICATIONS:

FAA Orders

6980.26	Battery Backup Power Systems - Theory and Selection Guidelines

Information Handling Services, 1999
August 11, 1999 10:38:37

Manuals

Department of Energy (DOE)

DOE/AD-0006/1	DOE Facilities Solar Design Handbook
DOE/CS-0011	Introduction to Solar Heating and Cooling Design and Sizing
DOE/CS-0132	Architects and Engineers Guide to Energy Conservation in Existing Buildings
DOE/CS-0133	Identifying Retrofit Projects for Buildings
SOLAR/0811-79/01	Engineering Concerns in Solar System Design and Operation

General Services Administration (GSA)

Energy Conservation Guidelines for Existing Office Buildings
Energy Conservation Design Guidelines for New Office Buildings

Regulations and Codes

10 CFR 400 to 499	Energy
	Federal Register

Handbooks

National Bureau of Standards (NBS)

NBS Handbook 135	Life Cycle Cost Manual for the Federal Energy Management Program

Office of Management and Budget

Circular A-94	Discount Rates to be Used in Evaluating Time Distributed Costs and Benefits

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specified procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Non-government documents. The following documents of the issue in effect on the date of invitation for bids or request for proposal form a part of this standard to the extent referenced herein. In the event of conflict between the documents referenced herein and the contents of this standard, the contents of this standard shall be considered a superseding requirement.

Information Handling Services, 1999
August 11, 1999 10:38:37

OTHER PUBLICATIONS:

American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)

	ASHRAE Handbook, Applications Volume
	ASHRAE Handbook, Equipment Volume
	ASHRAE Handbook, Systems Volume
90A,C	Energy Conservation in New Building Design

National Electrical Manufacturers' Association (NEMA)

MG-10	Energy Guide for Selection and Use of Polyphase Motors
MG-11	Energy Management Guide for Selection and Use of Single Phase Motors

Council of American Building Officials (CABO)

CABO Model Energy Code

Building Officials and Code Administrators International (BOCA), Inc.

BOCA Basic/National Energy Conservation Code

Brick Institute of America (BIA)
1750 Old Meadow Road, McLean, VA 22102

4, 4A - 4H	Technical Notes on Brick Construction

Commercial/Industrial Committee, Edison Electric Institute (EEI),
111 Nineteenth Street, N.W., Washington, D. C. 20036

EEI Energy Management Handbook

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.

Information Handling Services, 1999
August 11, 1999 10:38:37

(THIS PAGE INTENTIONALLY LEFT BLANK)

Information Handling Services, 1999
August 11, 1999 10:38:37

3.0 REQUIREMENTS

3.1 General. This standard establishes design requirements (as defined in 6.2.2) prescribed by codes and industry standards and sets forth the framework for considering and evaluating other design requirements for energy management and conservation. The requirements of this standard are not necessarily imposed on the designs of all physical facilities (as defined in 6.2.2). The applicability of this standard is defined in the FAA engineering requirement, task order or NAS subsystem or project specification. All energy management and conservation measures (as defined in 6.2.2) shall be cost effective and designs implementing these measures shall be in accordance with FAA-STD-032.

3.1.1 Air traffic control (ATC) mission impact. The impact of an energy conservation measure on ATC missions shall be assessed. No energy management and conservation measure, regardless of its technical and economic merit, shall degrade ATC mission objectives, safety and reliability but rather shall enhance those objectives wherever possible.

3.1.2 Current proven technology. All designs shall be of current proven technology. Systems and equipment shall be reliable, maintainable, and readily available in the market place.

3.1.3 Design objectives. The energy related designs shall meet the following objectives:

a. Reduce the life cycle cost of energy consuming facilities, systems, and equipment;

b. Reduce the total cost of energy consumed;

c. Reduce the total energy consumption;

d. Promote the efficient use of energy through better control and increased use of more efficient equipment;

e. Promote switching from petroleum based fuels and natural gas to other energy sources such as sunlight and wind, etc.

3.1.4 Energy sources.

3.1.4.1 Non-renewable energy sources. In the selection and analyses of non-renewable energy sources (as defined in 6.2.2) for any energy consuming system, the most accurate applicable current and projected prices and market availability of the various energy sources at the project site shall be evaluated (as defined in 6.2.2). The availability of the non-renewable energy, including the impact of disruptions due to foreseeable fuel shortages, shall be considered for the duration of the useful life of the physical facility. Specific data may be obtained from the following sources:

Information Handling Services, 1999
August 11, 1999 10:38:37

a. Federal Register;

b. 10 CFR 436, Subpart A;

c. NBS Handbook 135;

d. Energy distribution utility companies in the area of the project.

3.1.4.2 Alternative/renewable energy sources. Alternative/renewable energy sources (as defined in 6.2.2) shall be evaluated when they can be shown to be cost effective and when otherwise directed by FAA.

3.1.4.2.1 Alternative/renewable electric power sources. Alternative/renewable electric power sources shall be in accordance with FAA Order 6980.26. These sources include but are not limited to:

a. Sunlight;

b. Photovoltaic cells (as defined in 6.2.2);

c. Wind energy systems;

d. Fuel cells (as defined in 6.2.2);

e. Thermoelectric generators (as defined in 6.2.2);

f. Thermionic generators.

3.1.4.2.2 Solar thermal energy systems. Solar thermal energy (as defined 6.2.2) system design shall be in accordance with ASHRAE Handbook, Systems and Applications Volumes and DOE/AD-0006/1, DOE/CS-0011 and SOLAR/0811-79/01. Solar panels shall be vandal proof and shall be installed where they will not be subjected to shade from trees, buildings (as defined in 6.2.2), or other structures (as defined in 6.2.2). Freeze protection shall be provided for hydronic systems.

3.1.4.3 Thermal energy recovery. Thermal energy (or heat) recovery shall be evaluated for NAS physical facilities whenever there can be shown an availability of excess or wasted energy and the simultaneous need for that energy. The energy savings potential and cost benefits depend primarily upon the number of hours per year that excess energy is available and can be utilized for purposes that would otherwise require the use of additional purchased energy. Recovered energy may be used for conditioning of ventilation air, space heating and service water heating. Design of and considerations (as defined in 6.2.2) for heat recovery systems shall be in accordance with ASHRAE Handbook, Systems Volume. Where the availability of excess energy and the need for that energy are not simultaneous, consideration shall be given to storing excess energy when available and using it at a later time.

Information Handling Services, 1999
August 11, 1999 10:38:37

3.1.5 Climatic conditions and interior environments. Climatic conditions and interior environments for national standard and site adapted designs shall be in accordance with FAA-STD-032.

3.2 National codes and industry standards. The design of all new physical facilities and equipment shall, as a minimum, incorporate energy management and conservation measures as prescribed and recommended in nationally recognized codes and industry standards. Expansions to existing physical facilities shall be considered as new facilities. Rehabilitation and modernization projects for existing facilities shall also incorporate energy management and conservation measures prescribed by these codes and standards to the extent they are shown cost effective based on economic analysis. The following are nationally recognized energy codes and industry standards to be applied to FAA physical facilities:

a. ASHRAE Standard 90A;

b. ASHRAE Standard 90C;

c. BOCA Basic/National Energy Conservation Code;

d. CABO Model Energy Code;

e. NEMA MG-10;

f. NEMA MG-11.

3.3 Energy management and conservation measures. The following list identifies energy management and conservation measures that shall be used in the design or evaluated as potential candidates for implementation into designs for new NAS facilities or expansions or modernizations to existing NAS physical facilities. This list is not intended to be comprehensive nor exclude other energy management and conservation measures from evaluation.

3.3.1 Building. Primary consideration shall be given to non-energy consuming or passive energy components and devices.

a. All exterior doors shall be equipped with automatic door closing devices.

b. Vestibules shall be provided at moderately to heavily used exterior doors at manned physical facilities.

c. Vestibules shall be provided at loading dock areas at manned physical facilities where doors open directly into a conditioned space.

Information Handling Services, 1999
August 11, 1999 10:38:37

d. The use of air curtain systems and transparent plastic curtain strips shall be evaluated with the consideration of vestibules.

e. Thermal mass shall be considered and shall be in accordance with BIA Technical Notes in Brick Construction, 4 and 4A through 4H.

f. High maintenance dynamic exterior shading devices, such as solar tracking vertical louvers, shall not be used.

g. Consideration shall be given to placing insulation on building exteriors in predominantly southern or warm climate areas.

h. Double reflective roofs with a ventilated space between roofs shall be evaluated to reduce solar gain in unmanned facilities located predominantly in southern and southwestern regions.

i. Glass windows with high heat reflection capability or lower emissivity shall be evaluated.

3.3.2 Illumination.

3.3.2.1 Lamps. Lamps shall be the most efficient type suitable for the application. Consideration shall also be given to the lamp's useful life and its rate of lumen depreciation which affects overall lamp efficiency. Types of lamps shall include, but shall not be limited to:

a. Incandescent;

b. Fluorescent;

c. Mercury vapor;

d. Metal halide;

e. High pressure sodium;

f. Low pressure sodium.

3.3.2.1.1 Safety and security considerations. High efficiency lamps shall be used. Consideration shall be given to the color rendition of the candidate lamps and lighting system. Neither safety nor security shall be compromised by their use.

3.3.2.1.2 Incandescent lamps. The application of incandescent lighting shall be restricted to areas of infrequent and short duration use, such as in janitor's closets and remote unmanned facility toilet rooms. Incandescent lamps shall only be used where clearly shown to be the most cost effective type of lighting for those areas.

Information Handling Services, 1999
August 11, 1999 10:38:37

3.3.2.2 Interior lighting. The actual power used for interior lighting shall be as low as practical and shall not exceed 85% of the calculated lighting power budget (as defined in 6.2.2).

3.3.2.2.1 Task lighting systems. Task lighting systems shall be utilized whenever workspaces are designed for specific functions. Task lighting shall be on a separate circuit from the main lighting systems. Task lighting may be integrated in furniture or equipment.

3.3.2.2.2 Natural lighting. Natural lighting shall be utilized whenever feasible. Automatic dimming and switching systems shall be evaluated whenever natural lighting is available. Dimming devices shall be energy savings type. Skylights shall be evaluated as sources of natural lighting. Their use shall be determined by economic analysis and limited to areas not requiring glare-free or low ambient lighting systems.

3.3.2.2.3 Fixtures. Consideration shall be given to mobile fixtures and to fixed fixtures with heat removal capability.

3.3.2.2.4 Controls. Manual and automatic lighting controls shall be provided to avoid unnecessary consumption of electrical energy for lighting. Controls shall include, but shall not be limited to the following as applicable to the specific project:

a. Multiple switching;

b. Dimming devices;

c Key-activated switches;

d. Telephone signal-activated controls;

e. Three way switches;

f. Ballast load switching systems;

g. Door activated controls;

h. Photocell controls;

i. Photocell/timeswitch combination controls;

j. Dimmer/photocell combination controls;

k. Dimmer/timeswitch combination controls;

l. Radio-controlled high pressure sodium ballast system;

m. Personnel detection controls, such as ultrasonic, passive infrared, active infrared, and acoustic;

Information Handling Services, 1999
August 11, 1999 10:38:37

n. Centralized programmable lighting control systems.

3.3.2.3 Exterior lighting. Exterior lighting design shall provide safe and secure access to and egress from NAS facilities. Calculations shall include a cost-benefit analysis which compares the higher energy-efficiency/lower first cost for larger fixtures to the higher operational-efficiency and controllability of a greater number of smaller fixtures.

3.3.2.3.1 Excluded areas. Areas specifically excluded from consideration for exterior lighting include landscaping, general architectural lighting, or general site lighting.

3.3.2.3.2 Control. The electrical design shall incorporate sufficient system controls for exterior lighting to ensure energy-efficient operation of the system. System controls shall be both ambient light dependent and time/time-of-day dependent. Exterior lighting circuits shall be divided by lamp type and site vicinity in such a manner as to permit reductions in usable lighted parking zones and walk areas. The design shall provide for conformity to seasonal, occupancy, and shift changes common to the operation of larger manned facilities. For unmanned facilities, exterior lighting shall be controlled by a manually-activated timer switch.

3.3.3 Electric power.

3.3.3.1 Electrical services. Electrical services shall be obtained at the highest, most economically feasible voltage available. Consideration shall be given to power company rate schedules, service and transformer losses and service classifications.

3.3.3.2 Voltage drop and system losses. Voltage drop and system losses shall be minimized.

3.3.3.3 Voltage balance. Voltage imbalance of three-phase power shall be minimized.

3.3.3.4 Power factor correction. Where poor power factor results in a penalty by the utility or where power factor is less than 85%, power factor correction devices shall be evaluated. Economic analyses shall be used to determine the relative cost effectiveness of installing the power factor correction devices at the service entrance or at the individual sources of poor power factor which is the preferred location. Preference shall be given to the use of synchronous motors or to the replacement of large motors with energy efficient motors exhibiting higher power factors. When power factor correction is required, it shall be increased to the most cost effective level.

3.3.3.5 Transformers. The minimum transformer efficiency shall be 94%. The temperature rise for a transformer shall be the lowest available that is economically feasible for the size and type required.

Information Handling Services, 1999
August 11, 1999 10:38:37

3.3.3.6 Motors. High efficiency motors shall be used. Single-phase motors shall be selected in accordance with NEMA MG-11. Polyphase motors shall be selected in accordance with NEMA MG-10. Motors shall be sized to handle design loads and designed for the particular environment encountered. Where the motor load varies significantly for extended durations, the use of multiple motors (i.e., a small and a medium size motor) rather than one large motor shall be evaluated. Variable and multispeed motors and motors with variable or multispeed drives shall be evaluated. Variable frequency motor drives shall be utilized to the greatest extent that is economically feasible.

3.3.3.7 Peak load demand shaving. Peak load demand shaving (as defined in 6.2.2) shall be provided, where economically feasible, to reduce the peak demand. Peak load demand shaving techniques shall not adversely affect system reliability or maintainability. Peak load monitoring equipment shall operate in the same time interval as the power company's demand meter and if possible, shall utilize the power company's demand metering pulse.

3.3.3.7.1 Demand shaving techniques. Demand shaving techniques shall be considered, such as transfer of loads from normal power to standby engine generator systems, where available. A life cycle cost (as defined in 6.2.2) analysis shall be performed to determine the most economical engine generator system, gas, diesel, or gasoline. Consideration shall be given to local cost and availability of the various fuel types. Engine generator systems shall be carefully chosen to obtain the most efficient combination possible for the particular size required. Engine and generator efficiencies shall be reflected in the life cycle cost analysis.

3.3.4 Heating, ventilating and air conditioning (HVAC) systems.

3.3.4.1 Distribution. Air and water transport factors shall be the highest, most economical values consistent with ASHRAE Standard 90A. In order to minimize the energy consumed in distributing the conditioned air or thermal fluid, consideration shall be given to, but shall not be limited to the following energy management and conservation measures.

a. Minimize heat transfer through duct and pipes;

b. Minimize the pressure rating of the air handling system;

c. Minimize air/water leakage.

d. Conduct trade-off study between an all-air system versus a hydronic system;

e. Evaluate multiple delivery systems and multiple speed motors on individual fans or pumps for reduced loads or for staging.

Information Handling Services, 1999
August 11, 1999 10:38:37

3.3.4.2 Controls. Control systems shall be compatible with the central control monitoring system (CCMS) or the remote maintenance monitoring system (RMMS) and shall be connected to these systems as directed by FAA.

3.3.4.2.1 Direct, indirect and combination controls. When there is a choice between the type of equipment or system controls, direct controls shall be preferred over indirect controls. Where both are used in combination, direct controls, such as a room thermostat, shall override indirect controls, such as a supply temperature controller or outside air reset controller. Except at small and unmanned facilities, modulating controls shall be preferred over on-off or two-position controls.

3.3.4.2.2 Central and localized control. Localized controls shall cause heating or cooling energy to be consumed in proportion to the need. Localized control systems shall be compatible with the central control system. To the maximum extent practicable, all localized controls shall be designed to be overridden by the central control system.

3.3.4.2.3 Dead band control. The dead band temperature difference between the operation of the heating and cooling systems shall be adjustable and shall be set typically where no heating or cooling is provided until the space temperature is outside the specified dead band range provided in FAA-STD-032. Dead band control shall be used with the economizer cycle (as defined in 6.2.2).

3.3.4.2.4 Economizer cycle. Economizer cycle, allowing up to 100 percent outside air into the conditioned space, shall be used where it is cost effective and its use results in energy savings. Economizer cycle may be of the type regulated by outdoor air dry bulb temperature or by total heat content (enthalpy) of outdoor and indoor air. In high humidity areas, the total heat content economizer cycle shall be preferred over the outdoor air temperature type to ensure that additional load is not placed on the air conditioning system. The use of the economizer cycle shall be weighed against its effect upon recoverable heat energy so that useful recoverable heat energy is not arbitrarily exhausted from the conditioned space.

3.3.4.2.5 Load reset control. Load reset control, such as an outdoor air temperature reset control in a hydronic heating system or a room or zone thermostat to override a cooling coil discharge thermostat, shall be used to help reduce energy consumption which may be caused by the use of indirect controls.

3.3.4.2.6 Timed set-back controls. Timed set-back controls such as time-of-day, night, and weekend set-back, shall be used to reduce energy consumption during the period of time when heat or cooling is not needed. Set-back controls shall provide minimum conditioning to maintain set back temperature during non-occupied periods. Timed set back

Information Handling Services, 1999
August 11, 1999 10:38:37

controls shall be evaluated to ensure that excessive energy is not consumed during warm-up or cool-down periods to the extent that the benefits to be derived from the controls have been severely curtailed or eliminated.

3.3.4.2.7 Anticipatory controls. Anticipatory controls, such as automatic warm-up or cool-down cycles, shall be used to reduce or otherwise minimize energy consumption. Anticipatory controls shall anticipate the need for heating or cooling cycle so that space conditions will be gradually changed to the desired environment by the time the change is required.

3.3.4.2.8 Chilled water temperature controls. Chilled water supply temperature shall be selected at the highest level possible consistent with room humidity requirements to reduce energy requirements of water chilling equipment. Temperature range shall be maximized to reduce water flow rates and minimize pump energy and power requirements.

3.3.4.2.9 Chilled water flow control. Chilled water systems shall be designed for variable/staged flow to minimize pumping energy and distribution losses. Designs shall provide for minimum flow necessary through water chillers to prevent freeze-up. Two-way modulating control valves shall be used at terminal cooling units.

3.3.4.3 Air filtration. Air filtration efficiency shall be appropriate for the area served and shall be in accordance with the recommendations contained in the ASHRAE Handbook, Systems and Equipment Volumes. Initial and final pressure losses for filters shall be optimized to minimize energy and power requirements for the air handling system.

3.3.4.4 Ventilation requirements. Except with economizer operation, outside air ventilation requirements shall be kept to a minimum but shall neither violate code nor create any unsafe or hazardous conditions. Ventilation requirements shall be in accordance with FAA-STD-032.

3.3.4.5 HVAC system types. The compatibility of the system type and method of control to the area, facility or equipment served shall be of primary consideration in order to avoid unnecessary energy consumption. Upon analyzing the various system types, consideration shall be given to the following energy consumption comparisons.

a. Unitary systems generally consume less energy than central systems;

b. Single zone central systems are generally more efficient than multizone central systems;

c. Induction systems are generally more efficient than all-air systems.

Information Handling Services, 1999
August 11, 1999 10:38:37

3.3.5 HVAC equipment.

3.3.5.1 Heating equipment. Heating equipment shall be evaluated on the basis of maximum efficiency over the operating range of the equipment when cost effective.

3.3.5.2 Air conditioning equipment and heat pumps. Air conditioning equipment and heat pumps shall be evaluated on the basis of maximum coefficient of performance (COP) over the operating range of the equipment when cost effective.

3.3.5.2.1 Compressors. Compressors, such as reciprocating and centrifugal, shall be evaluated on the basis of full and partial load performance. The use of hot gas bypass shall be avoided. Variable speed drives and capacity control by adjustable inlet vanes shall be evaluated for partial load conditions.

3.3.5.2.2 Staging and arrangement. The size and quantity of equipment shall be determined from the operational profile of the physical facility. Equipment shall be arranged in series or parallel and shall be staged such that the minimum number of units are operating at or near maximum efficiency to meet the load requirements.

3.3.5.3 Dehumidification equipment. Dehumidification equipment shall be evaluated on the basis of maximum pints of water per hour per input kW.

3.3.5.4 Humidification. Steam humidification boilers shall be evaluated on the basis of maximum efficiency and shall be controlled by room sensor. The room sensor shall shutdown the boiler when there is no demand for humidification.

3.3.6 Service (domestic) hot water systems.

3.3.6.1 Storage capacity and recovery rate. Except for energy demand control, the storage capacity and recovery rate shall not exceed the design demand load requirements. Storage tank and equipment shall be insulated. Storage tank water temperature shall be kept as low as practical within code. Storage tank water temperature shall not exceed 105°F.

3.3.6.2 Distribution. Hot water distribution may be by direct discharge (non-recirculating) or recirculating. All piping shall be insulated.

3.3.6.2.1 Recirculating pump. The selection of the recirculating pump shall be based upon optimization of minimum horsepower and maximum efficiency. Pump operation shall be automatically controlled by timer or aquastat.

Information Handling Services, 1999
August 11, 1999 10:38:37

3.3.6.2.2 Recirculating versus non-recirculating. A trade-off study shall be conducted to determine which system results in the minimum energy consumption, including pump energy and heat losses.

3.3.6.3 Dishwasher hot water supply. Dishwasher hot water supply shall be independent from domestic hot water system where practical. The use of electric booster heaters shall be avoided; where necessary limiting controls shall be evaluated to avoid excess peak electric power demand. Consideration shall be given for dishwashers designed specifically for use with normal (105°F) domestic hot water temperature.

3.3.6.4 Energy demand control. Consideration shall be given to increased storage and reduced recovery rate of electric water heaters for electricity demand control, particularly where the service water heating energy requirements exceed 20 kW. The same principle shall apply to gas-fired water heaters subject to penalties for gas consumption under interruptible service conditions.

3.3.6.5 Fixtures. Fixtures shall be water-saver type with flow restrictors and automatic shut-off features. Fixtures shall not be a nuisance to the user which may result in overuse and defeat the purpose of its special design feature.

3.3.7 Process equipment. Process equipment energy is that which is consumed for purposes other than for comfort conditioning and illumination. In NAS facilities this equipment is largely comprised of navigation, communication, surveillance, and other electronic equipment as well as data processing equipment. Energy management and conservation requirements for this type equipment are provided in facility development specifications for each subsystem or project.

3.3.7.1 Heat recovery. Since process energy consumption normally results in additional energy requirements imposed on building environmental control systems, these systems must be examined (as defined in 6.2.2) for potential energy management and conservation measures. In particular, these systems shall be evaluated for energy recovery for preheating ventilation air or heating adjacent spaces.

3.3.7.2 Equipment enclosures. Equipment enclosures (as defined in 6.2.2) shall be evaluated as an energy management and conservation measures for electronic process equipment in unmanned facilities. The enclosure would provide a means to condition the minimum volume necessary to house and access the equipment for maintenance. Work areas outside the enclosures would then be designed for broad dead band temperatures.

3.3.8 Thermal energy recovery. Thermal energy (heat) recovery shall be evaluated for physical facility equipment and systems. In particular, consideration shall be given to recovery of excess energy from power conditioning equipment for heating adjacent battery rooms, engine generator rooms and other ancillary spaces.

Information Handling Services, 1999
August 11, 1999 10:38:37

3.3.9 Energy and load management. Energy management and control systems designed to reduce energy use or reduce energy costs shall be evaluated for use at NAS physical facilities. Energy management and control systems shall be evaluated for control throughout the physical facility, control of a group of systems or devices, or control of an individual device or system.

3.3.9.1 Localized energy management and control systems. Localized energy management and control systems provide independent, relatively low cost control for specified systems and equipment. Each local controller is independently controlling its specified system or equipment and without acting in conjunction with any other controlling device. Localized energy management and control systems include time controls, automatic temperature setback/setup controls, economizer cycle controls, supply temperature reset controls and dead band controls.

3.3.9.1.1 Dead band control system. A dead band control system operates solely on the basis of room temperature. It establishes a relatively wide range (dead band) over which no heating or cooling is provided. As the temperature falls below or rises above dead band settings, heating or cooling is gradually increased. A space demand reset control is provided which uses space temperature to automatically readjust the temperature of the air being supplied to heat or cool the space. A dead band control is applicable to HVAC systems which provide heating and cooling in sequence; it can be used effectively even when these systems have economizer cycle controls or are interfaced with higher levels of energy management control systems.

3.3.9.1.2 Chiller energy management controller. A chiller energy management controller uses programmed logic to load, unload, start, and stop centrifugal chillers. The controller also resets suction temperature automatically by sensing load requirements; remotely monitors and displays inlet vane position in percentage, as well as chiller operating hours; and starts the standby chiller automatically, when needed.

3.3.9.2 Remote limited and multifunction energy management control system. Remote limited and multifunction energy management control system devices are typified by a limited function demand controller, which interfaces with numerous energy consuming devices and systems to limit electrical demand. Energy management control system devices are programmable through use of microprocessors and provide for multifunction capability in a common enclosure. Remote limited and multifunction energy management control system devices usually are most applicable when the functions to be performed are limited, and there are fewer than one hundred (100) points to be monitored and controlled.

3.3.9.2.1 Demand controller. A demand controller prevents electrical demand from exceeding a predetermined maximum. Certain interruptible non-critical or secondary loads are connected to it. As usage approaches

Information Handling Services, 1999
August 11, 1999 10:38:37

maximum during an interval, secondary loads are shed. When usage subsides, or when the demand interval ends, the secondary loads are restored. Demand controllers shall be designed to contend with present utility rate structures and metering methods and to adjust to changes that might be imposed by utilities. Demand controllers shall be designed so as not to interfere with essential facility operations.

3.3.9.3 Centralized computer-based energy management control system. A centralized computer-based energy management control system comprises a microcomputer or minicomputer to monitor and control various points. Man-machine interface usually occurs in a master control room which contains various operator consoles. In some cases the computer and support devices are remote with data generated in the building being transmitted to the computer via leased telephone lines. Centralized computer-based systems usually are appropriate when:

a. Optimization functions are needed;

b. Control decisions are to be based on the number of parameters and conditions involved, and on the series of events which occur;

c. There are 200 or more points.

3.3.9.3.1 Chiller optimization. Chilled water optimization shall be evaluated for chilled water plants with multiple chillers. The optimization program selects the chiller or chillers required to meet the load with minimum energy consumption. System incorporates interlocks with chilled water pumps, condenser water pumps and automatic valves for isolation of non-operating pumps and chillers.

3.3.9.3.2 Chilled water temperature reset. Automatic chilled water temperature reset shall be evaluated to reduce energy input per ton of refrigeration. Chiller discharge temperature is reset upward during non-peak periods to the maximum which will satisfy space cooling and dehumidification requirements. The chilled water temperature is reset upward until the required space temperature or humidity can no longer be maintained. This determination is made by monitoring positions of chilled water valves on various cooling systems or by monitoring space temperature and humidity conditions.

3.3.10 Other energy management and conservation measures. Other energy management and conservation measures shall be identified and evaluated to determine potential candidates for implementation into designs for new facilities or expansions or modernizations to existing physical facilities. The following referenced documents shall be used for identifying potential energy management and conservation measures for evaluation. Only those measures applicable to NAS physical facilities shall be considered.

Information Handling Services, 1999
August 11, 1999 10:38:37

DOE/CS-0132	Architects and Engineers Guide to Energy Conservation in Existing Buildings
DOE/CS-0133	Identifying Retrofit Projects for Buildings
GSA	Energy Conservation Guidelines for Existing Office Buildings
GSA	Energy Conservation Guidelines for New Office Buildings
EEI	Energy Management Handbook

3.4 Energy consumption baseline and profile. An annual energy consumption baseline (as defined in 6.2.2) of all candidate energy sources under consideration shall be developed in accordance with ASHRAE 90C. The annual energy consumption baseline shall be provided for each new building or new energy consuming mechanical or electrical system, whichever represents the major design. All non-major design items shall be incorporated within the overall major design for the purpose of developing the annual energy consumption baseline. Energy units and conversion factors shall be as provided in 10 CFR 436, Subpart C. Preference shall be given to the utilization of alternative/renewable energy sources. Energy consumption baseline and profile shall include process energy required to power electronic equipment. The analysis shall clearly differentiate between the energy reduction attributed to the use of electronic equipment and the amount saved by energy management and conservation measures for the physical facilities.

3.4.1 National standard design. Energy consumption baselines shall be developed using the highest summer and lowest winter temperatures provided in the table of summer and winter climatic zones (as defined in 6.2.2) in FAA-STD-032 for each summer and winter climatic zone.

3.4.2 Site adapted design. An hour-by-hour fuel and energy consumption profile (as defined in 6.2.2) for each energy consuming system shall be developed for the hottest and coldest days and for a design summer (2-1/2 percent column) and winter (97-1/2 percent column) day for the location under consideration. Each profile shall be for a 24-hour period starting at midnight and shall include each candidate energy source under consideration and the overall sum total of these sources. When specified in an FAA engineering requirement, task order, or NAS subsystem or project specification, an hour-by-hour fuel and energy consumption profile shall be developed in the manner cited above for 8760 hours per year.

3.5 Economic analyses.

3.5.1 General. Unless otherwise stated, energy management and conservation measures for design or retrofit shall be analyzed for maximum cost-effectiveness. The type of economic analyses (simple payback or life cycle cost) shall be as provided in FAA engineering requirement, task order or system or subsystem specification. Where implementation of energy management and conservation measures is made

Information Handling Services, 1999
August 11, 1999 10:38:37

from selections based upon different types of economic analyses, life-cycle cost analysis (LCCA) shall be performed on all such energy management and conservation measures. The economic life of physical facilities is provided in FAA-STD-032.

3.5.2 Exceptions. For new physical facilities economic analyses will not be required for energy management and conservation measures imposed by national codes and industry standards.

3.5.3 Standard. Standard economic analyses shall be in accordance with 10 CFR Part 436, Subpart A. The energy management and conservation measures under analyses shall pass the presumption test under Section 436.13 of 10 CFR Part 436, Subpart A, prior to assessing cost effectiveness.

3.5.3.1 Economic feasibility.

3.5.3.1.1 Estimated simple payback time. Except for alternative/renewable energy source conservation measures, an energy management and conservation measure shall be considered economically feasible if its estimated simple payback time is less than or equal to six years.

3.5.3.1.2 Life cycle cost analyses. Except for alternative/renewable energy source conservation measure, an energy management and conservation measure shall be considered economically feasible if its savings-to-investment ratio (SIR) is greater than or equal to one.

3.5.3.1.3 Alternative/renewable energy sources. The test for economic feasibility and other economic factors for analyses of energy management and conservation measures involving use of alternative/renewable energy sources will be provided by FAA.

3.5.4 Analyses of multiple energy management and conservation measures. The cumulative effect of implementing more than one energy management and conservation measure shall be taken into account by using this or an equivalent procedure subject to FAA approval:

a. Calculate the energy savings on all energy management and conservation measures.

b. Rank the energy management and conservation measures in order of decreasing SIRs or increasing estimated payback time, depending upon the type of economic analysis being used.

c. Starting with the most cost-effective energy management and conservation measure as ranked above, reduce the total energy use (Btu or kWh) by the amount of energy it conserves. This result, i.e., the reduced total energy use, becomes the basis for the calculation for the second ranked energy management and conservation measure.

Information Handling Services, 1999
August 11, 1999 10:38:37

d. Continue successively in the same manner with each energy management and conservation measure until the calculations have been done for all ranked energy management and conservation measures.

e. Recompute the SIR or estimated simple payback times based upon taking the cumulative effect into account by using the successively reduced calculated total energy use.

3.5.5 Computational requirements. NBS Handbook 135 and Office of Management and Budget Circular A-94; which contains economic data, worksheets, computer programs, discount rates and methods; shall be used with 10 CFR 436, Subpart A.

3.6 Selection and implementation of energy management and conservation measures. Unless otherwise directed by FAA, all energy management and conservation measures shall be implemented into the design in the following order of preference within the constraints of construction time and budget:

a. imposed national code and industry standard energy management conservation measures

b. ranked in order candidate energy management and conservative measures

Whenever the estimated simple payback times or the SIRs of two energy management and conservation measures are within 10 percent, preference shall be given to the design feature exhibiting the greater energy savings which exceeds by at least 5 percent the energy saving of the energy management and conservation measures with the lower estimated simple payback time or higher SIR provided that reliability is not compromised by the more favorable energy conscious selection.

3.7 Quality assurance requirement. All designs implementing energy management and conservation measures for new physical facilities and modifications to existing physical facilities shall be in accordance with FAA-STD-032 and shall meet national and regional standards for construction, operation and maintenance and shall be subject to the scrutiny of the Joint Acceptance Inspection. Tests shall be conducted to ensure the validity of design or economic analysis techniques which have not been proven by previous application.

3.7.1 Internal design review. The architect or engineer (A/E) shall continually monitor and fully coordinate all assessments, economic analysis, designs, site inspections, site investigations, reviews and document preparation efforts. Preparation of specialized portions of designs shall be accomplished, or supervised by, and certified by experienced persons having state registration in the applicable field. Original tracings of all drawings, the first page of all specifications,

Information Handling Services, 1999
August 11, 1999 10:38:37

estimates, and similar deliverables shall be certified and signed by the A/E. The signature shall appear under the A/E's printed name and over the affixed replica of the professional seal or registration certificate number. Unless otherwise waived by FAA, each deliverable item requiring signature shall bear the signature of the registered professional person of the respective disciplines as applicable: civil, structural, architectural, mechanical, and electrical. In addition all structural calculation sheets, divisions, and other structural documents shall have the signature and seal of a professional structural engineer. The requirement for signatures by registered professional structural engineers will not be waived.

3.7.1.1 Seismic Zone IV. All structural documents prepared for Seismic Zone IV shall be sealed by a registered structural engineer from a state in which the facility will be located.

3.7.1.2 Unique design techniques. The A/E shall conduct such tests as are necessary to ensure validity of design techniques which have not been proven by previous application. The A/E shall prepare and submit reports on findings.

Information Handling Services, 1999
August 11, 1999 10:38:37

(THIS PAGE INTENTIONALLY LEFT BLANK)

Information Handling Services, 1999
August 11, 1999 10:38:37

4. QUALITY ASSURANCE PROVISIONS

This section is not applicable to this standard.

5. PREPARATION FOR DELIVERY

This section is not applicable to this standard.

Information Handling Services, 1999
August 11, 1999 10:38:37

(THIS PAGE INTENTIONALLY LEFT BLANK)

Information Handling Services, 1999
August 11, 1999 10:38:37

6. NOTES

6.1 Additional data required. Attention of procurement request initiators is invited to the items listed below which should be covered in the system/subsystem or engineering services specification or contract schedule.

6.1.1 General requirements. Specifications should not categorically impose all requirements of this standard. Only those requirements which are applicable to the specific project should be imposed. Identify FAA system/sub-system or equipment to be served by the physical facility. Specify the deliverables. Specify those energy management and conservation measures that should not be considered or evaluated. Specify any deviations from this standard (3.1).

6.1.2 Alternative/renewable energy sources. Provide direction to A/E on the implementation or evaluation of alternative/renewable energy sources. Provide economic incentive factors (if any) and other relevant economic data for economic analysis. Provide direction for disposition of these energy management control systems when alternative/renewable energy sources are determined not to be ecomonically feasible (3.1.4.2 and 3.5.3.1.3).

6.1.3 Facility occupancy. Specify facility human occupancy, i.e., number of persons, specific work areas, duration of work periods, level of activity, etc. for A/E determination of environmental requirements and automatic controls (3.3.2.2.1, 3.3.2.2.4 and 3.3.4.2.6).

6.1.4 Electric power demand control. Specify interruptible non-critical and secondary loads that may be connected to the demand controller. Specify essential facility operations which are not to be interfered with (3.3.3.7 and 3.3.9.2.1).

6.1.5 Controls connected to the CCMS or RMMS. Specify whether or not controls shall be connected to the CCMS and RMMS and indicate compatibility sequences of these controls (3.3.4.2).

6.1.6 Process equipment. Specify energy management and conservation requirements for process equipment (i.e., navigation, communication, surveillance, and other electronic and data processing equipment) (3.3.7).

6.1.7 Site adapted designs. Specify when an hour-by-hour fuel and energy consumption profile shall be developed for the entire 8760 hours in a year (3.4.2).

Information Handling Services, 1999
August 11, 1999 10:38:37

6.1.8 Economic analysis Specify the type of economic analyses, i.e., estimated simple payback period or life cycle cost analysis. Specify any exceptions to the maximum payback period or minimum saving-to-investment ratios which are imposed herein (3.5.1).

6.1.9 Selection and implementation of energy management and conservation measures. Specify deviations from standard. Provide constraints including construction time and budget (3.6).

6.1.10 Preparation for delivery. Specify requirements for deliverables, and post design delivery requirements, if any. Indicate if signature of registered professional person is waived (3.7.1).

6.2 Acronyms, abbreviations and definitions.

6.2.1 Acronyms and abbreviations. The following are definitions of acronyms and abbreviations used in this standard.

A/E	Architect/Engineer
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ATC	Air Traffic Control
BIA	Brick Institute of America
BOCA	Building Officials and Code Administrators
Btu	British Thermal Unit
CABO	Council of American Building Officials
CCMS	Central Control Monitoring System
CFR	Code of Federal Regulations
COP	Coefficient of Performance
DOE	Department of Energy
EEI	Edison Electric Institute
°F	Degrees Fahrenheit
FAA	Federal Aviation Administration
GSA	General Services Administration
HVAC	Heating, Ventilating, and Air Conditioning
kW	kilowatt
kWh	kilowatt Hours
LCCA	Life Cycle Cost analysis
NAS	National Airspace System
NBS	National Bureau of Standards
NEMA	National Electrical Manufacturers Association
RMMS	Remote Maintenance Monitoring System
SIR	Savings-to-Investment Ratio

Information Handling Services, 1999
August 11, 1999 10:38:37

6.2.2 Definitions.

6.2.2.1 Alternative energy sources. Alternative energy sources are those which are neither strictly classed as renewable nor non-renewable. The sources include thermoelectric generators, fuel cells, and thermionic generators, etc.

6.2.2.2 Climatic zone. A geographic area with a defined range of summer and winter conditions. Climatic zones are further defined in FAA-STD-032.

6.2.2.3 Consider. The word "consider" and all derivations, such as "consideration" and "shall be considered" mean that a candidate energy management and conservation measure is to be evaluated and analyzed for technical merit, practicality, and economic feasibility. "Consider" does not mean to give a candidate measure a passing thought, but rather, to perform an indepth analysis on it and include the analysis in the report.

6.2.2.4 Energy consumption baseline. An energy consumption baseline is a tabulation of the estimated quantities of fuel and energy sources required to meet the needs of a new or modified physical facility. The tabulation can be for hourly, daily, or annual energy consumption as needed to fulfill the requirements of the task. Energy consumption baselines can be provided for national standard and site adapted designs and are based upon specified interior/exterior conditions. The information may be used in FAA's energy management reporting system as reference data.

6.2.2.5 Energy consumption profile. An energy consumption profile is similar to an energy consumption baseline, except that the profile is based upon hourly changes in the interior/exterior conditions. An energy consumption profile can be developed for a 24-hour period or the entire year (8760 hours). Profiles can only be developed for site adapted designs and may also be used as a data reference by the FAA in its energy management reporting system.

6.2.2.6 Energy management and conservation measure. An energy management and conservation measure is a means or method which is primarily intended to reduce energy consumption, or to result in reduced energy consumption or to allow the use of alternate and renewable energy sources.

6.2.2.7 Evaluate. For words such as "evaluate", "evaluation", and "shall be evaluated", see "consider".

Information Handling Services, 1999
August 11, 1999 10:38:37

6.2.2.8 Economizer. Economizer or economizer cycle is a process in heating, ventilating and air conditioning whereby outside air is used to condition the interior space rather than using the mechanical systems except fans. Economizer cycle is used under specific temperature and humidity ranges and is employed to save energy.

6.2.2.9 Examine. Examine means to consider for technical merit.

6.2.2.10 Fuel cell. A fuel cell converts energy generated by chemical reaction into electrical energy. Its function is similar to a battery except that the chemicals generally are supplied from outside the cell.

6.2.2.11 Life cycle cost. Life cycle cost means the total costs of owning, operating, and maintaining a building over its useful life, including its fuel and energy costs, determined on the basis of a systematic evaluation and comparison of alternative building space-conditioning systems, except that in the case of leased buildings, the life cycle cost shall be calculated over the effective remaining term of the lease.

6.2.2.12 Lighting power budget. A lighting power budget is the upper limit of power to be available to provide the lighting needs in accordance with criteria and calculation procedures provided in ASHRAE 90A.

6.2.2.13 Non-renewable energy source. Non-renewable energy source refers to resources such as fuel oil, gasoline, natural gas, liquified petroleum gas, coal, and purchased steam or electricity generated from such resources.

6.2.2.14 Peak load demand shaving. Peak load demand shaving is a process by which electric loads are shed or transferred to standby generator power in order to reduce electric utility power charges which are imposed for dramatic increases in power consumption.

6.2.2.15 Photovoltaic. A photovoltaic system converts sunlight directly into electricity.

6.2.2.16 Physical facility. The total plant required for a subelement or subsystem to function. The physical facility will house, support or protect the subelement or subsystem at a particular geographic location. The physical facility will have various physical characteristics in accordance with the function of the subelement or subsystem. The physical facility can be of the following types depending on the required function:

a. Building - Consists of walls and a roof either single story or multi-story constructed of various material; usually fixed in location and housing personnel and equipment. The building may include air conditioning, power, etc., if required for the particular application.

Information Handling Services, 1999
August 11, 1999 10:38:37

b. Structure - Composed of interrelated parts which together form a structural entity, usually fixed in location containing equipment and which may be manned or unmanned. The structure may include air conditioning, power, etc., if required for the particular application.

c. Enclosure - Interrelated parts which surround or shut in equipment, fixed or movable, usually unmanned. The enclosure may include air conditioning, power, etc., if required for the particular application.

6.2.2.17 Requirement. A specified capability which must be provided by the system, subsystem, end item, contractor, etc. Type of requirements include operational, functional, performance, interface, facility, and verification requirements.

6.2.2.18 Renewable energy source. Renewable energy source refers to resources such as sunlight, wind, geothermal, biomass, solid waste, or other regenerating sources.

6.2.2.19 Solar energy. Energy derived from the sun directly through the solar heating of air, water, or other fluids, by electricity produced from solar photovoltaic or solar thermal processes, or indirectly from the use of wind, biomass or small scale water power.

6.2.2.20 Thermoelectric generators. Thermoelectric generators convert heat energy directly into electricity by using the thermocouple principle. They may be fossil-fueled or radioisotope-fueled.

6.3 Suggested computer programs. Computer program software may perform peak load calculations and the hour-by-hour calculations consistent with this standard. Computer analyses may be used to aid the designer in calculating energy loads, energy consumption, highlighting energy end losses, selecting the best HVAC equipment, sizing equipment capacity for efficiency and economy, and testing effectiveness of differing building characteristics, orientation, and exterior environments as described in this standard. Computer analyses and computer-aided design may be used whenever LCCA will be applied to the design options. Below is a list of suggested software. The list is by no means complete and the A/E is urged to use other programs subject to approval by FAA.

a. Solar

Name	Source
SOLCOST	Control Data's CYBERNET Services

Information Handling Services, 1999
August 11, 1999 10:38:37

b. Building form, exterior and interior

Name	Source
ECUBE 75	Control Data's CYBERNET Services
SUNSET	Dubin - Mindell - Bloome Associates
Glass Comparison	Libbey-Owens-Ford
ARK-2	Perry, Dean & Stewart
B.O.P.	Skidmore, Ownings & Merrill
CCB/CALERDA	Control Data's CYBERNET Services

c. Heating, Ventilating and Air Conditioning

Name	Source
ECUBE 75	Control Data's CYBERNET Services
NBSLD	Control Data's CYBERNET Services
BLAST	U. S. Army Construction Engineering Research Laboratory at Campaign, Ill.
CCB/CALERDA	Control Data's CYBERNET Services
HCC-III (Mini-Deck)	APEC
Equipment Selection	Trane Co.
Duct Program	APEC
Several	Dalton, Dalton, Little & Newport
Several	Giffels Associates, Inc.
Fan Static Calculations	Giffels Associates, Inc.
Energy Calculations I & II	ASHRAE Publications Sales Department

d. Domestic Water Piping Design

Name	Source
Piping Program	APEC
Several	Dalton, Dalton, Little & Newport
Several	Giffels Associates, Inc.

e. Lighting

Name	Source
Lighting II	APEC
Lighting	Dalton, Dalton, Little & Newport
Interior Lighting Analysis & Design	Giffels Associates, Inc.
Lighting Program	Isaac Goodbar
Lighting Program	Illumination Computing Service
Lighting Program	Ian Lewen
Lumen II	Smith, Hinchman & Grylls
Day lighting	Libbey-Owens-Ford

Information Handling Services, 1999
August 11, 1999 10:38:37

f. Electrical Demand

Name	Source
Electrical Demand Load Study	Giffels Associates, Inc.

g. Energy Audit and Baseline

Name	Source
Energy Programs (EP)	Control Data's CYBERNET Services

h. Energy Audit and Life Cycle Cost Analyses

Name	Source
Energy Analyst	American Energy Services, Inc.

Information Handling Services, 1999
August 11, 1999 10:38:37

(THIS PAGE INTENTIONALLY LEFT BLANK)

Information Handling Services, 1999
August 11, 1999 10:38:37

9003329 0011336 439

FAA-STD-010c
August 13, 1975
SUPERSEDING FAA-STD-010b
dated 10/27/72

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
STANDARD

GRAPHIC SYMBOLS FOR DIGITAL LOGIC DIAGRAMS

CHAPTER 1. SCOPE

1. SCOPE. This standard prescribes the graphic symbols to be used in the preparation of digital logic diagrams.

CHAPTER 2. PURPOSE

2. PURPOSE. The purpose of this standard is to provide guidance to personnel involved in the preparation of digital logic diagrams requiring the use of graphic symbols.

CHAPTER 3. REQUIREMENTS

3. APPLICATION. This standard is to be used in the preparation of digital logic diagrams for all FAA technical documentation.

4. GRAPHIC SYMBOLS. Graphic symbols used for digital logic diagrams shall be those specified in the latest issue of American National Standard Institute (ANSI) Y32.14. Graphic symbols not listed in ANSI Y32.14 shall not be used without approval.

NOTICE:

Contractors should submit requests for approval of non-listed symbols to the Contracting Officer.

Information Handling Services, 1999
August 11, 1999 06:22:12

Contracting Officers and all other FAA personnel shall obtain approval of all non-listed symbols from the Reliability Engineering Branch, ARD-350, prior to their use.

(Contractors having a need for this standard may obtain a copy from the Contracting Officer in the Federal Aviation Administration Office issuing the invitation for bids or request for proposals. Requests should fully identify the material desired; that is, the complete document number, date and title, also requests should cite the invitation for bids, request for proposals, or the contract involved, or other use to be made of the requested material).

(Information on obtaining copies of ANSI publications should be directed to American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018).

* * * * *

INDEX OF DOCUMENTS

ANSI Y32.14-1973	Graphic Symbols for logic diagrams (two-state devices)

* * * * *

Information Handling Services, 1999
August 11, 1999 06:22:12

FAA–STD–039A
October 27, 1993

U.S. Department
of Transportation
**Federal Aviation
Administration**

U.S. Department of Transportation

Federal Aviation Administration

Standard

OPEN SYSTEMS ARCHITECTURE AND PROTOCOLS

Information Handling Services, 1999
August 11, 1999 11:13:47

(THIS PAGE INTENTIONALLY LEFT BLANK)

Information Handling Services, 1999
August 11, 1999 11:13:47

DOCUMENT CHANGE NOTICE

1. Originator Name and Address SEIC Washington, DC	2. [ ] Proposed [X] Approved	3. Code Identification N/A 5. Code Identification N/A	4. Standard No. FAA-STD-039A 6. DCN No. 1
7. System Designation NAS	8. Related ECR/NCP No. see #14	9. Contract No. DTFA01-84-C-00017	10. Contractual Activity N/A
11. Configuration Item Nomenclature National Airspace System (NAS) Open System Architecture and Protocols, FAA-STD-039A		12. Effectivity N/A	

This notice informs recipients that the standard identified by the number (and revision letter) shown in block 4 has been changed. The pages changed by this DCN (being those furnished herewithin) carry the same date as the DCN. The page numbers and dates listed below in the summary of changed pages, combined with nonlisted pages of the original issue of the revision shown in block 4, constitute the current version of this specification.

13. DCN No.	14. Pages changed	S*	A/D*	15. Date
1	This change incorporates the following NCP: 16092. This NCP supercedes FAA-STD-039 in its entirety	S		10/27/93

*S = Indicates Supercedes Earlier Pages *A = Indicates Added Page * D = Indicates Deleted Page

Information Handling Services, 1999
August 11, 1999 11:13:47

(THIS PAGE INTENTIONALLY LEFT BLANK)

FOREWORD

This standard establishes a data communications architecture and defines the protocol standards for open systems communications within the National Airspace System (NAS). The architecture defined in this standard is based on the seven layer, Open Systems Interconnection (OSI) Basic Reference Model, as described in the International Organization for Standardization (ISO) document 7498-1.

The NAS will consist of various types of processors and communications networks procured from a variety of vendors. A well defined data communications architecture is required to ensure interoperability between NAS open end-systems.

This standard includes definitions in section 6.1.

Information Handling Services, 1999
August 11, 1999 11:13:47

(THIS PAGE INTENTIONALLY LEFT BLANK)

Information Handling Services, 1999
August 11, 1999 11:13:47

TABLE OF CONTENTS

Paragraph	Title	Page
1.	SCOPE	1
1.1	Scope	1
1.2	Purpose	1
2.	APPLICABLE DOCUMENTS	3
2.1	Government Documents	3
2.2	Non-Government Documents	3
3.	REQUIREMENTS	11
3.1	General	11
3.2	NAS Open System Profile	11
3.2.1	Upper-Layers	11
3.2.1.1	Application Layer Protocol Standards	21
3.2.1.1.1	Function of Application Layer Protocols	21
3.2.1.1.2	Application Layer Protocol Specification	21
3.2.1.1.2.1	Association Control Service Element	21
3.2.1.1.2.2	Remote Operations Service Element	21
3.2.1.1.2.3	File Transfer, Access, and Management	22
3.2.1.1.2.4	Message Handling System	22
3.2.1.1.2.5	Transaction Processing	22
3.2.1.1.2.6	Virtual Terminal	22
3.2.1.2	Presentation Layer Protocol Standards	22
3.2.1.2.1	Function of Presentation Layer Protocols	22
3.2.1.2.2	Presentation Layer Protocol Specification	23
3.2.1.2.3	Session Layer Protocol Standards	23
3.2.1.2.3.1	Function of Session Layer Protocols	23
3.2.1.2.3.2	Session Layer Protocol Specification	23
3.2.2	Lower-layers	24
3.2.2.1	Transport Layer Protocol Standards	24
3.2.2.1.1	Function of Transport Layer Protocols	24
3.2.2.1.2	Transport Layer Protocol Specification	24
3.2.2.1.2.1	Connection-Oriented Transport Service	24
3.2.2.1.2.2	Connectionless Transport Service	25
3.2.2.2	Network Layer Protocol Standards	25
3.2.2.2.1	Function of Network Layer Protocols	25
3.2.2.2.2	Network Layer Protocol Specification	25
3.2.2.2.2.1	Connectionless-Mode Network Service (CLNS)	25
3.2.2.2.2.1.1	Connectionless Network Protocol Functions	25

Information Handling Services, 1999
August 11, 1999 11:13:47

TABLE OF CONTENTS

Paragraph	Title	Page
3.2.2.2.2.1.2	Provision of the Underlying Service	26
3.2.2.2.2.1.3	Provision for Routing Protocols	26
3.2.2.2.2.1.3.1	End System to Intermediate System Routing Protocol	26
3.2.2.2.2.1.3.2	Intermediate System to Intermediate System Intra-Domain Routing Protocol	26
3.2.2.2.2.1.3.3	Boundary Intermediate System to Boundary Intermediate System Inter-Domain Routing Protocol	26
3.2.2.2.2.2	Connection-Oriented Network Service (CONS)	26
3.2.2.2.2.2.1	Optional User Facilities (for X.25 subnetworks)	27
3.2.2.2.2.2.2	Optional User Facilities (for ISO 8208 systems)	28
3.2.2.3	Data Link Layer Protocol Standards	28
3.2.2.3.1	Function of Data Link Layer Protocols	28
3.2.2.3.2	Data Link Layer Protocol Specification	28
3.2.2.3.2.1	High-level Data Link Control (HDLC) ISO 4335	28
3.2.2.3.2.1.1	CCITT X.25 LAPB	29
3.2.2.3.2.1.2	ISO 7776	29
3.2.2.3.2.2	ISO 7478 (Multilink Procedure)	29
3.2.2.3.2.3	CCITT X.32	30
3.2.2.3.2.4	ISO 8802-2	30
3.2.2.4	Physical Layer Protocol Standards	30
3.2.2.4.1	Function of Physical Layer Protocol Standards	30
3.2.2.4.2	Physical Layer Protocol Specification	30
3.2.2.4.2.1	EIA-530	31
3.2.2.4.2.2	EIA-232E	31
3.2.2.4.2.3	RS-232C	32
3.2.2.4.2.4	V.35	32
3.2.2.4.2.5	V.32	32
3.2.2.4.2.6	ISO 8802-x and ISO 9314-1	33
3.3	Naming and Addressing	33
3.4	OSI Directory Services	33
3.5	OSI Network Management	33
3.6	OSI Security	33
3.7	OSI Priority	33
4.	QUALITY ASSURANCE PROVISION	35
5.	PREPARATION FOR DELIVERY	37

Information Handling Services, 1999
August 11, 1999 11:13:47

TABLE OF CONTENTS

Paragraph	Title	Page
6.	NOTES	39
6.1	Definitions	39
6.2	Acronyms and Abbreviations	40

APPENDIX I

10.	X.25 Services.	I-1

FIGURES

Figure		Page
1	OSI Basic Reference Model	12
2	Standard Protocols for NAS Open Systems Communicating via Wide Area Networks (e.g., NADIN PSN)	13
3	Standard Protocols for NAS Open Systems Communicating via AAS LCN	14
4	Standard Protocols for NAS Open Systems Communicating via LANs (Except AAS LCN)	15
5	Standard Protocols for Communicating Between NAS Open End System and NAS Router via Wide Area Network (e.g., NADIN PSN)	16
6	Standard Protocols for Communicating Between NAS Open End System and NAS Router Communication via AAS LCN	17
7	Standard Protocols for Communicating Between NAS Open End System and NAS Router Communication via LANs (Except AAS LCN)	18
8	Standard Protocols for Communicating Between NAS Router and NAS Router	19
9	Standard Protocols for Communicating Between NAS BIS Router and Non-NAS BIS Router	20

Information Handling Services, 1999
August 11, 1999 11:13:47

(THIS PAGE INTENTIONALLY LEFT BLANK)

Information Handling Services, 1999
August 11, 1999 11:13:47

1. SCOPE

1.1 Scope. This standard specifies a minimal set of protocol and service requirements for the National Airspace System (NAS). The minimum set defined herein may exceed the minimal requirements for a particular end-system, but is necessary to facilitate interoperability. Additional protocols and services may be implemented for interfacing NAS open end-systems by mutual agreement. Requirements for NAS open end-system connectivity to the Aeronautical Telecommunication Network (ATN) are contained in the International Civil Aviation Organization (ICAO) ATN Manual.

The communications architecture and protocols described herein shall be used by Federal Aviation Administration (FAA) in the development of interface requirements as part of the design, procurement, and overall data communications planning of the NAS.

1.2 Purpose. The purpose of this standard is to establish a communications architecture for the modernization of NAS data communication systems. This standard also facilitates a migration for the implementation of OSI standards [ISO, International Telegraph and Telephone Consultative Committee (CCITT), American National Standards Institute (ANSI)] for existing NAS end-systems. It also facilitates interoperability of these systems. The communications architecture defined in this standard will incorporate FAA-developed standards, which are OSI compliant, where international/national standards are not available or feasible in meeting NAS-specific data communications requirements.

Information Handling Services, 1999
August 11, 1999 11:13:47

(THIS PAGE INTENTIONALLY LEFT BLANK)

Information Handling Services, 1999
August 11, 1999 11:13:47

2. APPLICABLE DOCUMENTS

2.1 Government Documents. The following documents form a part of this standard to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this standard, the contents of this standard shall be considered the superseding requirement.

FAA Standards

FAA-STD-042	National Airspace System (NAS) Open Systems Interconnection (OSI) Naming and Addressing, January 9, 1992
FAA-STD-043	National Airspace System (NAS) Open Systems Interconnection (OSI) Priority, January 9, 1992
FAA-STD-044	National Airspace System (NAS) Open Systems Interconnection (OSI) Directory Services, October 23, 1992

Federal Standards

FED-STD-1020A	Electrical Characteristics of Balanced Voltage Digital Interface Circuits
FED-STD-1030A	Electrical Characteristics of Unbalanced Voltage Digital Iterface Circuits
FED-STD-1032	High Speed 25-position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment
FIPS PUB 107	Baseband Carrier Sense Multiple Access with Collision Detection Access Method and Physical Layer Specifications and Link Layer Protocol
FIPS PUB 146-1	Government Open Systems Interconnection Profile (GOSIP), Version 2.0
FIPS PUB 154	High Speed 25-position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment

National Institute of Standards and Technology

NIST SP-500-206	Stable Implementation Agreements for OSI Protocols, Version 4

2.2 Non-Government Documents

Electronic Industries Association (EIA)

EIA-232D/E	Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange

Information Handling Services, 1999
August 11, 1999 11:13:47

EIA-530	High Speed 25-position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment
RS-232C	Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
RS-422A	Electrical Characteristics of Balanced Voltage Digital Interface Circuits
RS-423A	Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits

International Civil Aviation Organization

ICAO ATN Manual	Manual of the Aeronautical Telecommunication Network, Second Edition, June 18, 1993

International Telegraph and Telephone Consultative Committee (CCITT)

CCITT V.24	List of Definitions for Interchange Circuits Between Data Terminal Equipment and Data Circuit-Terminating Equipment
CCITT V.28	Electrical Characteristics for Unbalanced Double-Current Interchange Circuits
CCITT V.32A	Family of 2-wire, Duplex Modems Operating at Data Signalling Rates of Up to 9600 Bit/s for Use on the General Switched Telephone Network and on Leased Telephone-Type Circuits
CCITT V.35	Data Transmission at 48 Kilobits Per Second Using 60-108 kHz Group Band Circuits
CCITT X.21 bis	Use on Public Data Networks of Data Terminal Equipment (DTE) Which is Designed for Interfacing to Synchronous V-Series Modems - 1984
CCITT X.25	Interface Between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) for Terminals Operating in the Packet Mode on Public Data Networks - 1984
CCITT X.29	Procedures for the Exchange of Control Information and User Data Between a Packet Assembly/Disassembly (PAD) Facility and a Packet Mode DTE or Another PAD - 1984

Information Handling Services, 1999
August 11, 1999 11:13:47

CCITT X.32	Interface Between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) for Terminals Operating in the Packet-Mode and Accessing a Packet Switched Public Data Network through a Public Switched Telephone Network or a Circuit Switched Public Data Network - 1984
CCITT X.121	International Numbering Plan for Public Data Networks

International Organization for Standardization (ISO)

ISO 2110:1989	Information Technology - Data Communication - 25-Pin Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) Interface Connector and Contact Number Assignments, 3rd Edition
ISO 2593:1984	Data Communication - 34-Pin Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) Interface Connector and Pin Assignments, 2nd Edition
ISO 3309:1984	Information Processing Systems - Data Communication - High-level Data Link Control Procedures - Frame Structure, 3rd Edition
ISO 4335:1987	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Elements of Procedures, 3rd Edition
ISO 7478:1987	Information Processing Systems - Data Communication - Multilink Procedures, 1st Edition
ISO 7498-1:1984	Information Processing Systems - Open Systems Interconnection - Part 1: Basic Reference Model, 1st Edition
ISO/IEC 7498-2:1989	Information Processing Systems - Open Systems Interconnection - Basic Reference Model - Part 2: Security Architecture, 1st Edition
ISO/IEC 7498-3:1989	Information Processing Systems - Open Systems Interconnection - Basic Reference Model - Part 3: Naming and Addressing, 1st Edition
ISO/IEC 7498-4:1989	Information Processing Systems - Open Systems Interconnection - Basic Reference Model - Part 4: Management Framework, 1st Edition
ISO 7776:1986	Information Processing Systems - Data Communication - High-Level Data Link Control Procedures - Description of the X.25 LAPB-Compatible DTE Data Link Procedures, Version 1

Information Handling Services, 1999
August 11, 1999 11:13:47

ISO 7809:1984	Information Processing Systems - Data Communication - High-Level Data Link Control Procedures - Consolidation of Classes of Procedures, 1st Edition
ISO 8072:1986	Information Processing Systems - Open System Interconnection - Transport Service Definition, 1st Edition
ISO/IEC 8073:1988	Information Processing Systems - Open Systems Interconnection - Connection Oriented Transport Protocol Specification, 2nd Edition
ISO/IEC 8073:1988/ AD2:1989	Information Processing Systems - Open Systems Interconnection - Connection Oriented Transport Protocol Specification - Addendum 2: Class four Operation Over Connectionless Network Service
ISO/IEC 8208:1990	Information Processing Systems - Data Communications - X.25 Packet Level Protocol for Data Terminal Equipment, 2nd Edition
ISO 8326:1987	Information Processing Systems - Open Systems Interconnection - Basic Connection Oriented Session Service Definition, 1st Edition
ISO 8326/DAD2	Information Processing Systems - Open Systems Interconnection - Basic Connection Oriented Session Service Definition - Addendum 2: Incorporation of Unlimited User Data, June 1988
ISO 8327:1987	Information Processing Systems - Open Systems Interconnection - Basic Connection Oriented Session Protocol Specification, 1st Edition
ISO 8327/DAD2	Information Processing Systems - Open Systems Interconnection - Basic Connection Oriented Session Protocol Specification - Addendum 2: Incorporation of Unlimited User Data, June 1988
ISO 8348:1987	Information Processing Systems - Data Communications - Network Service Definition, 1st Edition

Information Handling Services, 1999
August 11, 1999 11:13:47

ISO 8348:1987/ AD1:1987	Information Processing Systems - Data Communications - Network Service Definition - Addendum 1: Connectionless Mode Transmission
ISO 8348:1987/ AD2:1988	Information Processing Systems - Data Communications - Network Service Definition - Addendum 2: Network Layer Addressing
ISO 8473:1988	Information Processing Systems - Data Communications - Protocol for Providing the Connectionless-Mode Network Service (CLNS), 1st Edition
ISO 8473:1988/ AD3:1989	Information Processing Systems - Data Communications - Protocol for Providing the Connectionless-Mode Network Service - Addendum 3: Provision of the Underlying Service Assumed by ISO 8473 over Subnetworks which Provide the OSI Data Link Service, 1st Edition
ISO 8571-1:1988	Information Processing Systems - Open Systems Interconnection - File Transfer, Access, and Management - Part 1: General Introduction, 1st Edition
ISO 8571-2:1988	Information Processing Systems - Open Systems Interconnection - File Transfer, Access, and Management - Part 2: Virtual Filestore Definition, 1st Edition
ISO 8571-3:1988	Information Processing Systems - Open Systems Interconnection - File Transfer, Access, and Management - Part 3: File Service Definition, 1st Edition
ISO 8571-4:1988	Information Processing Systems - Open Systems Interconnection - File Transfer, Access, and Management - Part 4: File Protocol Specification, 1st Edition
ISO 8602:1987	Information Processing Systems - Open Systems Interconnection - Protocol for Providing the Connectionless-mode Transport Service, 1st Edition
ISO 8648:1988	Information Processing Systems - Open Systems Interconnection - Internal Organization of the Network Layer, 1st Edition
ISO 8649:1988	Information Processing Systems - Open Systems Interconnection - Service Definition for the Association Control Service Element, 1st Edition

Information Handling Services, 1999
August 11, 1999 11:13:47

ISO 8650:1988	Information Processing Systems - Open Systems Interconnection - Protocol Specification for the Association Control Service Element, 1st Edition
ISO/IEC 8802-2:1990	Information Processing Systems - Local Area Networks - Part 2: Logical Link Control, 1st Edition
ISO/IEC 8802-3:1990	Information Processing Systems - Local Area Networks - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications, 2nd Edition
ISO/IEC 8802-4:1990	Information Processing Systems - Local Area Networks - Part 4: Token-Passing Bus Access Method and Physical Layer Specifications, 1st Edition
ISO/IEC 8802-5:1990	Information Processing Systems -Local Area Networks - Part 5: Token Ring Access Method and Physical Layer Specification, 1st Edition
ISO 8822:1988	Information Processing Systems - Open Systems Interconnection - Connection Oriented Presentation Service Definition, 1st Edition
ISO 8823:1988	Information Processing Systems - Open Systems Interconnection - Connection Oriented Presentation Protocol Specification, 1st Edition
ISO 8824:1987	Information Processing Systems - Open Systems Interconnection - Specification of Abstract Syntax Notation One (ASN.1), 1st Edition
ISO 8825:1987	Information Processing Systems - Open Systems Interconnection - Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1), 1st Edition
ISO 8878:1987	Information Processing Systems - Data Communications - Use of X.25 to Provide the OSI Connection-mode Network Service (CONS), 1st Edition
ISO 8880-1:1988	Information Processing Systems - Protocol Combinations to Provide and Support the OSI Network Service - Part 1: General Principles, 1st Edition
ISO 8880-2:1988	Information Processing Systems - Protocol Combinations to Provide and Support the OSI Network Service - Part 2: Provision and Support of the Connection-Mode Network Service, 1st Edition

Information Handling Services, 1999
August 11, 1999 11:13:47

ISO 8880-3:1988	Information Processing Systems - Protocol Combinations to Provide and Support the OSI Network Service - Part 3: Provision and Support of the Connectionless-Mode Network Service, 1st Edition
ISO/IEC 8886	Information Processing Systems - Data Communication - Data Link Service Definition for Open Systems Interconnection, April 1992
ISO 9040:1990	Information Processing Systems - Open Systems Interconnection - Virtual Terminal Basic Class Service, 1st Edition
ISO 9041-1:1990	Information Processing Systems - Open Systems Interconnection - Virtual Terminal Basic Class Protocol - Part 1: Specification
ISO 9072-1:1989	Information Processing Systems - Text Communication - Remote Operations - Part 1: Model, Notation and Service Definition, 1st Edition
ISO 9072-2:1989	Information Processing Systems - Text Communication - Remote Operations - Part 2: Protocol Specification, 1st Edition
ISO 9314-1:1989	Information Processing Systems - Fibre Distributed Data Interface (FDDI) - Part 1: Physical Layer Protocol (PHY), 1st Edition
ISO 9542:1988	Information Processing Systems - Telecommunications and Information Exchange Between Systems - End System to Intermediate System Routing Exchange Protocol for Use in Conjunction with the Protocol for Providing the Connectionless-mode Network Service
ISO 9545:1988	Information Technology - Open System Interconnection -Application Layer Structure, 1st Edition
ISO/IEC 10021-1:1990	Information Processing - Text Communication - Message Oriented Text Interchange System - Part 1: System and Service Overview
ISO/IEC 10021-2:1990	Information Processing - Text Communication - Message Oriented Text Interchange System - Part 2: Overall Architecture

Information Handling Services, 1999
August 11, 1999 11:13:47

ISO/IEC 10021-3:1990	Information Processing - Text Communication - Message Oriented Text Interchange System - Part 3: Abstract Service Definition Conventions
ISO/IEC 10021-4:1990	Information Processing - Text Communication - Message Oriented Text Interchange System - Part 4: Message Transfer System: Abstract Service Definition and Procedures
ISO/IEC 10021-5:1990	Information Processing - Text Communication - Message Oriented Text Interchange System - Part 5: Message Store: Abstract Service Definition
ISO/IEC 10021-6:1990	Information Processing - Text Communication - Message Oriented Text Interchange System - Part 6: Protocol Specifications
ISO/IEC 10021-7:1990	Information Processing - Text Communication - Message Oriented Text Interchange System - Part 7: Interpersonal Messaging System
ISO/IEC 10026-1:1992	Information Processing Systems - Open Systems interconnection - Distributed Transaction Processing - Part 1: Model
ISO/IEC 10026-2:1992	Information Processing Systems - Open Systems interconnection - Distributed Transaction Processing - Part 2: Service Definition
ISO/IEC 10026-3:1992	Information Processing Systems - Open Systems interconnection - Distributed Transaction Processing - Part 3: Protocol Specification
ISO/IEC 10589:1992	Information Technology - Telecommunication and Information Exchange between Systems - Intermediate System (IS) to IS - Intra-Domain Routing Information Exchange Protocol for use in conjunction with the Connectionless-mode Network Service.
ISO/IEC 10747:1993	Information Processing Systems - Telecommunications and Information Exchange between Systems - Protocol Exchange of Inter-Domain Routing Information among Intermediate Systems to Support Forwarding of ISO 8473 PDUs

Information Handling Services, 1999
August 11, 1999 11:13:47

3. REQUIREMENTS

3.1 General. This standard evolved from a requirement to provide a standard data communications architecture and protocols to facilitate the interconnection and interoperability of NAS open end-systems. NAS-SS-1000, Volume IV, paragraph 3.1.4.1, states that all interfaces shall conform to the ISO Basic Reference Model (ISO 7498-1). In addition, this standard supports convergence of FAA interfaces with OSI interface profiles to the extent compatible with specific FAA Mission elements, including the FAA primary mission to provide for " ...safe and efficient air traffic control...".

The implementation of an OSI architecture is specified as a general requirement, together with the use of appropriate ISO/CCITT/Institute of Electrical and Electronics Engineers (IEEE) and FAA-unique protocols for providing a set of standardized services. The protocol implementation requirements defined in this document are based on the Government Open Systems Interconnection Profile (GOSIP), FIPS PUB 146-1, and the Stable Implementation Agreements for OSI Protocols, NIST SP-500-206.

3.2 NAS Open System Profile. The NAS open systems data communications architecture shall be compliant with the OSI Basic Reference Model shown in Figure 1. The reference model can be divided into two groups of layers; upper layers and lower layers.

The first four OSI layers form the "lower layers" of the ISO/OSI model. These provide the end-to-end services responsible for data transfer. The remaining three OSI layers form the "upper layers" of the ISO/OSI model. These provide the application services responsible for information transfer. The NAS open end-systems profile defines the services and protocols selected for use at each layer.

The reference model can be divided into two groups of layers; upper layers and lower layers. Figures 2, 3, and 4 show the protocol architecture to be used for NAS open end-system communicating via the wide area networks (i.e., the NADIN PSN), Advanced Automation System (AAS) Local Communications Network (LCN), and Local Area Networks (LAN). Figures 5, 6, 7, 8, and 9 show the protocol architecture for NAS routers to be used when enabling communications between open end systems on separate subnetworks. The technical characteristics of each protocol standard and service definition are defined herein. Requirements for NAS open end-system connectivity to the Aeronautical Telecommunication Network (ATN) are contained in the International Civil Aviation Organization (ICAO) ATN Manual.

3.2.1 Upper-Layers. Layers 5, 6, and 7 (Session, Presentation, and Application) of the OSI Reference Model are responsible for the protocols necessary to allow two dissimilar systems to understand each other and communicate. This section describes the protocols selected for the implementation of the OSI upper-layers in the NAS.

Information Handling Services, 1999
August 11, 1999 11:13:47

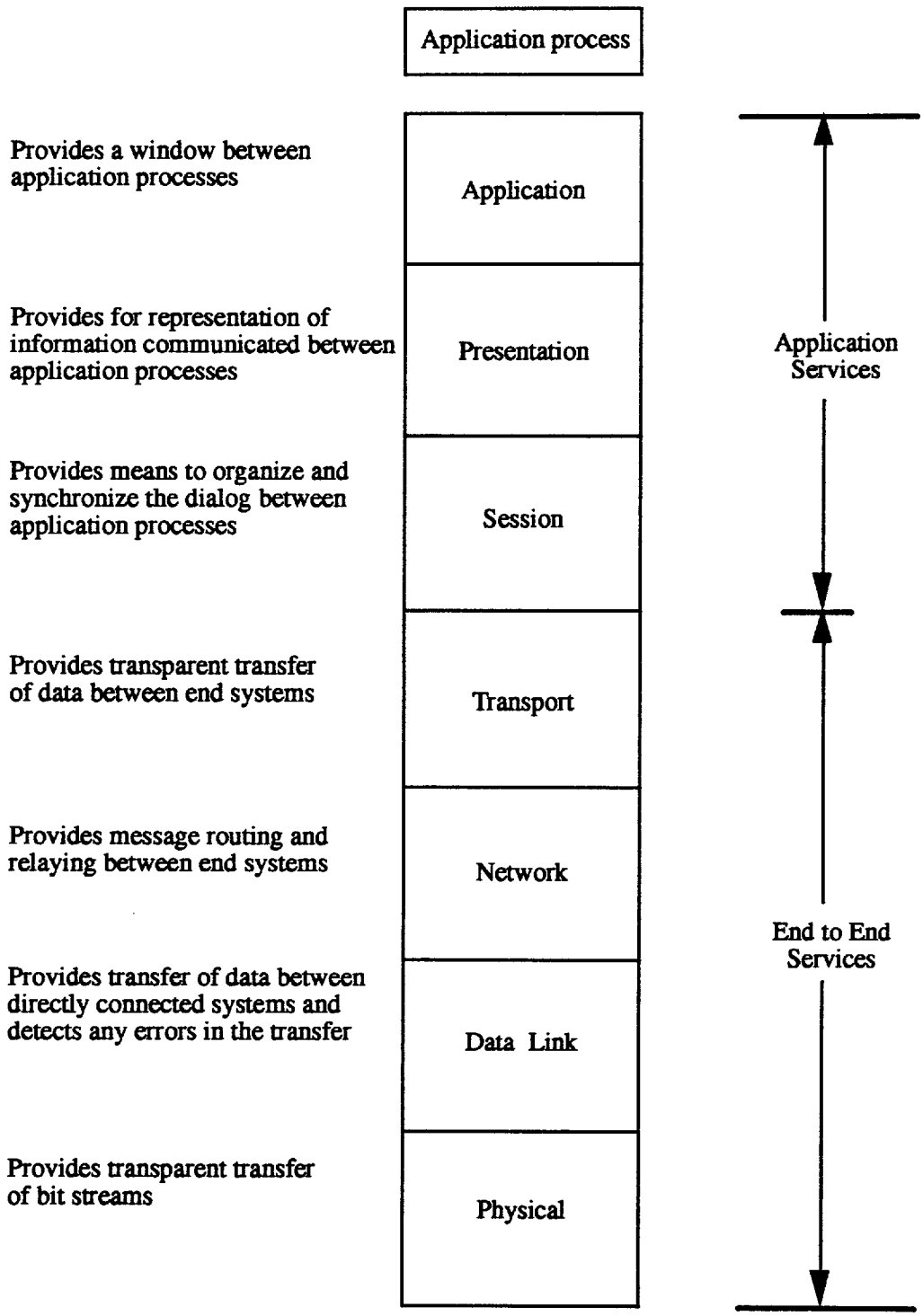


FIGURE 1 OSI Basic Reference Model

Information Handling Services, 1999
August 11, 1999 11:13:47

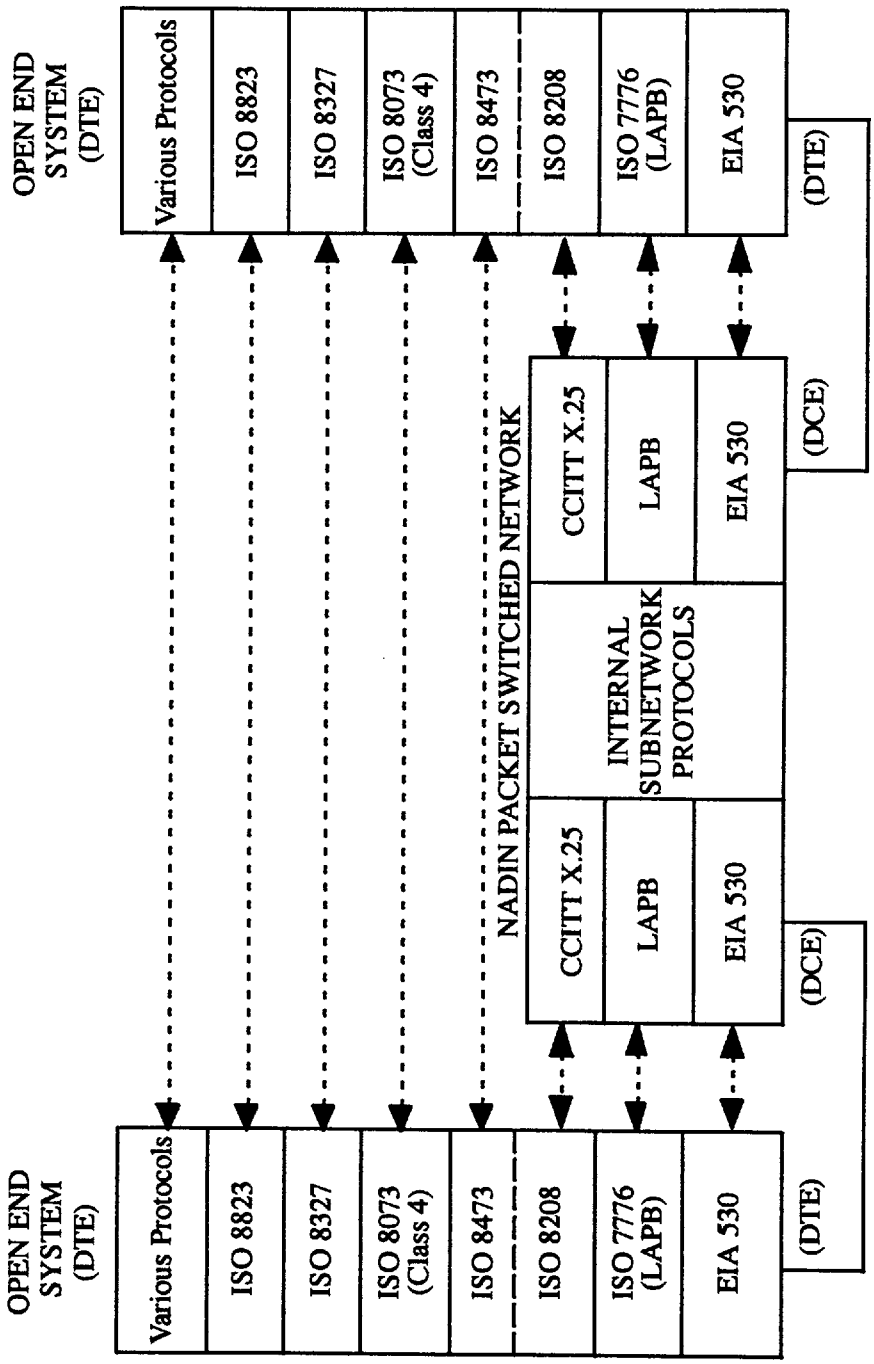


FIGURE 2 Standard Protocols for NAS Open Systems Communicating via Wide Area Networks (e.g., NADIN PSN)

Information Handling Services, 1999
August 11, 1999 11:13:47

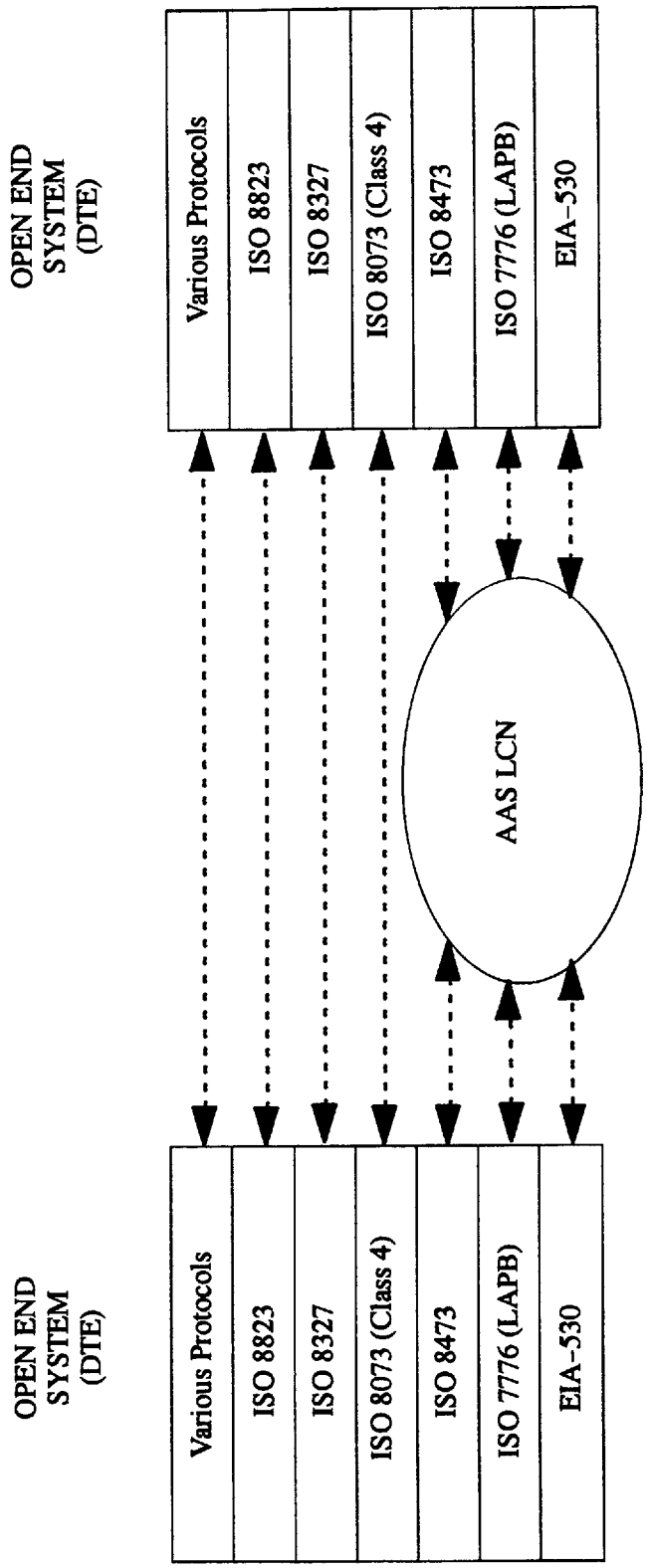


FIGURE 3 Standard Protocols for NAS Open Systems Communicating via AAS LCN

Information Handling Services, 1999
August 11, 1999 11:13:47

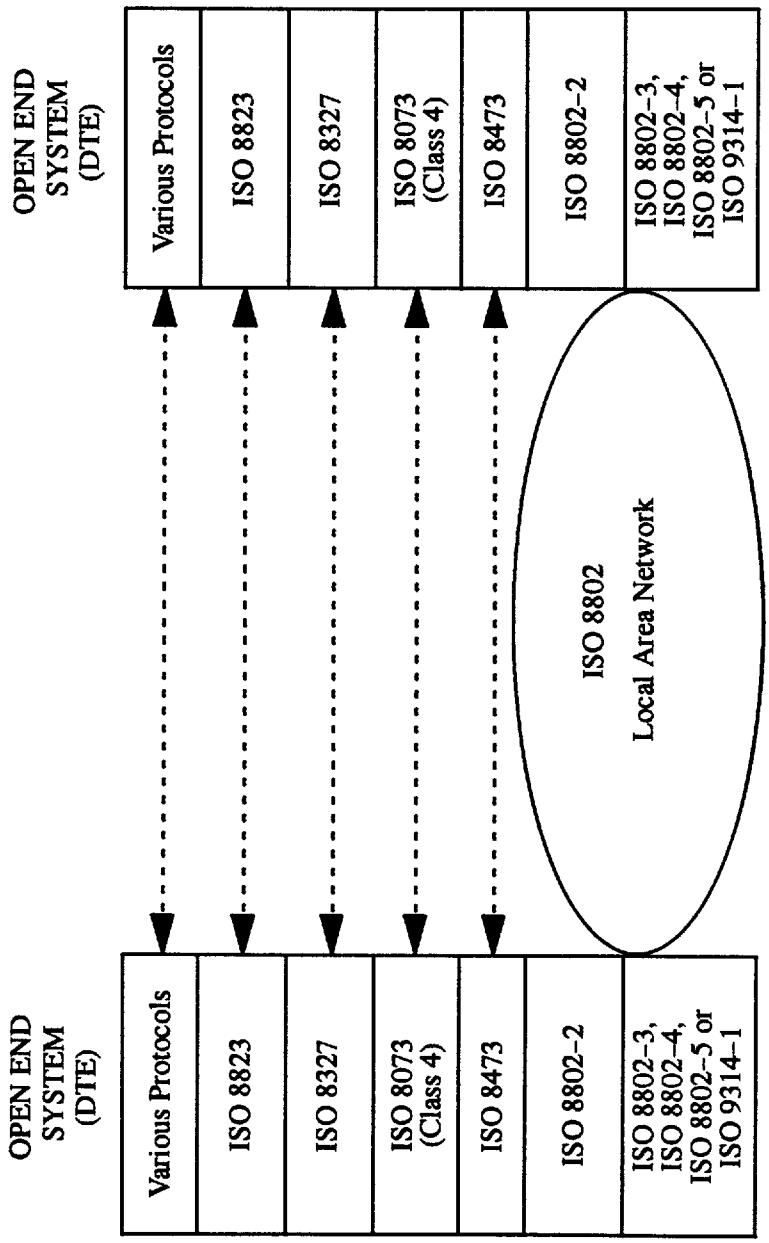


FIGURE 4 Standard Protocols for NAS Open Systems Communicating via LANs (Except AAS LCN)

Information Handling Services, 1999
August 11, 1999 11:13:47

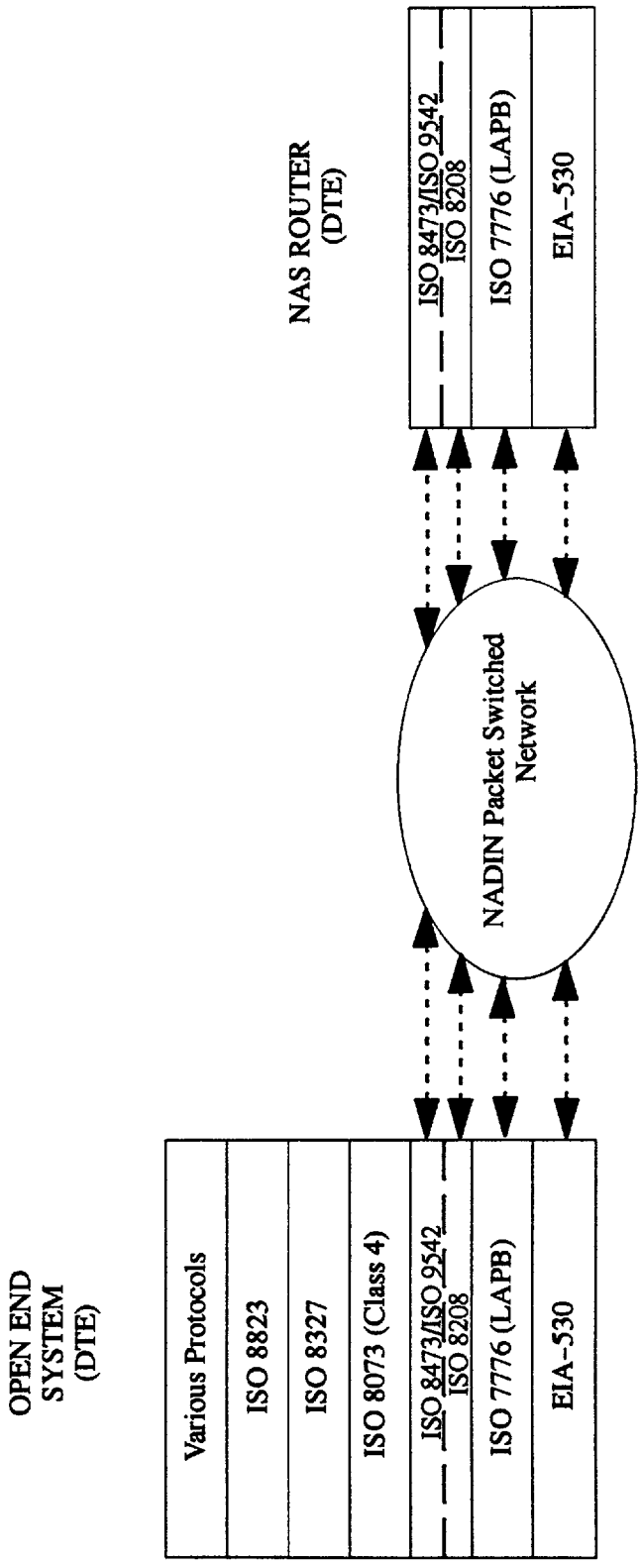


FIGURE 5 Standard Protocols for Communicating Between NAS Open End System and NAS Router via Wide Area Network (e.g., NADIN PSN)

Information Handling Services, 1999
August 11, 1999 11:13:47

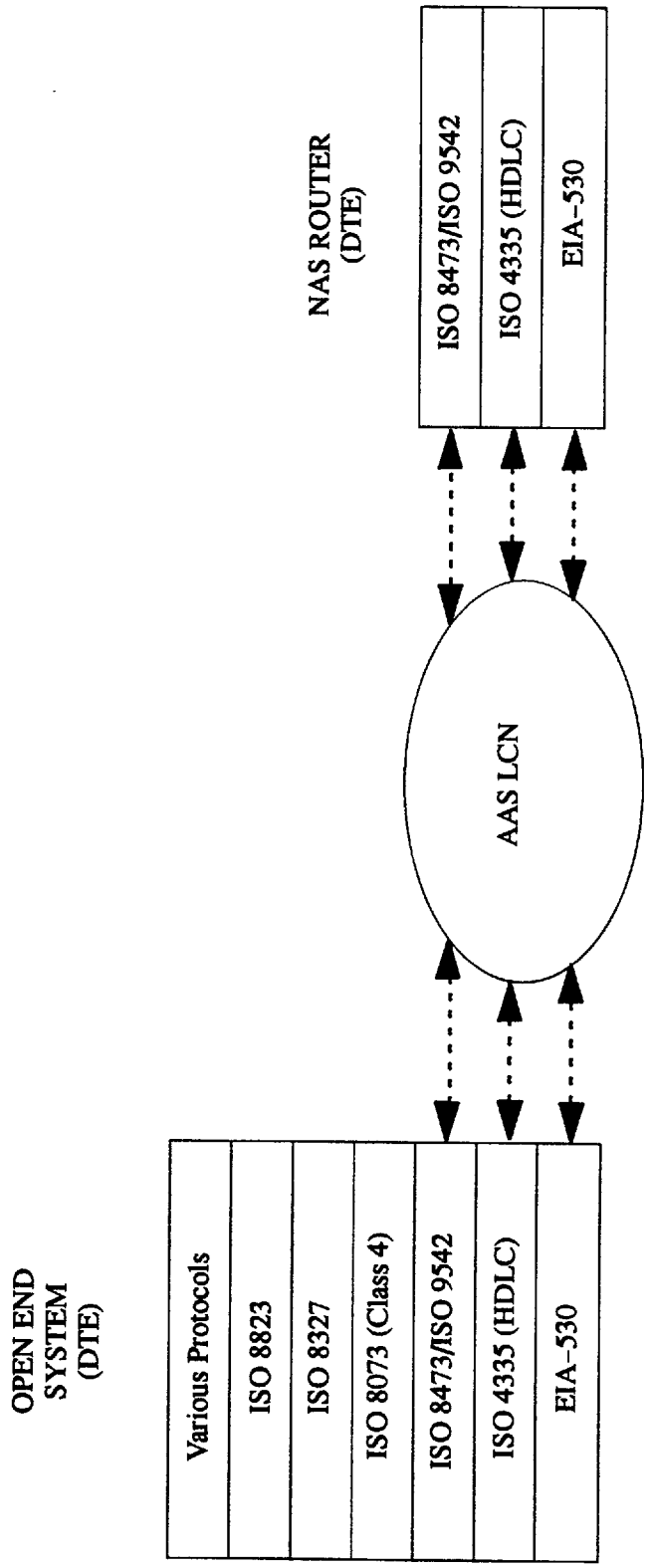


FIGURE 6 Standard Protocols for Communicating Between NAS Open End System and NAS Router Communication via AAS LCN

Information Handling Services, 1999
August 11, 1999 11:13:47

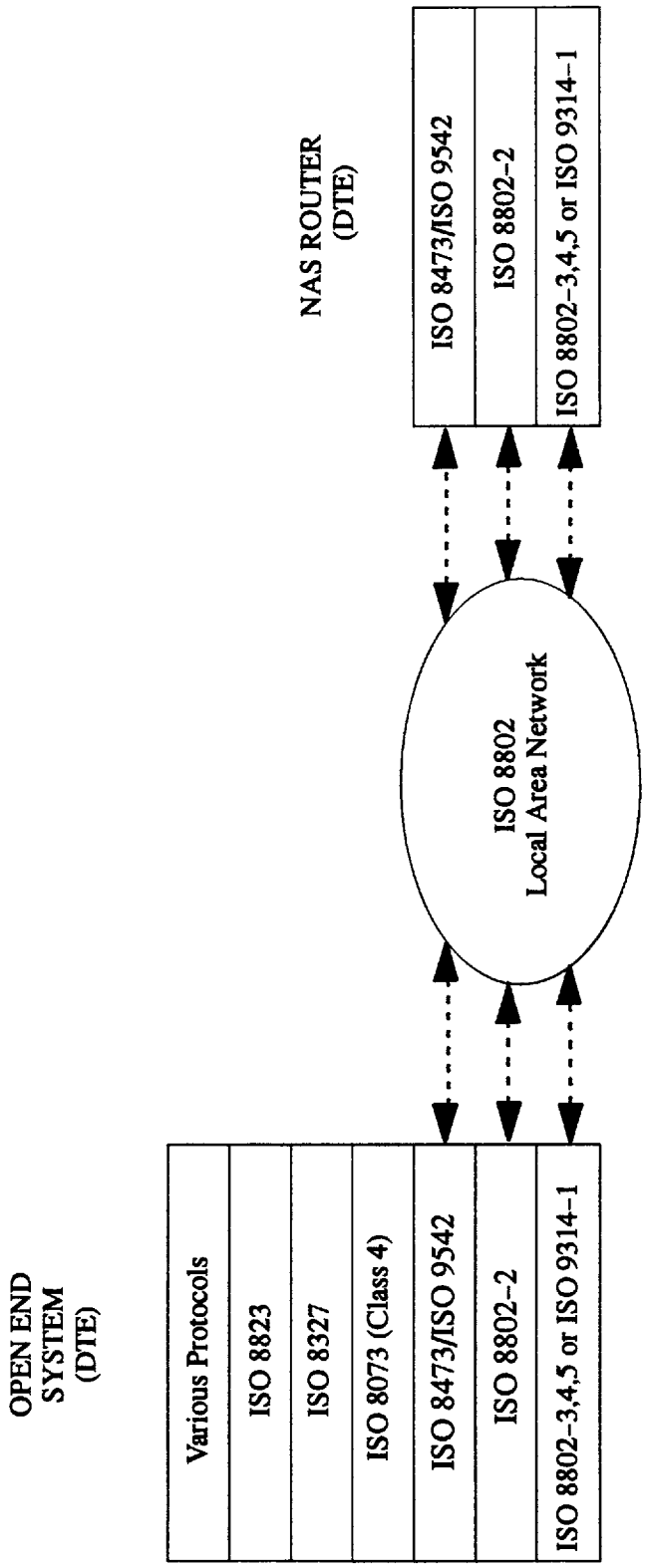


FIGURE 7 Standard Protocols for Communicating Between NAS Open End System and NAS Router Communication via LANs (Except AAS LCN)

Information Handling Services, 1999
August 11, 1999 11:13:47

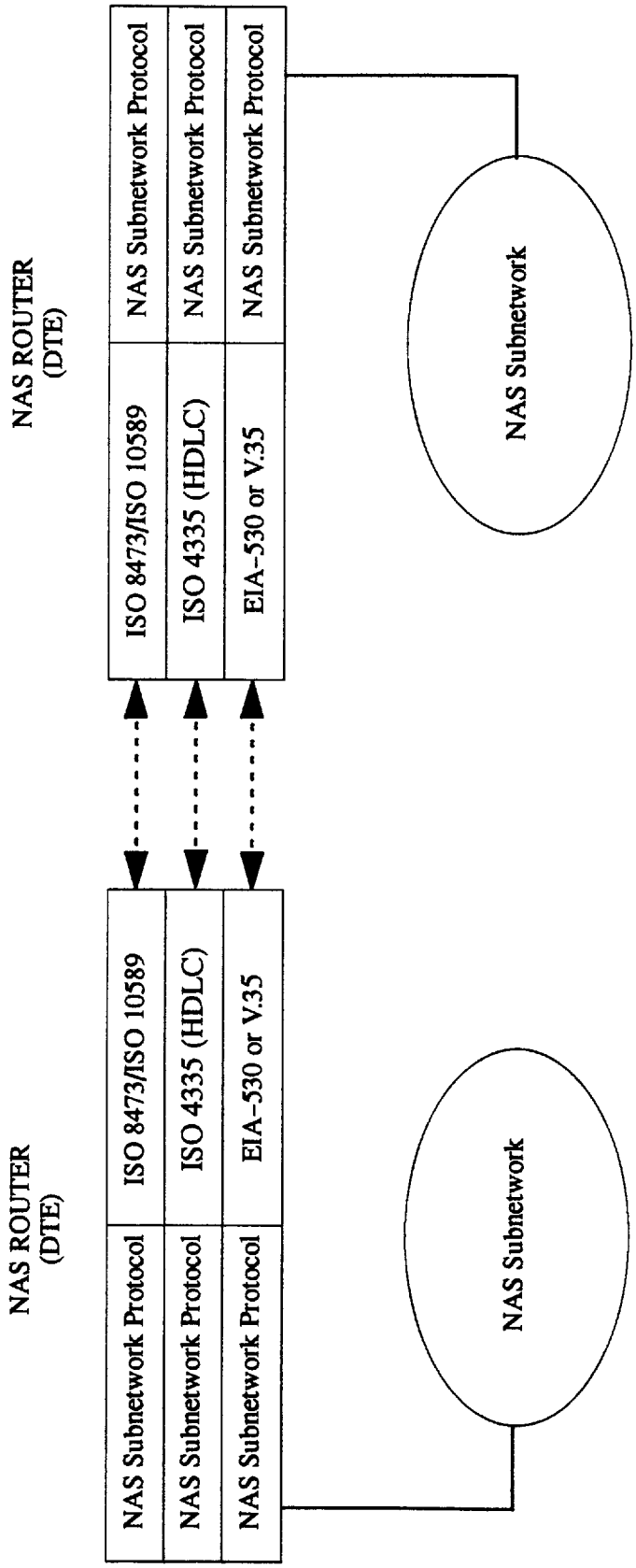


FIGURE 8 Standard Protocols for Communicating Between NAS Router and NAS Router

Information Handling Services, 1999
August 11, 1999 11:13:47

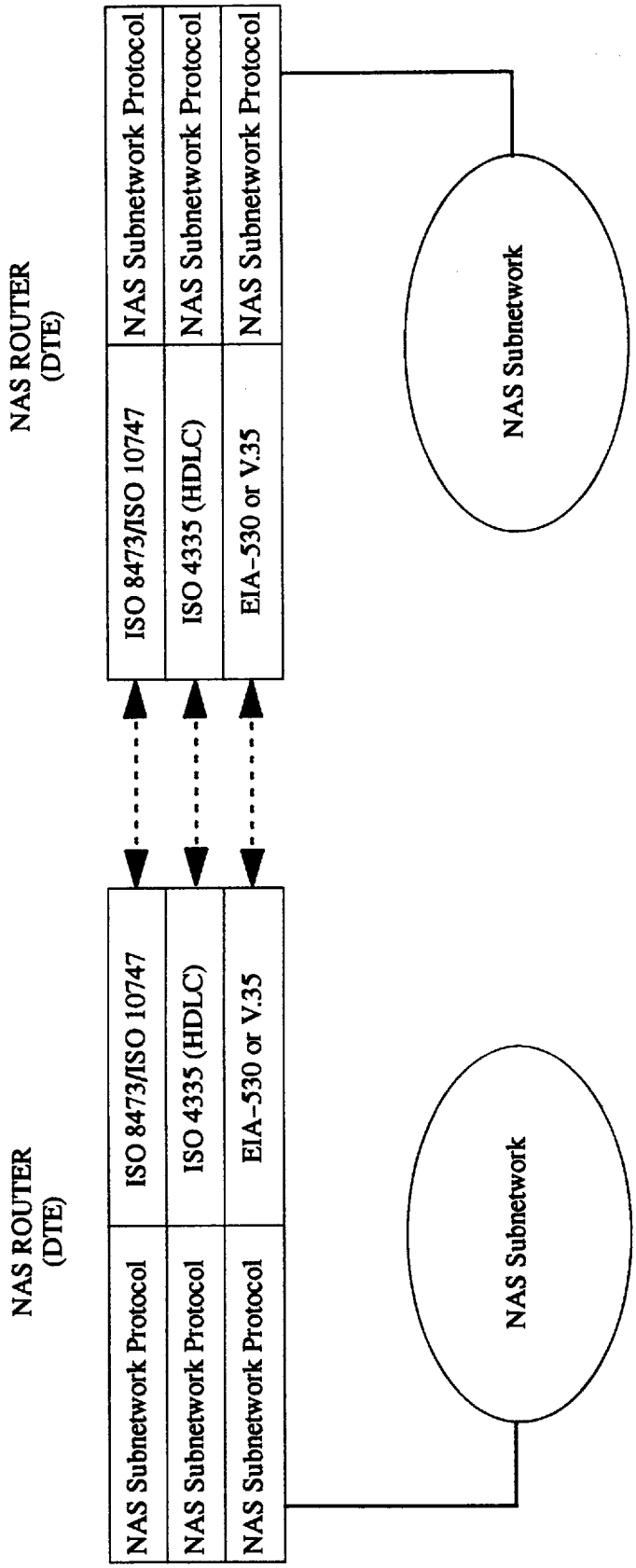


FIGURE 9 Standard Protocols for Communicating Between NAS BIS Router and Non-NAS BIS Router

Information Handling Services, 1999
August 11, 1999 11:13:47

3.2.1.1 Application Layer Protocol Standards. This section describes the Application Layer protocols selected for use by NAS open end-systems.

3.2.1.1.1 Function of Application Layer Protocols. The Application Layer allows for functions and services required by particular user-designed application processes. Functions satisfying particular user requirements are contained in this layer. Representation and transfer of information necessary to communicate between applications are the responsibility of the lower layers. The Application Layer functions are provided by application service elements (ASE). ISO 9545, Application Layer Structure, defines the nature of ASEs, the relationships among them, and the architectural framework in which individual OSI compliant Application Layer protocols are developed.

3.2.1.1.2 Application Layer Protocol Specification. NAS open end-systems will use common application service elements (ASE) to provide application layer services common to users applications. These ASEs include Association Control Service Element (ACSE) and Remote Operations Service Element (ROSE). NAS open end-systems may select from several specific ASEs to satisfy particular open end-system requirements. These ASEs include File Transfer, Access, and Management (FTAM), Message Handling System (MHS), Transaction Processing (TP), and Virtual Terminal (VT).

3.2.1.1.2.1 Association Control Service Element (ACSE). All NAS open end-systems shall implement the service of ACSE as defined in ISO 8649 and the protocol as defined in ISO 8650. The ACSE has two classes of service: Class 1 and Class 2. Class 1 consists of association control and information transfer facilities for operation in a known context. Class 2 consists of all Class 1 service elements, plus the mandatory service elements of the context management facility. The ACSE facilities are specified as follows:

(a) The association control facility is provided to initiate, maintain, and release an association between two application entities. It provides service elements to originate a new application association, including defining the application context and initiating a presentation connection.

(b) The information transfer facility is a set of application service elements that transfer information between associated application entities.

(c) The context management facility negotiates the sets of service elements to be used during the lifetime of the application association and allows switching between agreed contexts.

NAS open end-systems shall implement the association control and information transfer facilities at a minimum. They shall support Class 1 or 2 as required.

3.2.1.1.2.2 Remote Operations Service Element. ROSE, which is used in conjunction with other ASEs, defines the services and notations necessary to support interactive applications between distributed processing systems. NAS open end-system shall implement ROSE in accordance with ISO 9072-1, ISO 9072-2, and the NIST Stable Implementation Agreements for Open Systems Interconnection Protocols.

Information Handling Services, 1999
August 11, 1999 11:13:47

3.2.1.1.2.3 File Transfer, Access, and Management. NAS file transfer applications between open end-systems shall use FTAM. NAS open end-system FTAM implementations shall be in accordance with ISO 8571-1, ISO 8571-2, ISO 8581-3, ISO 8571-4, and the NIST Stable Implementation Agreements for Open Systems Interconnection Protocols.

3.2.1.1.2.4 Message Handling System. NAS electronic mail applications between open end-systems shall use MHS. NAS open end-system MHS implementations shall be in accordance with ISO 10021-1, 10021-2, 10021-3, 10021-4, 10021-5, 10021-6, 10021-7, and the NIST Stable Implementation Agreements for Open Systems Interconnection Protocols.

3.2.1.1.2.5 Transaction Processing. NAS open end-system applications requiring interactive update of files, in which results are generated immediately after data entry, shall use TP. NAS open end-system TP implementations shall be in accordance with ISO 10026-1, ISO 10026-2, 10026-3 and the NIST Stable Implementation Agreements for Open Systems Interconnection Protocols.

3.2.1.1.2.6 Virtual Terminal. NAS open end-system applications requiring simple line at a time or character at a time dialogue shall use VT. NAS open end-system VT implementations shall be in accordance with ISO 9040, ISO 9041-1, and the NIST Stable Implementation Agreements for Open Systems Interconnection Protocols.

3.2.1.2 Presentation Layer Protocol Standards. This section describes the Presentation Layer protocols selected for use by NAS open end-systems.

3.2.1.2.1 Function of Presentation Layer Protocols. The Presentation Layer provides services that determine how all data exchanged by its users (i.e., by application entities) will be represented while in transit across the network. A common meaning is provided through the use of a common transfer syntax between different end-systems. This common syntax is used to represent information including character codes, data types, and file formats.

The Presentation Layer protocol acts as an arbitrator, negotiating a common transfer syntax to be used for the representation of information that the application processes will exchange.

Presentation Layer services include the management of data entry, exchange, display, and representation between application entities. The meaning (semantics) of the data is maintained, while the format and language differences (syntax) are resolved.

The connection-oriented presentation service is defined in ISO 8822. The connection-oriented presentation protocol specification is defined by ISO 8823 and consists of two functional units: kernel and context management.

The kernel is mandatory and is always available for service. It supports the presentation connection and the transfer of data. It also negotiates for the use of one or more transfer syntaxes. Transfer syntaxes may make use of data compression techniques such as run-length encoding.

Context management is an optional service and is negotiable at the time of connection. It allows presentation contexts to be added or deleted during the lifetime of a presentation connection. All new presentation contexts are added to a defined context set.

Information Handling Services, 1999
August 11, 1999 11:13:47

3.2.1.2.2 Presentation Layer Protocol Specification. NAS open end-systems shall implement the connection-oriented presentation service as defined in ISO 8822 and the connection-oriented presentation protocol as defined in ISO 8823.

At a minimum, NAS open end-systems shall implement the presentation kernel. Context management is optional, and shall be used only if needed by particular interfaces.

The Application Layer defines the syntax of messages by using a formal description language called Abstract Syntax Notation One (ASN.1). The abstract syntax used by NAS open end-systems shall be in accordance with ISO 8824 (ASN.1). The transfer syntaxes used by NAS open end-systems shall be encoded in accordance with ISO 8825 (Basic Encoding Rules for ASN.1). These rules include coding rules for integers, floating point, octet strings, time data, etc. The minimum transfer syntax shall be OCTET STRING, primitive encoding, with pre-agreed upon syntax. Other transfer syntaxes may be defined at a later date for special purposes.

3.2.1.2.3 Session Layer Protocol Standards. This section describes the Session Layer protocols selected for use by NAS open systems.

3.2.1.2.3.1 Function of Session Layer Protocols. The Session Layer allows cooperating application entities to organize and synchronize conversation and to manage data exchange. To transfer data, session connections use transport connections. During a session between application entities, Session Layer services are used to regulate dialogue by ensuring an orderly message exchange on the session connection.

The structured aspects of session dialogue include protocols for turn to talk, for how long to talk, and communications mode (i.e., full duplex or half duplex). Additional functions are establishment of major and minor synchronization points, mapping of names to addresses, reporting of error conditions, and splitting of dialogue into logical activities that are managed on a session basis.

The session service operates in one of three distinct phases:

(a) Connection Establishment Phase -- Cooperating users are identified and the facilities (tokens) and parameters to be used during the session are negotiated.

(b) Data Transfer Phase -- Normal and expedited classes of data exchange are provided, supported by token management, session synchronization, and exception reporting facilities.

(c) Connection Release Phase -- Services are provided for orderly release, user-initiated (presentation) abort, and provider (session) abort. The latter two cases may result in the loss of some protocol data units.

3.2.1.2.3.2 Session Layer Protocol Specification. NAS open end-systems shall implement the connection-oriented session service as defined in ISO 8326 and the connection-oriented session protocol specification as defined in ISO 8327. The Session Version 2 (Unlimited User Data) shall be supported in accordance with ISO 8326/DAD2 and ISO 8327/DAD2. The session protocol consists of a kernel, and 11 other functional units. These functional units may be used in various combinations, depending on the required functions. The set of functional units to be implemented is determined by the requirements of the Application Layer protocol. At a minimum, NAS open end-systems shall implement the kernel and full-duplex functional units. Certain applications may require the implementation of additional functional units.

Information Handling Services, 1999
August 11, 1999 11:13:47

3.2.2 Lower-layers. Layers 1, 2, and 3 of the OSI Reference Model (Physical, Data Link, and Network) are responsible for the data communication protocols used to interface the data communications network with the communicating NAS end-system processors. Layer 4 of the OSI Reference Model (Transport Layer), isolates the upper-layers from the detailed workings of the lower-layers. This section describes the protocols selected for NAS open end-system implementation of the OSI lower-layers.

3.2.2.1 Transport Layer Protocol Standards. This section describes the Transport Layer protocols selected for use by NAS open end-systems.

3.2.2.1.1 Function of Transport Layer Protocols. The Transport Layer provides reliable, transparent transfer of data between cooperating session entities. The Transport Layer entities optimize the available network services to provide the performance required by each session entity. Optimization is constrained by the overall demands of concurrent session entities and by the quality and capacity of the network services available to the Transport Layer entities. Transport protocols regulate flow, detect and correct errors, and multiplex data, on an end-to-end basis.

To provide a basis for deciding which Transport Layer protocol should be used, three types of Network Layer connections have been defined regarding error rates in relation to user requirements. Type A network connections have an acceptable residual (unsignaled) error rate and an acceptable signaled error rate. Type B network connections have an acceptable residual (unsignaled) error rate and an unacceptable signaled error rate. Type C network connections have an unacceptable residual (unsignaled) error rate. An important point is that acceptability is determined relative to the needs of the applications, rather than being an absolute measure.

3.2.2.1.2 Transport Layer Protocol Specification. There are two types of Transport Layer services: Connection-Oriented and Connectionless. NAS open end-systems shall implement the Connection-Oriented Network Service (CONS).

3.2.2.1.2.1 Connection-Oriented Transport Service. NAS open end-systems shall implement the connection oriented transport service as defined in ISO 8072 and the protocol as defined in ISO 8073 and ISO 8073/AD2. The connection-oriented protocol is divided into five classes (0 through 4):

(a) Class 0 - Simple Class -- This class is designed to be used with Type A network connections. It is the simplest type of transport connection. It provides neither error recovery nor multiplexing (e.g., systems with a requirement for X.400 mail systems shall support Class 0).

(b) Class 1- Basic Error Recovery Class -- This class is designed to be usedwith Type B network connections. It provides a basic transport connection with minimal overhead. Recovery from network disconnect or reset is included.

(c) Class 2 - Multiplexing Class -- This class is designed to be used with Type A network connections. It multiplexes several transport connections onto a single network connection. There is no error detection or recovery procedure. The transport connection is terminated when an error is signaled from the Network Layer.

(d) Class 3 - Error Recovery and Multiplexing Class -- This class is designed to be used with Type B network connections. It provides the multiplexing capabilities of Class 2 with the error recovery capabilities of Class 1.

Information Handling Services, 1999
August 11, 1999 11:13:47

(e) Class 4 - Error Detection and Recovery Class -- This class is designed to be used with Type C network connections. It provides the characteristics of Class 3, and the capability to detect and recover from lost, duplicated, or out-of-sequence transport protocol data units (TPDU). It also provides the optional detection of damaged TPDUs by use of a checksum. It allows for increased throughput by permitting a transport connection to use multiple network connections.

NAS open end-systems shall implement ISO 8073, Class 4, and shall comply with the transport procedures stated in the Stable Implementation Agreements for OSI protocols.

3.2.2.1.2.2 Connectionless Transport Service. Although ISO has defined a connectionless (datagram) transport protocol (ISO 8602), there are currently no NAS open end-systems requirements specified for its use.

3.2.2.2 Network Layer Protocol Standards. This section describes the Network Layer protocols selected for use by NAS open systems.

3.2.2.2.1 Function of Network Layer Protocols. The Network Layer provides functions for the relaying and routing of information between OSI users on end-systems which may or may not be connected by intermediate systems. End-systems and intermediate systems provide the same Network Layer functions, with the exception of relaying functions which are performed by intermediate systems only. The Network Layer provides hop-by-hop network service enhancements, flow control, and load leveling. Services provided by this layer are independent of the distance separating interconnected networks. The Network Layer shall be structured in accordance with ISO 8648, Internal Organization of the Network Layer.

3.2.2.2.2 Network Layer Protocol Specification. NAS open systems shall support the Connectionless-Mode Network Service (CNLS) and the Connection-Oriented Network service (CONS) as defined in ISO 8348, ISO 8348/AD1, and ISO 8473.

NAS open end-systems communicating over packet switching networks (e.g., NADIN PSN) shall implement ISO 8208 as the subnetwork access protocol whether implementing CLNS or CONS. ISO 8208 will provide for direct layer 3 connections between open end-systems (DTE to DTE) as well as connections through an intermediate system such as a packet switching network (DTE to DCE) Intermediate systems shall implement CCITT X.25 (1984) provided they correctly interface to end-systems implementing ISO 8208.

3.2.2.2.2.1 Connectionless-Mode Network Service (CLNS). The CLNS provides the Transport Layer with a connectionless network service where network connections between end-systems are not established. Information is transferred via individual data unit transfers which are independent of previous transfer requests. All NAS open end-systems and intermediate systems shall implement ISO 8348/AD1, Network Service Definition, Addendum 1: Connectionless Mode Transmission.

3.2.2.2.2.1.1 Connectionless Network Protocol Functions. All NAS open end-systems shall implement ISO 8473, Protocol for Providing the Connectionless-Mode Network Service. A subset of the Full Protocol (see Table 4 of ISO 8473) shall be supported utilizing the following protocol functions: (See Clauses 6.1 through 6.18 and Table 4 of ISO 8473 for a description of the functions)

Information Handling Services, 1999
August 11, 1999 11:13:47

(a) Type 1 functions: All Type 1 functions are mandatory under the standard.

(b) Type 2 functions: Type 2 functions are optional.

(c) Type 3 functions: The following Type 3 functions shall be supported:

(1) Priority

(2) Quality of Service

3.2.2.2.2.1.2 Provision of the Underlying Service. NAS open end-systems shall provide the subnetwork dependent convergence function as specified in ISO 8473 - clause 8.5.2. The convergence function will map the connectionless services of the Network Layer to the services provided by the X.25 connection-oriented network access protocol. ISO 8473/AD3 shall be implemented for open end-systems providing ISO 8473 over an OSI data link service.

3.2.2.2.2.1.3 Provision for Routing Protocols. NAS open end-systems, requiring communications via routers, shall implement the End System (ES) to Intermediate System (IS) Routing Protocol in conjunction with ISO 8473. NAS intermediate systems providing NAS routing shall implement shall implement the IS to IS Intra-Domain Routing Protocol. NAS intermediate systems providing routing to external networks shall use the Boundary Intermediate System (BIS) Inter-Domain Routing Protocol.

3.2.2.2.2.1.3.1 End System to Intermediate System Routing Protocol. NAS open end-systems, that require communication through routers, shall use the ES-IS routing protocol to enable routing service. The ES-IS protocol shall be in accordance with ISO 9542 and the OIW Stable Agreement for Open Systems Interconnection Protocols and shall be used in conjunction with ISO 8473.

3.2.2.2.2.1.3.2 Intermediate System to Intermediate System Intra-Domain Routing Protocol. NAS open intermediate systems, providing NAS routing, shall use the IS-IS intra-domain routing protocol to enable routing within the NAS routing domain. The IS-IS protocol shall be in accordance with ISO 10589 and the NIST Stable Agreement for Open Systems Interconnection Protocols and shall be used in conjunction with ISO 8473. Intra-domain routing between the NAS and the ATN shall be in accordance with the ATN Manual.

3.2.2.2.2.1.3.3 Boundary Intermediate System to Boundary Intermediate System Inter-Domain Routing Protocol. NAS open boundary intermediate systems, providing routing, shall use the BIS-BIS inter-domain routing protocol to enable routing between the NAS routing domain and an external routing domain (e.g., ATN routing domain). The BIS-BIS protocol shall be in accordance with ISO 10747 and the NIST Stable Agreement for Open Systems Interconnection Protocols and shall be used in conjunction with ISO 8473. Inter-domain routing between the NAS and the ATN shall be in accordance with the ATN Manual.

3.2.2.2.2.2 Connection-Oriented Network Service (CONS). The CONS provides the Transport Layer with a network connection service where network connections between end-systems are to be established. CONS shall be implemented in accordance with ISO 8880-1 and ISO 8880-2. CONS may be used over a specific interface provided there are either no intermediary networks or only X.25 intermediary networks. For NAS open end-systems communicating over X.25 wide area networks, CONS shall be provided as defined in ISO 8878, Use of X.25 to Provide OSI Connection-mode Network Service.

Information Handling Services, 1999
August 11, 1999 11:13:47

3.2.2.2.2.2.1 Optional User Facilities (for X.25 subnetworks). X.25 supports a wide variety of features and options called facilities. The following optional user facilities shall be supported by the X.25 subnetwork (e.g., NADIN PSN) in accordance with CCITT X.25 (1984). The X.25 subnetwork shall provide the facility if requested by the end-system.

(a) On-line facility registration;

(b) Extended packet sequence numbering;

(c) Nonstandard default window sizes;

(d) Default throughout classes assignment;

(e) Incoming calls barred;

(f) Outgoing calls barred;

(g) One-way logical channel incoming;

(h) One-way logical channel outgoing;

(i) Closed user group;

(j) Closed user group with outgoing access;

(k) Closed user group with incoming access;

(l) Reverse charging acceptance;

(m) Nonstandard default packet sizes;

(n) Flow control parameter negotiation;

(o) Throughput class negotiation;

(p) Fast select acceptance;

(q) D-bit modification;

(r) Call redirection;

(s) Hunt group.

The following optional facilities shall be provided by the X.25 subnetwork when requested by the end-system on a per-call basis:

(a) Fast select;

(b) Closed user group selection;

(c) Reverse charging;

(d) Registered Private Operating Agency (RPOA);

(e) Flow control parameter negotiation;

(f) Throughput class negotiation;

(g) Called line address modified notification;

(h) Call redirection notification;

(i)(Network user identification.

Information Handling Services, 1999
August 11, 1999 11:13:47

In addition, the X.25 subnetwork shall support CCITT-specified DTE facilities as described in Annex G of the X.25 Recommendation.

3.2.2.2.2.2.2 Optional User Facilities (for ISO 8208 systems). NAS open end-systems implementing the CONS shall support the following optional user facilities in accordance with Clause 5.1 ISO 8878:

(a) Fast select;

(b) Fast select acceptance;

(c) Throughput class negotiation;

(d) Transit delay selection and indication;

(e) Called address extension;

(f) Calling address extension;

(g) End-to-end transit delay negotiation;

(h) Expedited data negotiation;

(i) Minimum throughput class negotiation.

This standard does not require or prohibit use of other X.25 facilities by NAS open end-systems. The facilities used will vary among different interfaces.

3.2.2.3 Data Link Layer Protocol Standards. This section describes the Data Link Layer protocols selected for use by NAS open systems.

3.2.2.3.1 Function of Data Link Layer Protocols. The Data Link Layer provides services related to the reliable interchange of data without loss across a physical link between adjacent systems. Data link protocols manage the logical establishment, maintenance, and release of data link connections. In addition, these protocols control the synchronization and flow of data, and supervise error recovery. The Data Link Layer functions are provided as services to the Network Layer. In bit-oriented protocols, the detection of transmission errors is typically accomplished through a cyclic redundancy check (CRC) algorithm. The data stream is broken down into the basic transmission units (data frames). The Data Link Layer protocols may provide mechanisms to handle lost, damaged, or duplicate data frames, acknowledgment of receipt of current data frames, line turn-around, and basic flow control.

3.2.2.3.2 Data Link Layer Protocol Specification. The Data Link Layer protocol standards implemented by NAS open systems shall be ISO 4335, ISO 7478, CCITT X.32, and ISO 8802-2.

3.2.2.3.2.1 High-level Data Link Control (HDLC) ISO 4335. NAS open systems shall implement the Data Link Layer service as defined in ISO Draft International Standard (DIS) 8886 and the protocol as defined in ISO 4335 (HDLC). ISO standards 3309 (HDLC frame structure) and 7809 (HDLC consolidation classes of procedure) are also applicable. The options recommended for use by NAS open systems are described below:

(a) Option 2 - Reject -- This option is required by ISO 7776 [Link Access Procedure Balanced (LAPB)] and permits the prompt initiation of the recovery process for missing information frames (I-frame) by providing for a negative acknowledgment (reject).

Information Handling Services, 1999
August 11, 1999 11:13:47

(b) Option 3 - Selective Reject -- This option allows requesting retransmission of a single I-frame and recovers I-frame sequence errors. It may improve efficiency on links with long transmission delay (e.g., satellite links or systems using modulo 128).

(c) Option 4 - Unnumbered Information Frames -- This option provides ability to exchange information without impacting the send and receive variables. This option allows datagram transmission (i.e., transmission with no acknowledgment of receipt).

(d) Option 7 - Multiple Octet Addressing -- This option allows the use of one or more address octets. It allows multiple octet addresses and therefore allows more address combinations. Note that multiple octet addresses are not required.

(e) Option 8 - I-Frames Transmitted Only as Commands -- This option is required by ISO 7776 (LAPB) and is required to achieve greater compatibility, particularly for NADIN PSN interfaces (which must comply with this for proper operation).

(f) Option 10 - Extended Sequence Numbering -- This option allows sequence numbers to be extended from modulo 8 to modulo 128. This option can improve efficiency on links with long transmission delay (e.g., satellite links), especially if used in conjunction with option 3.

(g) Option 12 - Data Link Test -- This option enable performance of Data Link Layer loopback tests.

The HDLC normal response mode (NRM) shall be used in cases where multi-drop or polling systems are used and the use of the standard seven layer protocol architecture is inappropriate or special options are required.

3.2.2.3.2.1.1 CCITT X.25 LAPB. The standard NAS open systems implementation for X.25 intermediate systems shall be balanced asynchronous [Class Balanced Asynchronous (BA)] with options 2 and 8. Class BA with options 2, 8, and 10 is recognized as an optional, subscription-time selectable, extended sequence numbering service that may be available to serve DTE applications having a need for modulo 128 sequence numbering.

3.2.2.3.2.1.2 ISO 7776. ISO 7776 shall be used by X.25 DTEs to insure a compatible LAPB interface to the DCE.

3.2.2.3.2.2 ISO 7478 (Multilink Procedure). NAS open end-systems required to transfer data over multiple parallel physical connections to achieve a reliable, available, and variable bandwidth between the DTE/DCE interface shall implement the multilink procedure (MLP) in accordance with ISO 7478. The MLP function resides as an upper sub-layer of the Data Link Layer. It operates between the multiple single data link protocol functions and the Network Layer. X.25 users shall implement MLP as a subscription time option as described in section 2.5 (LAPB) of CCITT Recommendation X.25, 1984 version. The implementation of MLP in the NAS shall facilitate the mitigation of a critical path failure without the interruption of services and shall:

(a) Achieve economy and reliability of service by providing multiple physical connections between the DTE and DCE interface;

(b) Permit addition and deletion of single physical connections without interrupting the services provided by the multiple connections;

Information Handling Services, 1999
August 11, 1999 11:13:47

(c) Optimize bandwidth use of a group of connections through load sharing;

(d) Achieve graceful degradation of service when a single connection or multiple connections fail;

(e) Provide each group with the appearance of a single logical data link to the Network Layer;

(f) Provide, when required, resequencing of the received data units before to delivery to the Network Layer;

(g) Minimize the impact that multilink operation may have on the Network Layer protocols and existing data links;

(h) Maximize the applicability of the procedure to a variety of link control protocols, line speeds, and configurations.

The MLP link control functions, link layer addressing, frame structure, and link parameters shall be implemented in accordance with ISO 7478 [CCITT X.25 (1984) for X.25 users].

3.2.2.3.2.3 CCITT X.32. Dial-in/dial-out services and procedures shall be implemented in accordance with CCITT X.32 when the packet switching network uses a public telephone network as its backbone.

3.2.2.3.2.4 ISO 8802-2. NAS open systems shall implement ISO 8802-2 as the standard for logical link control (LLC) in conjunction with ISO 8802-3, 8802-4, or ISO 8802-5. Either connectionless or connection-oriented operations shall be supported.

3.2.2.4 Physical Layer Protocol Standards. This section describes the Physical Layer protocol standards selected for use by NAS open end-systems.

3.2.2.4.1 Function of Physical Layer Protocol Standards. As the lowest layer in the OSI Reference Model, the Physical Layer interface provides services to the next higher layer, the Data Link Layer. It is responsible for establishing the physical connection and interface to the transmission medium [e.g., Data Terminal Equipment (DTE)/Data Circuit-Terminating Equipment (DCE) interface]. The characteristics of this layer are independent of the physical media, which could be coaxial cable, twisted copper wire, fiber optic cable, and many other cable types. The Physical Layer interface is concerned primarily with the following physical interface characteristics:

(a) Mechanical: This characteristic defines the physical attributes of the connector (i.e., the number of pins, shape, and dimensions of the connecting block).

(b) Electrical: This characteristic specifies whether the connection is balanced or unbalanced and what voltages are to be used.

(c) Functional: This characteristic defines which electrical circuit performs control, timing, and grounding.

3.2.2.4.2 Physical Layer Protocol Specification. NAS open systems shall implement one of the following standards at the physical layer interface: EIA-530, EIA-232E, RS-232C, V.35, V.32, ISO 8802-X, AND ISO 9314 (FDDI).

Information Handling Services, 1999
August 11, 1999 11:13:47

3.2.2.4.2.1 EIA-530. EIA-530 shall be the primary Physical Layer interface standard implemented by new systems. EIA-530 has the following interface characteristics:

(a) Data rate: Lines speeds between 0 to 2 Mbps are supported in accordance with FIPS PUB 154.

(b) Cable length: Cable lengths up to 200 feet (maximum) are supported for high-speed lines. Cable lengths up to 4000 feet (maximum) are supported for low-speed lines (0 to 20 kbps).

(c) Mechanical: D-shaped, 25-pin interface connector is specified for all interchange circuits in accordance with ISO 2110. The DTE requires male (pin) contacts and a female shell (plug connector); the DCE requires a female contacts and a male shell.

(d) Electrical: The maximum voltage is +/- 6V. The balanced electrical characteristics are defined in RS-422A and FED-STD-1020A (EIA-530, Category I). The unbalanced electrical characteristics are defined in RS-423A and FED-STD-1030A (EIA-530, Category II).

(e) Functional: EIA-530 interchange circuits fall into four general classifications: ground (or common return), data circuits, control circuits, and timing circuits. A functional description of the interchange circuits, pin assignments, and selected communication system configurations are specified in EIA-530 (FED-STD-1032 and FIPS PUB 154).

The additional functions [local loopback (LL), remote loopback (RL), and test mode (TM)] shall assist users in tracking down a defective unit and fault isolation between DTE/DCE.

EIA-530 will not interoperate with equipment using RS-232 electrical characteristics. EIA-530 does not support secondary signals and dial-up applications.

3.2.2.4.2.2 EIA-232E. EIA-232E shall be used by NAS interfaces that are required to implement dial-up applications and secondary signals. This standard is a revision of RS-232C and EIA-232D. This revision updates the standard to conform to CCITT V.24 (modem connection to the telephone network), V.28, and ISO 2110. It also includes the specification for a 25-pin interface connector and adds LL, RL, and TM interchange circuits. A shield has been added, the protective ground has been redefined, and some terminology has been changed. EIA-232E is compatible with the electrical characteristics of EIA-232D but not with EIA-530. EIA-232E is compatible with the electrical characteristics of EIA-232C but has additional functionality. EIA-232E has the following interface characteristics:

(a) Data rate: Low-speed lines up to 20 kbps are supported.

(b) Cable length: Cable lengths up to 50 feet (maximum) are supported for low-speed lines. When more than 50 feet of cable is required, a low capacitance, shielded cable is recommended in accordance with EIA-232E.

(c) Mechanical: D-shaped, 25-pin interface connector is specified for all interchange circuits in accordance with ISO 2110.

Information Handling Services, 1999
August 11, 1999 11:13:47

(d) Electrical: The operating voltage range is +/- 3V to +/- 25V, unbalanced. Unbalanced circuits (each circuit uses only one pin and a common ground return) are defined in the EIA-232D standard. Electrical signal characteristics are defined in CCITT V.28 and the EIA-232D standard.

(e) Functional: Synchronous/asynchronous and full/half duplex communications are supported via the interchange circuits and pin assignments as defined in CCITT V.24 and the EIA-232D standard.

3.2.2.4.2.3 RS-232C. RS-232C shall be supported for interfacing with existing NAS interfaces. RS-232C is a part of CCITT recommendation X.21 bis and is used for low-speed data communications.

(a) Data rate: Low-speed lines of 20 kbps or less are supported.

(b) Cable length: Cable lengths up to 50 feet (maximum) are supported.

(c) Mechanical: The 25-pin connector is defined in an appendix of the RS-232C standard.

(d) Electrical: Unbalanced circuits (each circuit uses only one pin and a common ground return) are defined in the RS-232C standard. Electrical signal characteristics are defined in the RS-232C standard.

(e) Functional: Synchronous/asynchronous and full/half duplex communications are supported via the interchange circuits and pin assignments as defined in the RS-232C standard.

3.2.2.4.2.4 V.35. V.35 is a CCITT recommendation for data transmission on wide band group channels. This standard shall be used by NAS open end-systems to meet the following Physical Layer interface requirements:

(a) Data rate: Line speeds up to 64 kbps are supported.

(b) Cable length: Cable lengths up to 50 feet (maximum) are supported.

(c) Mechanical: A 34-pin connector is defined in ISO 2593.

(d) Electrical: A combination of unbalanced voltage and balanced current is supported. Data and clock circuits are driven by balanced generators. These are not compatible with RS-422A circuits. Control signals are unbalanced and compatible with the RS-232C standard.

(e) Functional: The functional interface circuits are identical to the circuits defined in the RS-232C standard.

3.2.2.4.2.5 V.32. V.32 is a CCITT recommendation for full duplex, low speed transmission over dial-up lines. The V.32 modem provides for leased and dial line communication. It also provides synchronous, asynchronous, and auto dialing modes. This standard shall be used by NAS open end-systems to meet the following Physical Layer interface requirements:

(a) Data rate: Line speeds up to 9.6 kbps are supported.

(b) Mechanical: A terminal interface (25 pin) is supported. The mechanical characteristics of EIA-232D and CCITT V.24/V.28 are supported. A line interface (modular jack or terminal) is supported.

Information Handling Services, 1999
August 11, 1999 11:13:47

3.2.2.4.2.6 ISO 8802-x and ISO 9314-1. IEEE has approved several interface standards for the Physical Layer for operation in the 1 to 16 Mbps range. ISO has also adopted the IEEE LAN standards for use in OSI compliant networks. NAS open end-systems shall implement ISO 8802-2 and ISO 8802-3 which have been adopted as FIPS PUB 107 for federal LAN implementations when required to use a collision detection access protocol. ISO 8802-3 is similar, but not compatible with Ethernet. NAS open end-systems shall implement ISO 8802-4 when required to use a token passing protocol suitable for broadband bus architectures. It has four levels of priority and can operate at 1, 5, 10, or 16 Mbps. NAS open end-systems shall implement ISO 8802-5 when required to use a token passing protocol suitable for ring architectures. It has eight levels of priority and can operate at 1, 4, or 16 Mbps. NAS open end-systems shall implement ISO 9314-1 fiber optic ring LAN standard operating at 100 Mbps, when required to use a connectionless token passing protocol. This standard is titled Fibre Distributed Data Interface (FDDI).

3.3 Naming and Addressing. Naming and addressing requirements for NAS open systems (i.e., intermediate and end-systems) shall be in accordance with FAA-STD-042. Naming and addressing requirements for Aeronautical Telecommunication Network (ATN) open systems shall be in accordance with the ATN Manual.

3.4 OSI Directory Services. NAS open end-systems that use directories shall implement OSI Directory Services as specified in FAA-STD-044.

3.5 OSI Network Management. Work to establish U.S. Government and international standards on network management is underway; however, general implementation of the international work has not yet been accomplished. As an interim measure, the U.S. Government may adopt an industry standard for network management. Network Management requirements shall conform to ISO 7498-4.

3.6 OSI Security. The OSI security model has recently been approved as an international standard (ISO 7498-2), but no actual mechanisms have been agreed upon to implement the security model. The OSI security work is not sufficiently advanced at this time for this standard to levy NAS-wide security requirements.

3.7 OSI Priority. NAS open end systems that require the transmission of prioritized data shall use the priority indicators as specified in FAA-STD-043. NAS open end systems that communicate with the ATN shall use the priority indicators specified in the ATN Manual.

Information Handling Services, 1999
August 11, 1999 11:13:47

(THIS PAGE INTENTIONALLY LEFT BLANK)

Information Handling Services, 1999
August 11, 1999 11:13:47

4. QUALITY ASSURANCE PROVISION

This section is not applicable to this standard.

Information Handling Services, 1999
August 11, 1999 11:13:47

(THIS PAGE INTENTIONALLY LEFT BLANK)

Information Handling Services, 1999
August 11, 1999 11:13:47

5. PREPARATION FOR DELIVERY

This section is not applicable to this standard

Information Handling Services, 1999
August 11, 1999 11:13:47

FAA-STD-039 REV A ■ 9003329 0008613 017 ■

(THIS PAGE INTENTIONALLY LEFT BLANK)

Information Handling Services, 1999
August 11, 1999 11:13:47

6. NOTES

6.1 Definitions. The terms defined below are frequently used throughout this document. They are defined here to assist in the understanding of the information presented herein.

Protocol - In the Open System Interconnection reference model, the communications functions are partitioned into seven layers. Each layer, N, provides a service to the layer above N+1, by carrying on a conversation with the layer N on another processor. The rules and conventions of that N-layer conversation are called the protocol.

End-system - An end-system contains the application processes that are the ultimate sources and destinations of user-oriented message flows. The functions of an end-system can be distributed among more than one processor/computer.

Intermediate System - A system providing an OSI reference model network layer relay function (that is, a system that receives data from one correspondent Network entity and forwards it to another corresponding Network entity).

Open System - An open system is a system capable of communicating with other open systems by virtue of implementing OSI protocols and services. End-systems and intermediate systems are open systems. However, an open system may not be accessible by all other open systems. This isolation may be provided by physical separation or by technical capabilities based upon computer and communications security.

OSI Environment - Is concerned with the exchange of information between open systems (and not the internal functioning of each individual real open system).

OSI is concerned only with interconnection of systems. All other aspects of systems which are not related to interconnection are outside the scope of OSI.

OSI is concerned not only with the transfer of information between systems, i.e., transmission, but also with their capability to interwork to achieve a common (distributed) task. In other words, OSI is concerned with the interconnection aspects of cooperation between systems.

Information Handling Services, 1999
August 11, 1999 11:13:47

6.2 Acronyms and Abbreviations. The following are definitions of acronyms and abbreviations used in this standard.

AAS	advanced automation system
ACSE	association control service element
AD	addendum
ANSI	American National Standards Institute
ASE	application service element
ASN	abstract syntax notation
ATN	aeronautical telecommunication network
BA	balanced asynchronous
BER	bit encoding rules
BIS	boundary intermediate system
CCITT	International Telegraph and Telephone Consultative Committee
CLNS	connectionless network service
CONS	connection-oriented network service
CRC	cyclic redundancy check
CSMA/CD	carrier sense multiple access/collision detection
DAD	draft addendum
D-bit	delivery confirmation bit
DCE	data circuit-terminating equipment
DIS	draft international standard
DTE	data terminal equipment
EIA	Electronics Industries Association
ES	end-system
FAA	Federal Aviation Administration
FDDI	fibre distributed data interface
FED	federal
FIPS	federal information processing standards
FTAM	file transfer access and management
GOSIP	Government Open Systems Interconnection Profile
HDLC	high-level data link control
I-frame	information
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IRD	interface requirements document
IS	intermediate system
ISO	International Organization for Standardization
kbps	kilobits per second
kHz	kilohertz
LAN	local area network
LAPB	link access procedure balanced
LCN	local communications network
LLC	logical link control

Information Handling Services, 1999
August 11, 1999 11:13:47

LL	local loopback
MAC	media access control
Max	maximum
M-bit	more data bit
Mbps	megabits per second
MHS	message handling service
MLP	multilink procedure
NADIN	National Airspace Data Interchange Network
NAS	National Airspace System
NBS	National Bureau of Standards
NIST	National Institute of Standards and Technology
NIU	network interface unit
NRM	normal response mode
NSAP	network service access point
OSI	Open Systems Interconnection
PAD	packet assembler/disassembler
PHY	physical
PUB	publication
PVC	permanent virtual circuit
Q-bit	qualifier bit
RI	ring indicator
RL	remote loopback
RPOA	Registered Private Operating Agency
ROSE	remote operation service element
RS	recommended standard
STD	standard
TM	test mode
TM	trade mark
TP	transaction processing
TPDU	transport protocol data unit
TSAP	transport service access point
V	volts
VC	virtual call
VT	virtual terminal
WAN	wide area network

Information Handling Services, 1999
August 11, 1999 11:13:47

(THIS PAGE INTENTIONALLY LEFT BLANK)

Information Handling Services, 1999
August 11, 1999 11:13:47

APPENDIX I

10. X.25 Services.

NAS open systems shall implement the following X.25 services in accordance with CCITT X.25 (1984 version):

(1) Types of Service -- There are two types of services: virtual call (VC) and permanent virtual circuit (PVC). The former service is the most commonly used. Virtual calls go through three phases: call set-up, data transfer, and call clearing. An X.25 option, "Fast Select," allows small amounts of data to be transmitted during call set-up and allows immediate call clearing. This combines the three phases and minimizes the overhead involved. PVCs are initiated when users join the network and are left connected permanently; therefore, there is no call set-up or call clearing. PVCs are used when data is frequently exchanged and the delay involved in call set-up is not acceptable. Since the end users and the network or networks involved in a PVC must permanently reserve resources for these circuits, they should be used only where a true need exists.

(2) Delivery Confirmation Bit (D-Bit) -- End-to-End delivery confirmation is a layer 4 function in the OSI model. However, it can sometimes be useful to have this function performed in the Network Layer. In the normal mode of operation, the communications equipment acknowledges receipt of a packet back to the sender immediately. Setting the D-bit to "1" causes the communications equipment to withhold this acknowledgment until confirmation of receipt of a packet by the destination DTE has been received by the communication equipment. This can be useful if the particular connection does not use a standard layer 4 protocol providing end-to-end confirmation. An example would be the gateway between NADIN PSN and MSN. Since the use of the D-bit can limit throughput and increase delay time it, should not be used unless it is absolutely necessary. Throughput reduction can be minimized by using the D-bit in coordination with the M-bit.

(3) The More Data Mark (M-bit) -- The M-bit is used to mark a sequence of multiple data packets, typically packets that are part of a single message. Setting the M-bit to "1" indicates that more packets in the same sequence are to be received at the destination DTE. The Network Layer entity in the destination DTE will reassemble the packets into a single message before passing the message up to the Transport Layer. The most efficient way of combining the M-bit and the D-bit is to set the D-bit to "1" on only the last packet of a sequence. X.25 networks deliver packets in order, therefore, if end-to-end acknowledgment of the last packet is received, it guarantees that the entire sequence was received.

(4) Data Qualifier Bit (Q-bit) -- The data qualifier bit, the Q-bit, is sent transparently by X.25 networks. This means that it can be used by the two DTEs for any predefined purpose. Its use in communicating with packet assemblers/disassemblers (PAD) is described by CCITT Recommendation X.29. Because of potential unforeseen problems, it is recommended that this bit not be used except for communicating with PADs.

Information Handling Services, 1999
August 11, 1999 11:13:47

(5) Nonstandard Default Packet Size -- The standard default packet size for X.25 networks is 128 octets of user data. The NADIN PSN's initial default packet size is 256 octets. This is the maximum amount of user data in a packet. Smaller amounts of data can be sent and no padding is required. This facility would be selected if a different size packet would optimize information transfer. It is more efficient to minimize the number of packets, thus, if a user typically sends lone, multi-packet messages, a larger packet size will improve performance. Excessively large packet sizes, on the other hand, waste buffer space in both the DTE and the network. Values other than the default value can be selected during call set-up using the "flow control parameter negotiation" facility.

(6) Nonstandard Default Window Size -- The window size is the number of packets that can be outstanding for which an acknowledgment has not yet been received by the DTE or DCE. The standard default window size is 2, thus, if there are two outstanding packets, the sending DTE cannot send additional packets until one or both have been acknowledged by the receiving DCE. The window size can be adjusted to optimize performance. Too large a window requires large buffers and may result in many packets being retransmitted if an error occurs. Too small a window results in frequent flow control restrictions and lower throughput. Values other than the default value can be selected during call set-up via the "flow control parameter negotiation" facility.

(7) Closed User Group-Related Facilities -- This is a group of seven related facilities that allow limits to be placed on users relating to which users they may call or which users may call them. Examples include a closed user group with incoming access (members of the group can call only each other, but anyone can call into the group), and outgoing calls barred within a closed user group (members of the group cannot call each other, but may call or be called by anyone else). In the NAS, external users such as airlines will be restricted from calling any addresses other than those to which they have authorized access.

(8) Call Redirection -- If this facility is used, it must be subscribed to; it cannot be selected on a call-by-call basis. It allows calls to be redirected if the destination DTE is out of service or busy. The destination DTE subscribes to the type of call redirection desired. Four options are allowed by the NADIN PSN network: no redirection, automatic redirection, semi-automatic redirection, or manual redirection. Automatic redirection occurs immediately upon detection of the destination being out of service. Semi-automatic redirection occurs after a destination fails and the NADIN PSN Network Control Center (NCC) authorizes redirection. Manual redirection occurs upon command from the network control center. Up to three alternate subnetwork addresses can be associated with a given desired destination address. They form a list that is tried in order if automatic redirection is used. If manual or semi-automatic redirection has been selected, the network control center specifies which of the three alternate addresses is to be used.

Information Handling Services, 1999
August 11, 1999 11:13:47