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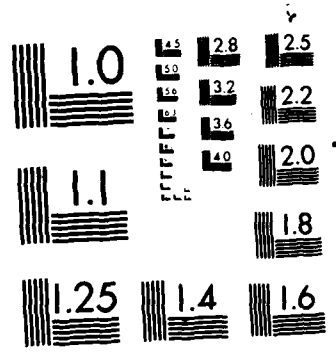
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IMPLEMENTATION PLAN FOR WORLDWIDE AIRBORNE COMMAND POST (WWABNCP) OPERATOR COMPUTER-BASED TRAINING (PLATO): DECISION PAPER

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PREPARED FOR:
HQ USAF/DPPT
DIRECTORATE OF PERSONNEL PROGRAMS
TRAINING PROGRAMS DIVISION

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The Directorate of Personnel Programs, Training Programs Division (AF/DPPT) contracted the development of an Implementation Plan for the Worldwide Airborne Command Post (WWABNCP) Operator Computer-Based Training (PLATO) to Akman Associates, Inc. The project commenced June 1, 1985 under Contract No. F49642-84-D0039-0002. The purpose of this report is to provide a Decision Paper with information needed for the Air Force to formally accept transfer of the training system from the Defense Communications Agency.

The Decision Paper includes a brief introduction, a summary of the findings in the first phase of the study and a recommendation to assume follow-on responsibility for the training system. The following report presents additional information on the training product and the user requirements. This report is organized into three sections: Background, Training Product Analysis, and User Requirements.



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**Decision Paper for Worldwide Airborne Command Post
Radio Communications Operators**

1. → Defense Communications Agency developed a computer-based training system designed to augment ground training for Airborne Radio Communications Operators at unit level. The system was funded and developed by DCA. Current plans call for the Air Force to assume responsibility as lead military department, providing follow-on support for maintenance, operation and future development.

2. JCS documented the need to improve strategic connectivity during POLO HAT exercises. DCA determined that the performance of Radio Communications Operators needed to be improved. Improved performance could be accomplished by increased equipment familiarization and procedural training. DCA provided a computer-based training program to the 1st, 2nd, 4th, 6th, 9th and 10th Airborne Command and Control Squadrons with training programs on AFSATCOM, LF/VLF, HF, UHF/ARA-60 communications systems. — V

3. Airborne Command and Control Squadrons must be trained on mission execution, control and operational reporting procedures to provide survivable command and control capability where mission execution and direction of SIOP forces can be effected. In a severe operational environment, inaccurate transmission wastes valuable processing and telecommunications time.

4. Based on a survey and review of ACCS training requirements the following two constraints were reported: first, a limited number of aircraft are available for in-flight and ground alert training; and second, classroom training is limited by instructor availability and inadequate training facilities. Constraints on training resources resulted in overcrowded training flights hampering mission training quality. Insufficient classroom instruction and preflight practice reduced the quality of ground training and inflight training missions. The ACCS training personnel indicated the need to improve ground training programs by providing adequate opportunity for pre-flight training, developing comprehensive continuation training for qualified operators, and standardizing lesson plans to ensure quality content and thorough delivery of training program.

5. The PLATO/SPIRITUS Training Program and supporting Airborne Radio Command Post Communications System courseware provide standardized, comprehensive equipment familiarization and procedural training on unclassified communications systems aboard EC-135 and E-4B aircraft. ACCS personnel anticipate using the training system for extensive ground training, thereby reducing in-flight training time and instructor workload. This training system is an excellent simulator for basic indoctrination of communication systems training. It provides realistic hands-on training in a safe environment without the use of an aircraft.

6. Recommend Air Force assume responsibility as lead MILDEP for the PLATO/SPIRITUS Training System. The Air Force will obtain formal agreement for organizational and resource support from participating MAJCOMs prior to continued implementation planning. Recommend ATC/TTXB be designated as Office of Primary Responsibility (OPR) and ATC/TTQE designated as Office of Coordinating Responsibility (OCR). Resource support to be provided by SAC, TAC, PACAF and USAFE on a per share basis as the functional users of the training system. In addition, recommend maintenance of existing courseware be contracted because in-house resources are not in place to support timely, accurate system updates. Maintenance requirements on existing software should be documented during the Implementation Planning Phase of this study. Recommend the Air Force develop additional courseware on communications applications generated by the PACER LINK II aircraft modification program. Recommend the Air Force submit resource requirements to support the training system for inclusion in the FY 89 Program Objective Memorandum. Finally, recommend MPP Training Programs Division continue development of a comprehensive Implementation Plan and Life Cycle Management Plans.

I. BACKGROUND

The POLO HAT Program Exercise documented the need to improve strategic connectivity by improving the performance of Airborne Communications System Operators. The exercise emphasized the need to improve procedural operations and equipment familiarization training. It was concluded that increased unit level training was required to reinforce equipment operation and crew coordination techniques learned at Air Force technical training schools. The Defense Communication Agency (DCA) investigated instructional techniques for improving the performance of Airborne Communication Systems Operators at the Airborne Command and Control Squadrons (ACCS). DCA objectives were to provide standardized training in a stand-alone mode at the ACCSs. The training system would ensure consistent quality of lessons and standard training among the CINCs. This approach would eliminate duplicate efforts to establish a baseline training system.

DCA contracted the development of a prototype computer-based training system to Electrospace Systems, Inc. (ESI). ESI conducted a market search for training systems that would enhance unit level training, minimize cost-prohibitive flying time, and work within an environment of limited ground training resources. A prototype lesson was developed by ESI based on the AFSATCOM Emergency Action Message (EAM) transmission procedures.

The PLATO/SPIRITUS Training System with the supporting lesson package was selected by DCA. DCA demonstrated the PLATO/SPIRITUS Training System to user personnel at the Airborne Command and Control Squadrons (ACCS). This system was selected because it was effective in meeting the training objectives, and was readily available and supportable at a relatively low cost. DCA has since procured and installed a PLATO/SPIRITUS Training System for the 1st, 2nd, 4th, 6th, 9th, and 10th ACCS. Two additional sys-

tems with author stations have been procured and are currently being used for courseware development at ESI. The completion of four lesson plans is scheduled for October 1985. DCA plans to transfer the operation and maintenance of the system to the Air Force in October 1985 contingent upon their acceptance. **However, the Air Force has not formally committed to accepting the system and providing resources necessary to sustain and maintain the system.**

II. TRAINING PRODUCT ANALYSIS

This training product analysis is intended to describe the aspects of the Program Learning for Automated Teaching Operations (PLATO)¹/SPIRITUS² Training System which are important to the future Air Force implementation of the system. This analysis gives important information to those organizations charged with implementing and executing the training system. It also provides information needed to successfully integrate the system into the existing training program.

Section II is organized into the following subsections:

A. System Description

1. Functional Description
2. Control Data 110-PLATO Terminal and Components
3. SPIRITUS Metatron Audio Visual System
4. Courseware

B. Expected Benefits and Utility of the System

C. Constraints and Assumptions Employed During System Development

D. Development, Maintenance and Future Development Costs

E. Identification of Skill and Information Requirements

F. System's Potential for Future Courseware Development and System Enhancement

¹ PLATO is a trademark of Control Data Corporation.

² SPIRITUS is a trademark of SPIRITUS, Inc.

A. System Description

1. Functional Description

The PLATO/SPIRITUS Training System is designed to augment unit level training programs at the Airborne Command and Control Squadrons (ACCS). The computer-based training system is designed as a self-paced, simulated training aid, containing standardized instructional information. It will provide basic instruction, refresher training, and recurring training. The training system employs several instructional strategies including tutorial/inquiry, drill/practice, simulation and problem analysis. The training will be used for Initial Qualification Training (IQT), Certification Training (CT) and upgrade training on the EC-135 and E-4B aircraft, and will support both classroom and ground training programs.

The training system is comprised of three components: the PLATO computer-based system, the SPIRITUS Metatron audio visual system and the Airborne Command Post Communications Systems Courseware developed by Electrospace Systems, Inc. (ESI). The Control Data 110 PLATO Delivery System includes a Viking 721 Terminal and a Flexible Disk Subsystem. The SPIRITUS Metatron system is comprised of a random access cassette recording and a random access high resolution color slide visual presentation. This combination of hardware and software is intended to train the student in a realistic, effective and safe environment.

Interaction between the student and the training system is a key element in PLATO/SPIRITUS training. The tutorial begins with a slide presentation on the SPIRITUS screen which displays the individual pieces of equipment the operator will use on the EC-135 or E-4B aircraft. The presentation is accompanied by a prerecorded description of the equipment and instructions detail-

ing the procedures to follow when operating the equipment. Subsequently, the student is presented with a graphic representation of the equipment component, including switches, dials, lamps, etc., on the PLATO touch-sensitive screen. The student is required to actively participate by answering questions about the course content and practicing the operational procedures through positioning the switches, dials etc. on the touch-sensitive PLATO screen. The screen simulates the actual movement and operation of the equipment. Visual feedback of correct/incorrect positioning is provided immediately. The student must correctly complete each task prior to advancing to the next task in the lesson segment. The student may request multiple practice segments, remedial review, or additional testing prior to advancing to the next lesson segment.

PLATO/SPIRITUS training for novice students presents course material in individual, one-hour segments consisting of simulation, testing and practical review exercises. Refresher and recurring training allows the student to progress immediately to specific lesson segments where he can elect to review the detailed instruction, practice simulation exercises, and/or simply complete the test on the particular segment.

The features, capabilities and system specifications of the training system's components are covered below.

2. Control Data 110 - PLATO Terminal and Components

a. Features and Capabilities

PLATO provides a stand-alone, off-line training delivery system. PLATO has been operating in a stand-alone mode for more than 20 years. This stand-alone capability is absolutely essen-

tial for the WWABNCP training program because the world-wide locations of the participating ACCSs prohibit the networking of major systems.

PLATO simulates several equipment systems used by radio communications operators so that students will be trained to perform various recording, switching and voice communications in support of airborne command control operations. For example, the PLATO keyboard can be reprogrammed to simulate the UGC-129 keyboard. This keyboard is the standard keyboard used for data transmission on board the EC-135 and E-4B ABNCP aircraft.

The basic 110 PLATO student station consists of a Viking 721 terminal, a primary flexible disk drive subsystem, parallel port options and dual RS 232 ports. The Viking 721 terminal is comprised of a keyboard and a monochrome monitor (green on black). The high-resolution display monitor can be programmed for extensive use of graphic displays and simulations. The high-resolution display monitor is required, due to the extensive technical graphics presented in the Airborne Command Post Communications Systems course material. The primary flexible disk drive provides 64K random access memory allowing the execution of lessons entirely off-line. The disk drive uses 8-inch, double-sided, double-density flexible (floppy) disks. The parallel port options and the dual RS 232 ports transmit information simultaneously from the SPIRITUS Metatron audio visual system. Control Data provides the PLATO interface needed to drive the SPIRITUS Metatron audio visual system. Control Data can provide world-wide maintenance support.

The two authoring stations provided to the courseware developer as government furnished equipment, contain the basic 110 PLATO student station, an internal modem, a secondary flexible disk drive and a graphics/character printer. The authoring sta-

tions are used to develop instructional programs (or courseware). The internal modems enable access of the authoring stations to the Control Data CYBER 120 mainframe network. As currently configured, in order to develop courseware, access to a CYBER 120 mainframe is required. Courseware cannot be developed in a stand-alone mode. Access to a mainframe can be obtained by purchasing a CYBER mainframe outright or by purchasing a subscription from Control Data Corporation to use their mainframe at a cost ranging from \$500.00 to \$800.00 dollars per terminal per month. The secondary flexible disk drive provides the additional storage capacity needed to develop courseware, increasing the capacity from 1.21 million characters (single disk drive) to 2.4 million characters in the double disk drive. The graphics/character printer is a dot-matrix printer that prints both text and graphics.

The keyboard and touch-sensitive screen monitor have the capabilities of providing graphics presentation, simulation, testing, response handling, and recordkeeping through both student and instructor interaction. Instructors can direct the progress of students through preprogrammed lessons and monitor their performance by using the recordkeeping capability to track test scores. This capability allows the instructor to identify specific problem areas for a particular student or an entire class.

b. System Specifications

Viking 721 Terminal

- Z80B microprocessor.
- 64K characters of Random Access Memory (RAM).
- High resolution display (512x512 dot matrix) for PLATO graphics and up to 32 lines of text with 64 characters per line using PLATO characters.
- Touch-sensitive screen panel with 256 addressable positions.

- Telephone communications to the PLATO network uses ASCII modems, compatible with Bell System 212A which is full duplex (sends and receives information simultaneously).*
- Courses are packaged on soft-sector, double sided, double density flexible disks.

Keyboard

- Serial, with a flexible cable that allows 991mm(39 inch) separation between keyboard and monitor.
- Provides standard alphanumeric and mode-dependent special function keys. Overlays can be used to mark special function keys.

Monitor

- Swivel/tilt monitor adjusts to varying operator positions, operator preferences, and lighting conditions.
- 380-mm (15 inch) monitor provides a viewing area of approximately 200mm by 250mm (8" by 10").
- Representation can include a constant underline, blinking underline, solid block or a blinking solid block.

Flexible Disk Subsystem

- A 154mm cable connects the unit to the parallel I/O channel of the terminal. The secondary drive connects to the subsystem via a 762mm cable.
- Storage Capacity: Double sided, double density; 1,025,024 bytes.
- Latency: Maximum 116.6 ms, Average 83.3 ms.

* Exclusive to authoring stations.

- Positioning Time: $3N + 20\text{msec}$, where N is the number of tracks to be moved.
- Transfer Rate: Direct memory access (DMA) asynchronous 0 to 140K bytes/second dependent.
- Response Time: .5 seconds for one sector of data for terminal requesting access*.
- Controller: Housed in the disk subsystem and containing the logic to operate Master (and Slave*) flexible disk drives and self-diagnostics.

60 Hz/120 VAC

- Operating Power Requirements
 - Voltage: 104-128 VAC
 - Phase: Single
 - Frequency: 60 Hz
 - Current: Master 1 AMP, Slave .75 AMP*
 - Temperature: 50F to 90F (10C to 32C)
 - Humidity: 20% to 80% RH
- Physical Characteristics
 - Height: 8in. (202.85mm)
 - Width: 15in. (381mm)
 - Depth: 19.78 in. (502.5mm)
 - Weight: 37.00 lbs (16.78kg) Master
36.00 lbs (16.33kg) Slave*

50 Hz 220/240 VAC

Equivalent to 60 Hz/120 VAC except for:

- Operating Power Requirements
 - Voltage: 191-256 VAC
 - Phase: Single
 - Frequency: 50 Hz
 - Current: .5 AMP Master
.38 AMP Slave

* Exclusive to ESI authoring stations.

- Physical Characteristics

- Weight: 44.5 lbs (20.19kg) Master
43.5 lbs (19.73kg) Slave*

3. SPIRITUS Metatron Audio Visual System

a. Features and Capabilities

SPIRITUS is a random-accessed slide/sound system, unique in that it can be driven by the PLATO system. SPIRITUS enhances computer-based instruction with audio and visual information. SPIRITUS provides a high resolution color slide presentation of system components and operational procedures to WWABNCP operators.

The SPIRITUS Metatron system purchased for the PLATO/SPIRITUS Training System consists of a single-screen Metatron student station, complete with random access projector, handset, headset, Viking interface cable and operations manual. In addition, the system includes a Metatron spareboard parts kit and a maintenance kit, consisting of frequently used small items, such as projector lamps. SPIRITUS does not offer extended maintenance contracts for the system; it is simply a 90-day warranty.

The ESI authoring stations include in addition to the student equipment just mentioned: two Metatron authoring single screen stations, complete with two random-access projectors, handsets, Viking interface cables, authoring manuals and a Metatron service manual complete with drawings.

The slide presentation uses a dual half-track audio cassette format with tape time, control codes and digital information recorded on the control track. Program audio information is re-

* Exclusive to ESI authoring stations.

corded on the second track. The micro based players and recorders offer complete control over a random access projector and a random access audio cassette tape. This programmed presentation permits the SPIRITUS audio visual presentation to be synchronized with the PLATO presentation so the student progresses through the lesson either sequentially or the student can randomly choose specific areas of the lesson for instruction.

The 128-character, transmitting and receiving buffers provide control, communication, and status reporting. All transmissions to and from SPIRITUS are ASCII standard STX-ETX format. Baud rates and parity are switch selectable. A maximum of eight macro commands can be custom programmed. Numerics and control characters (flags and commands) can be recorded on tape, issued by a host computer, or entered from the SPIRITUS handset for complete control and communication. Branching commands offer testing, menu selection, remedial work, and reinforcement capabilities. Strings of data up to 128 characters in length can be interleaved with the time code on the control track. This technical capability allows the student to progress immediately to areas where he needs tutorial or refresher training rather than starting at the beginning of the lesson each time.

The extremely versatile program format of SPIRITUS encourages the development of both simple and complex interactive programs. It is easily programmed and controlled from the 110 PLATO Viking 721 computer terminal or from the response control handset. Audio control codes can be utilized alone or with projector control codes for simplicity. The SPIRITUS slide/sound system interfaces with PLATO by means of a software driver and editor, copyrighted by Control Data Corporation.

b. System Specifications

- RS 232 interface;
- 35mm slides;

- Audio frequency response, 40 Hz to 12000 Hz;
- 105/250 VAC, 50/60 Hz; and
- Physical Characteristics for cabinet model:
 - Height: 23.1"
 - Width: 19.75"
 - Depth: 29.5"

4. Courseware

a. Features and Capabilities

The Airborne Command Post Communications Systems Courseware developed by ESI includes four courses. The courses are designed to teach equipment familiarization and procedural operation for the AFSATCOM, LF/VLF, HF, and UHF/ARA-60 communications systems. The course titles, lesson segments and basic equipment or subsystems covered in each course are summarized in Exhibit I.

The AFSATCOM course familiarizes the student with: the equipment associated with the AN/ASC-21 AFSATCOM System, the checklist procedures on board the aircraft in accordance with the appropriate technical order, and the functions and operation of the AN/UGC-129 (ASR) terminals used with the AN/ASC-21 AFSATCOM system. In addition to instruction on the Random and Time Division Multiplex (TDM) modes of Satellite operation of the AN/ASC-21 AFSATCOM equipment, students learn the necessary actions and procedures required to compose and transmit a JCS Emergency Action Message (EAM). Finally, the students learn fault recognition and correction procedures utilized on the AN/ASC-21 AFSATCOM communications system.

The LF/VLF course covers clear and secure record communications by familiarizing students with the LF/VLF System associated equipment and the checklist procedures on board the aircraft.

EXHIBIT I
COURSEWARE

<u>Course</u>	<u>Lesson Segments</u>	<u>Equipment/System</u>
AFSATCOM	Equipment Familiarization Checklist Procedures ASR Keyboard EAM Transmission Satellite Operational Modes Fault Recognition	EC-135 AN/ASC-21 AFSATCOM System and Equipment
LF/VLF	Equipment Familiarization Checklist Procedures Message Transmission & Receipt Fault Recognition	EC-135 LF/VLF System and Equipment
HF	Equipment Familiarization Radio NETS/NET Procedures E-4B Checklist Procedures	EC-135 & E-4B AN/ARC 190 HF System and associated equipment, Selected components of the KY-75 Secure Voice System, WWABNCP and GIANT TALK NETS
UHF/ARA-60	Equipment Familiarization Preflight Procedures Data Flow/Fault Recognition/ Isolation JANAP 128 Message Format	EC-135 & E-4B UHF Radio System and AN/ARA-60 Teletype Communications System and Equipment

This training is in accordance with appropriate technical orders. Also, students learn how to perform necessary actions and procedures required to compose and transmit messages via the LF/VLF system. Students become familiar with fault recognition and correction procedures used on the LF/VLF communications system.

The HF communications system course content includes: familiarization training for the equipment associated with the AN/ARC-190 HF System and selected components of the KY-75 secure voice system; familiarization training using netting concepts and procedures within the GIANT TALK (the SAC worldwide Command and Control HF Network) and WWABNCP nets used to provide National Command Authorities, Joint Chiefs of Staff, and the Commanders-in-Chief of appropriate specified commands with a survivable command, control and communications capability. Lastly, this lesson familiarizes the student with the HF system checklist procedures aboard the E-4B aircraft.

The UHF/ARA-60 course is divided into two sections. Section I covers the UHF Radio System while Section II is devoted to the ARA-60 teletype communications system. Section I familiarizes the student with associated equipment and troubleshooting procedures for the UHF Radio System and the AM Dropout System. In addition, students learn the equipment and procedures for operating the secure voice system, the VHF FM Radio telephone system (EC-135 C Model only), the Manual Switchboard aboard the EC-135 J and P model aircraft, and the Electronic Switching Systems.

Finally, the AN/ARA-60 Teletype Communications lesson provides familiarization training for the AN/ARA-60 teletype communications system associated equipment, and the pre-flight and checklist procedures for record communications operators

(EC-135) and Data Operator's Normal Procedures (E-4B). In addition, the student is taught AN/ARA-60 Data Flow Fault recognition and isolation procedures. Finally, instructions for using correct procedures to compose and edit messages are provided using the JANAP-128 Message Format.

ESI employed a combination of several instructional strategies when developing the courseware: tutorial/inquiry, drill/practice, simulation of operational equipment, and problem analysis.

The tutorial/inquiry strategy typically includes a text presentation broken into fairly small tasks, followed by questions for students to answer concerning the material presented in each task. Depending on his answer to a question, a student will either be given remedial instruction tailored to the information needed to correct his particular wrong answer or he will receive approval for answering the question correctly. In this way, an intelligent information base was built into the courseware, suiting the training needs of individual students.

The drill/practice strategy requires students to repeatedly perform new skills or practice learned skills. This is accomplished using repetitive questions and answers.

Simulation of the work environment allows the radio communications operator to practice skills in a training situation without affecting the actual equipment or environment. The trainee's attention is focused on the simulated experience, where a computer-generated graphic display replaces the actual equipment.

Problem analysis is the final instructional strategy employed in the development of the training system's courseware. Proper problem analysis is of primary importance to the performance

of a radio communications operator's duties during actual emergency actions. In such an environment, an operator is expected to analyze the scenario and determine the most effective and efficient way to operate the record equipment, voice communications equipment and switching communications equipment at his disposal. Operators are expected to perform proper procedures expeditiously and accurately. It is imperative that all information be received and transmitted correctly and quickly. Repeat transmissions wastes valuable time and hinders operational effectiveness. With this objective in mind, the courseware was designed to present emergency scenarios to students. These scenarios require them to analyze the problem and determine the most effective and efficient solution.

Using these strategies, course material was developed to provide both basic instructional training for newly assigned radio communications operators and refresher or recurring training for more experienced personnel. In basic instructional training, the student progresses through the course material sequentially, covering fundamental material first, and then more specific and complex material. A building block approach, going from simple to complex is used for course material development. For experienced personnel, refresher training permits the student immediate access to the more advanced lesson segments, where course material can be reviewed, practice exercises completed and/or a test taken.

The courseware is designed to be user-friendly. Programmed instruction is menu-driven. ESI maximized the use of the touch-sensitive screen by designing the software so that the student can touch his selection on the screen or can type in commands on the keyboard. The touch-sensitive screen allows the user to

interact directly with the system in the simplest way possible, thus reducing any "computer anxiety" or frustration caused by hitting the wrong key.

The courseware provides personalized, one-on-one instruction tailored to the abilities of the individual student. The amount of remedial work and the number of additional help segments are dependent on either a student's request or his failure to complete an exercise correctly. This is an especially valuable feature for slow learning students. This ensures that the student progresses at his own rate, mastering each step before advancing to a higher level.

Comprehension and retention of information are emphasized in the courseware design. Drill/practice, immediate feedback on performance, and the use of multiple senses (auditory, visual and tactile) in training are recognized methods that encourage information comprehension and retention.

Courseware is standardized by aircraft. That is, lessons for EC-135 or the E-4B communications systems are the same regardless of the Airborne Command and Control Squadron. Thus, every student using the training system is assured of receiving a baseline of information. Standardization of courseware was agreed to by all ACCSs during the development process.

At the end of each segment the student is tested to assess his understanding of course material. Training instructors at the ACCSs develop and alter (as appropriate) questions and answers to be used in testing. Tests contain both required questions, determined by the instructor, and randomly generated questions selected by the computer. As many as 100 questions may be incorporated into tests. The instructor specifies test length.

Of the total number of questions, the instructor decides which questions are required and which may be generated by the computer randomly. The answers to multiple choice questions are reordered each time a test is given to ensure each student has a command of the material rather than a familiarity with the test. The tests are not used for job performance purposes or evaluation/promotion purposes; they are simply an aid to assess the student's understanding of the lesson content. These tests provide the students with immediate feedback about their progress and give the instructor a means to assess where a student or class is having trouble.

Security over use of the system is controlled by passwords given to both students and instructors. Instructors gain access to test scores and to student lesson progress by using the proper password.

b. Courseware Specifications

For development purposes, access to a Control Data Corporation CYBER 120 mainframe is required. The programming for the courseware is done in MICROTUTOR. The PLATO system can be programmed in either TUTOR or MICROTUTOR. Programming in MICROTUTOR provides the flexibility to upgrade the hardware in the future without redeveloping software applications. Programs are transferred onto 8-inch flexible (floppy) disks, allowing the ACCSs to use the system independently in a stand-alone mode.

All courseware developed is unclassified. When classified material is required to train the radio operators, trainees are referred to the instructor for classroom or one-on-one instruction.

c. Courseware Development

Using the instructional strategies described above, each course can be developed in the following manner:

1. A single Subject Matter Expert (SME is a specialist in the airborne communications field) is responsible for developing a strawman lesson plan on the designated course material. Lesson plans are based on technical publications, technical orders and operational procedures at the ACCS.

2. A strawman lesson plan is sent for review and comment to the participating ACCSs.

3. Representatives from each ACCS attend a conference hosted by the courseware developer to discuss changes to the strawman lesson plan. The objective of the conference is to get an approved, standardized lesson plan for development.

4. The original SME works with the courseware developer's curriculum scriptor. During this step, the SME and the scriptor write the text for the lesson as it is displayed on the screen and the script for the cassette. The complete lesson plan is documented.

5. Audio visual supplements are developed concurrently with lesson scripting. The audio is likewise scripted, taped and approved. The courseware developer travels to the ACCSs to photograph equipment on the aircraft for the slide presentation. The cassette tapes are synchronized with the graphic displays so they play at the appropriate times.

6. The courseware developer travels to the ACCSs to review and verify the final draft of the lesson plan prior to programming. Complete scripting of lesson material takes approximately three weeks once a lesson plan has been approved.

7. The completed lesson plan is coded, tested and debugged by the courseware developer's programmers. At this time, an internal quality assurance review is conducted to ensure that

the completed program runs as intended. Once this has been completed, programs are down-loaded from the mainframe to the floppy disk.

8. The courseware developer travels to the host command that originally developed the lesson plan. At this time, SMEs reievew the lesson plan and verify screen displays. Any changes or modifications to software are noted.

9. Courseware is updated or modified and redelivered for final check-out.

10. Documentation for the lesson plan was developed throughout courseware development is completed. Included in the final delivery are the Airborne Command Post Communications System Users Manual, the Airborne Command Post Communications System Maintenance Manual, master and backup disks containing each course and a master and back-up set of slides and cassette tapes. The users manual includes a description of the system, check-out procedures and start-up procedures. An insert containing instructor's procedures to operate, use and maintain the equipment is included in this manual. The maintenance manual includes a listing of all software that comprises the courseware. The software lists contain the program code and in-line documentation. In-line documentation provides an explanation or comments that describe exactly what each specific program should do. This feature allows program modifications to be made easily and quickly, thereby reducing software maintenance time.

To date, segments of the AFSATCOM, LF/VLF and ARA-60 courses have been delivered to the Airborne Command and Control Squadrons. Specifically, the equipment familiarization, checklist procedures, ASR keyboard, satellite operational modes and fault recognition have been delivered for the AFSATCOM courseware. For the LF/VLF Courseware, the equipment familiarization, message

transmission and fault recognition segments have been delivered. Finally, only the data flow and fault recognition segments of the ARA-60 courseware are completed. All segments for the four courses are expected to be completed by 31 October 1985. ESI plans to develop two additional courses on the Trailing Wire Antenna (TWA) and the ARC-171 systems in the manner outlined above.

B. Expected Benefits and Utility of the System

1. Expected Benefits

This subsection provides a summary of the expected advantages of the PLATO/SPIRITUS Training System. In sum, the system provides increased operational effectiveness, improved delivery of training and reduced training costs. These expected benefits are based on information and opinions received from DCA, the user requirements survey, and the developers of the hardware and software of the system.

Operational Benefits

- Improved performance of WWABNCP radio communication operators in the operation of various communications systems equipment;
- Increased supply of qualified operator personnel due to shorter initial qualification periods;
- Greater standardization of training among the ACCSs and CINCs;
- Fewer trainee errors on operational missions due to greater pre-flight hands-on training; and
- Decreased demand for training aircraft.

Training Benefits

- Greater basic instruction training availability (24-hour/day);
- Increased availability of recurring and refresher training;
- Decreased instructor training time in the classroom and in-flight;
- Greater instructor attention to individual and class problems;
- More operator practice in hands-on training;
- Improved problem analysis training;
- Increased responsiveness to the individual's training needs; and
- Heightened student interest in training.

Cost Benefits

- Reduced training costs; and
 - Reduced number of training flights
 - Reduced training-related travel
- Reduced personnel training time.

2. Expected Utility

The PLATO computer-based training system is designed to augment unit-level training at the Airborne Command and Control Squadrons. Although the PLATO/SPIRITUS training system is a self-taught system, use of the training system does not eliminate the need for instructors. The PLATO/SPIRITUS Training System augments classroom and ground training and does not replace either type of training. Since system configuration varies in the EC-135 models and the training system is limited to standardized equipment functions, local procedures and aircraft configurations must be taught by qualified instructors in the classroom or on grounded or ground-alert aircraft.

The PLATO/SPIRITUS Training System supports unit level requirements for initial qualification, refresher and recurring training. During initial qualification training, PLATO/SPIRITUS provides students with equipment familiarization and procedural training needed to become qualified communications voice systems operators, communications record systems operators and switching systems operators. Essentially, students receive a basic indoctrination to communications system(s) to which they are assigned. Students become familiar with the system's functions, how it supports the mission, and the procedures for operating component equipment. They are afforded the opportunity to simulate actual equipment operation prior to their first training flight or operational sortie.

PLATO/SPIRITUS provides experienced personnel with an available means to fine tune their knowledge and remain current. Refresher and recurring training allow the student to select lesson segments such as fault recognition/isolation, emergency action message (EAM) transmission or satellite transmission based on his judgment or requirements for re-emphasis and retraining. Students can operate the training system strictly in a refresher mode. Refresher training consists of review exercises, practice of proper operational procedures based on a given scenario and/or retesting. The audio visual instructional information is not provided during refresher training. Qualified radio communications operators can also use the system to satisfy recurring training requirements to ensure they remain knowledgeable and proficient in all areas pertinent to their assigned duties. Personnel in this career field are subject to continual recertification to remain qualified.

The PLATO/SPIRITUS Training System is flexible in that it enables the student to concentrate on the system(s) he will operate. Communications personnel are not required to be qualified

on all six aircraft positions. Although requirements vary among the ACCSs, students are certified mission ready on the two or three systems required to qualify them as communications voice systems operators, communications record systems operators or switching systems operators. Therefore, students use the PLATO/SPIRITUS Training System to meet their individualized training needs on specific airborne radio communications systems.

One PLATO/SPIRITUS Training System student station will be located at each ACCS in the Training Section. (Two units are currently located at Electrospace Systems, Inc. and are being used for courseware development. Upon completion of the courseware, these units will be returned to the Defense Communications Agency until specific plans for the system are in place).

The training system is available for training 24 hours a day and seven days a week. Only one student can, however, use a student station at any given time. Therefore, students must schedule time in advance. The amount of system usage varies depending on where the student is in the training progression. Initial qualification training generates more usage because new trainees need complete equipment familiarization and procedural training. As students advance, in-flight training increases and training system usage decreases.

The PLATO/SPIRITUS computer-based training system presents strictly unclassified information. Although all scenarios and procedures closely resemble "real-world" situations, all classified procedures and operations must be taught by instructors.

Finally, training requirements that are not included in the initial library of courseware, such as TWA, ARC-171, and unit level requirements (life support systems, security, espionage,

sabotage and subversion, anti-hijacking procedures, survival courses etc.) must be instructor taught throughout the training program.

C. Constraints and Assumptions Employed During System Development

Defense Communications Agency developed the PLATO/SPIRITUS Training System under funding limitations. According to the DCA project officer, funding was limited to approximately \$850,000.00. The available funding imposed two constraints on system development: the system would be unclassified and four standardized courses would be developed.

DCA concluded that the classified portion of the lessons could be taught by instructors more cost-effectively. DCA stated (DCA/CCEC G700 Msg 241449Z May 84) that classified lesson plan development required procurement of costly TEMPEST approved mainframe computer, TEMPEST approved terminals or a screened room, and encryption between the mainframe computer and the developer's site. Given the requirement for the use of a commercial computer mainframe in courseware development and the fact that many commercial users have access to this mainframe, DCA decided that it was impracticable to undertake classified lesson plan development.

HQ SAC (HQ SAC/DC msg 211600Z Dec 83) objected to the lack of a classified system stating that it limited the utility of the system for total unit training. HQ SAC's views were supported by some ACCSs claiming that an unclassified system would constrain opportunities for expanded courseware. For example, training for Electronic Warfare Officers would not be feasible since the majority of their instruction is classified. Other ACCSs, however, pointed out the system should be used as a procedural training

aid and given that most procedures are unclassified, realism could be achieved by using "fake codes." Consequently, they determined an unclassified system should not pose a significant problem. After taking these objections under advisement, DCA still concluded funding limitations required development of an unclassified system.

During initial development, DCA learned that all ACCSs did not operate in the same manner despite several similarities. Since DCA had limited funding they could not develop courseware unique to each ACCS and aircraft configuration. DCA therefore determined that four lesson plans standardized by the communications system on the aircraft (EC-135, E-4) would be developed. As stated in DCA/CCEC G700 message (241449Z May 84), the four courses were selected in coordination with the ACCSs. The courses are considered to be an "initial library" of instruction available to Radio Communications Operators.

D. Development, Maintenance and Future Development Costs

1. Development Costs

The PLATO/SPIRITUS Training System's development costs are discussed in two categories: hardware and software costs. Hardware cost estimates are derived from actual purchase agreements with Control Data Corporation and SPIRITUS; software costs are a compilation of estimates provided by Defense Communications Agency, Electrospace Systems, Inc. and Air Force SMEs.

Hardware procurement costs of the PLATO system and SPIRITUS system are displayed in Exhibits 2 and 3, respectively. Exhibit 4 summarizes the total hardware costs. Current plans call for no reimbursement of hardware costs to DCA should the Air Force accept responsibility for the training system.

EXHIBIT 2

PLATO HARDWARE COSTS

PLATO Student Stations	<u>Unit Price</u>	<u>Qty</u>	<u>Total</u>
Viking 721 Terminal	\$2,750.00	6	16,500.00
Primary Disk Drive	1,895.00	6	11,370.00
Parallel Port Options	100.00	6	600.00
Dual RS 232 Ports	<u>190.00</u>	6	<u>1,140.00</u>
Per Unit	\$4,935.00		29,610.00
PLATO Authoring Stations			
Viking 721 Terminal	2,750.00	2	5,500.00
MODEM	660.00	2	1,320.00
Primary Disk Drive	1,895.00	2	3,790.00
Secondary Disk Drive	1,663.00	2	3,326.00
Parallel Port Options	100.00	2	200.00
Dual RS 232 Ports	190.00	2	380.00
SPIRITUS Drive Editor	5,500.00	1	5,500.00
Printer	2,708.00	1	2,708.00
Printer Cable	<u>143.00</u>	1	<u>143.00</u>
	15,609.00		22,867.00
Total Cost PLATO Equipment			52,477.00

EXHIBIT 3

SPIRITUS HARDWARE COSTS

SPIRITUS Student Stations	Unit Price	Qty	Total
Metatron	\$8,253.00	6	49,518.00
Metatron Maintenance Kits	390.00	6	2,340.00
Metatron Spareboard Ports	3,800.00	6	22,800.00
(Export Model (Overseas))	<u>470.00</u>	1	<u>470.00</u>
	\$12,913.00		75,128.00
SPIRITUS Authoring Stations			
Metatron Author	8,595.00	2	17,190.00
Metatron Service Manual	350.00	1	350.00
Metatron Maintenance Kit	<u>390.00</u>	1	<u>390.00</u>
	9,335.00		17,930.00
Total Cost SPIRITUS Equipment			93,058.00

EXHIBIT 4

HARDWARE COST SUMMARY

	<u>Total</u>
PLATO Student Station	29,610.00
SPIRITUS Student Station	75,128.00
PLATO Authoring Station	22,867.00
SPIRITUS Authoring Station	<u>17,930.00</u>
Total Hardware Procurement	145,535.00

Software development required large up-front costs due to the labor-intensive effort involved in developing courseware for a computer-based training system. Technical personnel, education and training specialists and computer programmers were required to staff the development effort. The large number of instructional strategies employed and the highly interactive nature of the system increased the number of development labor hours.

Electrospace Systems, Inc. developed 40 instructional hours at a total cost of approximately \$700,000.00. Included in this price are ESI's personnel costs, computer charges and support materials (i.e., film, tapes, disks). Electrospace Systems Inc. employed a technical staff experienced in airborne radio communications, training specialists, education specialists and computer programmers experienced in educational programming languages. ESI also utilized Air Force SMEs experienced in airborne communications training at the Airborne Command and Control Squadrons.

As referenced in the courseware section, ESI employed a combination of the following instructional strategies: tutorial/inquiry, drill/practice, simulation and problem analysis. Based on these strategies and the personnel employed, ESI estimates that 495 courseware development hours were required to produce one hour of computer-generated instruction. Air Force SMEs spent an additional 36 hours developing each hour of instruction. Air Force SME time was not accounted for in the ESI development costs associated with the software. Hence, total development time results in 531 courseware development hours required for each instructional hour. Electrospace Systems, Inc. estimates the average development cost per hour of instruction ranges from \$12,000 to \$15,000 per hour. The courseware development charges are computed based on a pre-existing basic order agreement contract with DCA.

Electrospace Systems Inc. purchased a subscription to the CYBER 120 mainframe from Control Data Corporation at a cost of \$800.00 per terminal per month. Other support charges included the costs associated with developing audio visual materials.

High software development costs are not uncommon according to a report by Advance Technology titled Nonpersonal Studies and Analysis Services for Assessment of New Training Analysis (June 1985). Advance Technology cites cost variations of 100 to 200 courseware development hours per instructional hour for computer-based training (CBT) using tutorial/inquiry and drill/practice instructional strategies. The cost for intelligent computer-assisted instruction (ICAI) rises to a much higher cost of 500-1000 courseware development hours per instructional hour because the data base must be tailored to provide responses tailored to student input. Although the costs of developing computer generated courseware are difficult to assess, they are regarded as the highest cost in advanced technology training delivery systems.

2. Maintenance Costs

The costs projected for system operation are divided into hardware and courseware maintenance costs. Regarding hardware maintenance costs, DCA required each ACCS to purchase an annual maintenance contract for the PLATO equipment from Control Data Corporation. The contract provides on-site world-wide maintenance at a cost of \$91.00 per month (DCA msg 121445Z Sep 84). SPIRITUS, Inc. offers no maintenance contract on the SPIRITUS Metatron audio visual system. However, included in the procurement package is a spare parts kit for frequently failed items such as light bulbs. If additional maintenance is required, arrangements can be made with SPIRITUS, Inc. on an as-needed basis (DCA msg 121445Z Sep 84). The annual hardware maintenance cost

of the eight PLATO/SPIRITUS units currently in place is \$8,736.00. Of this total cost, the Air Force is funding \$6,552.00 for six units at the ACCSs.

Courseware maintenance cost estimates are based on a compilation of information provided by DCA, Electrospace Systems, Inc. and AF SMEs at the ACCSs. Changes to technical orders or modifications to the aircraft drive the requirement to update the courseware. AF SMEs indicate that courseware would require semi-annual updates to remain current with technical orders which change (depending on communications system) on the average of every six months. Courseware maintenance charges are contingent on the magnitude of the change and are largely driven by personnel requirements. A minor procedural change (e.g., checklist procedures contained in one lesson segment) will cost much less than an extensive equipment modification (e.g, development of new graphic displays used in several lesson segments). ESI estimates that courseware maintenance charges could vary from \$12,000 per instructional hour to as much as \$21,000 per instructional hour. Based on past courseware modifications, the average time required to update or modify courseware was 90-120 hours.

3. Future Development Costs

Future system expansion and courseware development costs must also be considered. Although projected resource requirements are speculative, they can be used to determine the feasibility for affording future developments. System expansion can easily be accomplished by purchasing additional PLATO and SPIRITUS hardware at an increased cost of 10 percent over the original purchase price. One additional unit for each ACCS (6 total) would cost about \$120,000.

Costs for upgrading the system will be explored during the Life Cycle Management Plan in Phase III of this study. Initial review indicates that the cost of upgrading hardware to IBM compatible equipment may double the initial procurement cost. However, trade-in arrangements for the PLATO/SPIRITUS units would partially offset the cost, considering there was no initial equipment investment by the Air Force.

Additional courseware development provides a viable means to expand the training capability of the training system. Since courseware is designed to be system specific it lends itself to incremental expansion. Additional courses may be developed for complete communications systems on a specific aircraft.

ESI estimates future development costs would be \$21,000 per instructional hour. This estimate is contingent on the communication system application and could conceivably drop to \$15,000-\$16,000 if much of the ground work is already done (e.g., character sets for graphic displays already exist). This estimate, however, requires the Air Force to provide an SME from each ACCS to develop the strawman lesson plan and work with an Electrospace Systems, Inc. scriptor. The Air Force would be required to support travel costs of Air Force SMEs attending conferences or scripting lesson plans. These costs are significantly higher than the original development costs and warrant further exploration during Phase III of this study, Life Cycle Management.

Currently, the Air Force is developing courseware on the PLATO system. In-house estimates must be compared to contractor estimates in terms of total development hours per instructional hour. Courseware developed for the Airborne Radio Communications Operators total 531 hours per instructional hour. In contrast, courseware development time for lessons used at the School of

Health Care Sciences ranged from 200-300 hours per instructional hour. The Air Force is also developing a PLATO computer-based training system for Air Traffic Controllers at Keesler AFB. To date, estimated total development hours per instructional hour for this effort are not available. While the possibility for in-house courseware development does exist, resources are not currently in-place to assume additional requirements.

Various requirements for additional courseware development were identified by the ACCSs. Two more lesson plans will be developed by ESI on the TWA and ARC-171 communications system. The completion date is unscheduled at this time. The PACER LINK II modification program will generate significant changes in the communications systems aboard the EC-135 aircraft. In some instances, communications modifications will incorporate touch sensitive panels similiar to the touch sensitive screens used in PLATO.

It is reasonable to assume that near-term courseware maintenance must be contracted out to sustain the training system until funds can be programmed in the POM. Until that time, plans to obtain funding must be developed in the Implementation Plan. Plans for courseware expansion must be developed if the training system is to remain a viable training aid in the long term. The decision to use in-house capability or contractor support warrants futher examination during Phase III of this study, in the Life Cycle Management Plan. At that time, procedures for programming additional resources in the FY 89 Program Objective Memorandum (POM) will be developed.

E. Identification of Skill and Information Requirements

According to the system's developers, no special skills are required for a student to operate the PLATO/SPIRITUS Training System. It was designed so that all potential users could oper-

ate the system without formal training. Checkout procedures that activate the system are explained to the student through the Airborne Command Post Communications System Users Manual and computer prompts. The student should simply be able to read and follow directions.

Based on conversations with training personnel at the ACCSs, however, students do require some guidance when using the training system. Normally, an instructor "walks-through" the first lesson segment making sure the student understands the system, how it works, and the course material. This approach is deemed necessary to prevent students from spending an inordinate amount of time mastering the system or becoming frustrated using the system. The results have been very favorable. Very rarely is there a problem using follow-on lesson-segments after the initial system introduction is completed.

F. System's Potential for Future Courseware Development and System Enhancements

1. Future Courseware Development

The PLATO/SPIRITUS Training Sytem's courseware is capable of being easily upgraded, revised or augmented with new lessons. Since the courseware is contained on individual disks, newer disks can be substituted or added to the current collection. Similiarly, the random-accessed audio visual portion of the lesson can be altered or expanded with the addition of slides or cassettes. Student Manuals would have to be revised or added corresponding to these changes.

The process by which lessons or the audio visual portion of lessons would be changed in the future would need to follow the basic steps in the development of courseware. (See Subsection A4

for more details.) The Air Force would have the option of contracting this service as it did in the past or could investigate the possibility of performing this service in-house. An in-house capability would potentially allow each user to tailor the courseware to local procedures.

The Air Force is currently developing some courseware for the PLATO system in-house. At the School of Health Care Sciences at Sheppard AFB, courseware is being developed for PLATO applications for health care professionals' training, such as physician assistants, as an augmentation of classroom training. Seventy terminals and 17 courses are being used in this training. The school leases mainframe time from the Army, at Fort Leavenworth, at a cost of \$200.00 per month per terminal. The school presently has a staff of five (one officer and four enlisted) dedicated to PLATO training. The staff is expected to increase to seven next year. Courses are programmed in TUTOR which is compatible with the Viking 721. Through the use of PLATO, the school was able to decrease student time from 30 hours to 14 hours for a medical technician course. However, courses of a more complex or technical nature are not expected by the school to reduce student time by as much.

Another in-house PLATO capability can be found at Keesler AFB where courseware is currently being scripted for a course to train Air Traffic Controllers. This unit level training course is expected to have 30 lesson plans. The course is expected to cut student time from the traditional 96 hours of classroom instruction to 30 hours of PLATO instruction. Currently, Keesler is leasing mainframe time from Control Data Corporation for \$500.00 per month per unit for eight units. This PLATO effort is part of a study to validate the efficiency and effectiveness of using PLATO training as compared with classroom instruction.

2. Future System Enhancements

If users wish to upgrade the system's hardware in the future in order to take advantage of changing and improved technologies and capabilities, there are a number of options which would seem feasible, given the system's current configuration and purpose. For example Control Data Corporation proposed the following option. The future PLATO system, referred to as the PLATO Personal Training Station (PPTS), would consist of the following major components:

- Zenith 158 or 200 terminal
- 5 1/4 inch disk
- MicroSoft Disk Operating System (MS-DOS)
- MICROTUTOR Software Programming

Although Zenith manufactures several IBM compatible terminals, the Zenith 158 or 200 terminal is necessary to provide the high resolution graphics required in the Airborne Command Post Communications System courseware. This upgrade would allow users to take advantage of a broad array of IBM compatible software that could greatly expand the ACCSs' present use of the system (e.g, scheduling and recordkeeping).

Conversion to a Zenith-made IBM compatible computer would also permit off-line development of courseware, a key advantage where courseware development costs are concerned. Without the requirement of a mainframe computer for courseware development, as is the case with the present system, future development could be contracted out more competitively. Numerous vendors are capable of supplying IBM expertise and mainframe subscriptions and would be able to bid competitively for courseware development, as opposed to the current system where vendors are few in number and contracts must undergo sole source justification.

Acquiring an upgraded PLATO system would require substantial investment costs and the technologies for conversion are not yet complete. Acquiring the upgraded system just discussed would require substantial costs over the present system, especially since the Viking 721's are cost free. The technology for converting from 8 inch to 5 1/4 inch disk is presently being developed.

In addition to upgrading hardware by acquiring IBM compatible Zenith microcomputers, another option would be to convert the current SPIRITUS slide sound system to an interactive video disk system. The interactive video disk system would provide color motion pictures of equipment and operations with excellent clarity compared to the SPIRITUS black and white slides. Although much more popular, such a video-disk system would cost considerably more than the SPIRITUS hardware now used.

III. USER REQUIREMENTS

A. Introduction and Background

This section follows the Training Product Analysis to enable readers to compare the training system with the training needs and requirements of the ACCSs. This chapter describes the users of the training system and their requirements for training WWABNCP operators. It also presents their viewpoints concerning current unit level training and the expected use of the PLATO/SPIRITUS system, given their limited exposure to it.

The information contained here was derived from user requirements surveys and Air Force regulations. Since formal documentation of user requirements was not available from DCA, a formal user requirements survey was administered to obtain this information. This survey was approved by AFMPC/MPCYOS (SCN 85-72) and disseminated to ACCS training personnel.

The survey was developed and coordinated with DCA/CCSO, 2nd ACCS, 6th ACCS, and HQ USAF/DPPT. A copy of the user requirements survey is appended to this report as Appendix A. Responses were received from all the participating ACCSs.

B. Findings of the Survey

The primary mission of the Airborne Command and Control Squadrons (ACCS) is to provide survivable command control capability through which execution and direction of SIOP forces can be effected. As members of the Worldwide Airborne Command Post network, the ACCSs maintain a 24-hour alert Operational responsibilities include controlling and flight-following forces under normal and emergency conditions, according to the requirements of

the command being supported. The ACCSs must maintain a state of readiness to alert and commit forces according to emergency action directives and command authorities. To accomplish this, ACCS command post personnel must be trained on mission execution, control and operational reporting procedures. They are trained, tested and certified according to established standards of each command supported by the command post.

ACCS personnel must be trained on one or more airborne communications systems to be a qualified communication voice systems operator, communications record systems operator or switching system operator in the 116X0 (Airborne Radio Communications Operators) career field. These systems include, but are not limited to, AFSATCOM System, ARA-60 teletype data system, LF/VLF Data System, Trailing Wire Antenna System, High Frequency Radio System, Ultra High Frequency Radio System, Secure Voice Switching Equipment, Semi-Automatic Switching System (SASS), and the AUTODIN System. Trainees must be able to accomplish step by step procedures for operating all equipment in accordance with appropriate publications, regulations and technical orders. Training on these systems includes such things as equipment familiarization, pre-flight and post-flight checklist procedures, equipment operation, operation under normal and emergency conditions, and fault recognition and isolation. According to ACCS user requirements surveys, training time on communications systems ranges from 90 to 150 days to qualify on each system.

Training is accomplished using an intensive ground training system program and in flight training missions. ACCSs conduct ground training using classroom instruction, slide and sound presentations, hands-on training using ground alert aircraft, TWA simulators and the PLATO/SPIRITUS training system. In addition, the 1st ACCS uses training mock-ups for the SASS console, the Radio Operator console and the AUTODIN console.

All ACCSs conduct intensive ground training, although programs do vary among the ACCSs. Due to the limited number of instructors and aircraft available, one ACCS reports that classroom and ground training account for 75% of all training. Another ACCS indicates that the majority of its training program is conducted on ground-alert or in-flight aircraft, with limited amount of classroom training. This ACCS states that classroom training is limited by instructor availability, although it cited thorough classroom instruction and preflight practice as key factors to successful inflight training missions. Still another ACCS indicates training was conducted on ground-alert aircraft using a training syllabus as a guide. Emergency procedures taught in the classroom prior to inflight training missions were common to all ACCSs. In addition to classroom and ground training, students are assigned extensive reading assignments on manuals, regulations and technical orders and are examined periodically.

In-flight training generally consists of an orientation flight and then in-flight training missions. During an orientation flight, the trainee observes communications systems operation. One ACCS indicates the bulk of their training is accomplished during in-flight missions where students learn equipment operational procedures. This ACCS conducts 60 hours of in-flight training each month at a cost of \$12,000-\$14,000 per flying hour. ACCS in-flight communications training ranges from 12-200 hours per month. Likewise, the cost per flying hour varies from \$2,300 to \$14,000. Recognizing the value of real mission training, one ACCS reported that in-flight training time is an ongoing problem where overcrowding flights are a common occurrence in order to meet imposed training limitations.

All trainees are evaluated according to local procedures upon completion of training. Evaluation procedures vary from periodic oral examination to formal written exams and in-flight

evaluation. Trainees are evaluated as "qualified," "qualified with training" or "unqualified." Students are evaluated on knowledge, procedures, safety of flight and successful accomplishment of mission. The following types of evaluations are used to certify mission readiness: qualification, recurring, re-evaluation, spot, no-notice, requalification and difference. Non-currency and/or failure to maintain qualified status may result in decertification. The ACCSs indicated that 94%-100% of students successfully complete training in the allotted timeframe.

Several deficiencies in current unit level training programs were reported by ACCS training personnel. First, the limited availability of instructors and training flights leads to overcrowding training flights thereby curtailing valuable mission training. Second, inadequate classroom time (constrained by instructor availability) and pre-flight practice reduce the quality of inflight training missions. Third, inadequate training facilities interfere with effectively conducting ground training. Fourth, comprehensive continuation training for qualified operators is lacking. Finally, several ACCSs reported that limited courseware availability for the PLATO/SPIRITUS training system restricted its use in ground training. At the time of the survey, most ACCSs had received just one segment of the AFSATCOM course and therefore had limited exposure to PLATO/SPIRITUS.

Expectations are high among users for the future utility of the training system. One enthusiastic user reported: "this system will be far above anything available now. It will eliminate the need for hands-on ground training and it will drastically reduce the workload on instructors." Another ACCS speculated that the training system's use will eliminate all flying time usually required for equipment operation training and familiarization. Using the training system, a faster checkout time was predicted once students start working the actual equipment.

Users saw the future training systems as being a major portion of and improving to current ground training.

The major advantages of the PLATO/SPIRITUS training system, according to users, will be its simulator capability which gives hands-on equipment training to students, eliminating the need for aircraft and instructor availability. Other advantages reported were the training system's constant availability, its clarity of instruction, its advantages to slower students, and the heightened student interest and involvement.

A few mechanical problems occurred during the initial implementation of the system in two of the ACCSs but have since been repaired to the user's satisfaction and user confidence in the system's ability to perform is intact.

Regarding future expansion and development of the system, individual users requested additional courseware II for all new communications systems generated by the PACER LINK II Modification Program be developed. Several unique unit training applications were identified as possible expansions for the training system: EWO (classified), new satellite terminal (TDM-3) and unit level training requirements. ACCSs stated that in order to keep the system current with technical order changes, courseware updates would be needed semi-annually.

APPENDIX A
USER REQUIREMENTS SURVEY

USER REQUIREMENTS SURVEY

This survey has been approved by AFMPC/MPCYOS USAF Survey Control Number: 85-72. Please answer all questions on a separate page and return to Akman Associates, Inc.

1. What are your unit training requirements for WWABNCP operators?
 - a. List equipment for which training is required.
 - b. Identify other unit level training required.
 - c. Identify proficiency requirements for the student or for each piece of equipment.
 - d. List time frame for completing the required training.
2. What training is actually conducted for WWABNCP operators?
 - a. List equipment for which training is provided.
 - b. Explain how training is conducted for each piece of equipment (i.e., classroom, ground-training, training on-board aircraft, in-flight missions).
 - c. If you conduct training that is not equipment specific, identify the course and explain how training is conducted.
 - d. Identify training equipment used to support each course identified in 1a and b.
 - e. Identify the resources required to support each segment (training on specific equipment documented in 1a and b). Include personnel, aircraft, flying hours, training equipment, funding, hours of instruction, etc.
 - f. Identify deficiencies in current training (what needs to be taught that is not taught). Explain.
 - g. Provide the training syllabus for each course of instruction.

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3. What are the procedures for evaluating performance?
 - a. What are procedures for evaluating training?
 - b. What are the performance measures for evaluating training?
 - c. What percentage of students satisfactorily complete the course in the allotted time frame?
 - d. For each course, indicate the range of performance scores and the average performance scores.
 - e. Upon completion of the course material, what are the procedures for identifying and correcting deficiencies in student performance?
 - f. What are the procedures for evaluating job performance?
4. What are the current problems or potential problems in meeting the unit training requirements for WWABNCP operators (i.e., limited instructors, aircraft availability, limited flight time etc.)
 - a. What are the suggested improvements for the overall training program?
 - b. What are the suggested improvements for the individual courses identified in question 1?
 - c. What training requirements do you envision the PLATO/SPIRITUS computer-based training system could satisfy?
5. What are the flying requirements of your unit?
 - a. What operational aircraft are assigned to your squadron?
 - b. How many aircraft are assigned to your unit?
 - c. How many total flying hours are expended per month?
 - d. How often do you fly operational missions? What is the duration of the flight?
 - e. How many students fly on operational flights?

- f. How many non-operational flights do you fly (training, other specify)? What is the length of these flights?
 - g. How many students and instructors fly during a training mission? What is the student instructor ratio?
 - h. What is the cost per flying hour (of each aircraft identified)?
6. For FQ 4/85, what are the number of manpower authorizations by AFSC for radio communications operators, instructors and battle staff personnel as indicated on the Unit Manpower Document (UMD) for your squadron?
 - a. What is the manning experience level of personnel assigned?
 - b. How many assignees are trained per year?
 - c. What is the average time on station per student?
 - d. How many instructors assigned per year?
 - e. What is the average time on station per instructor?
 - f. What are the recurring training requirements for radio communications operators?
 - e. What are the training requirements for the battle staff personnel?
7. Document current organizational roles and responsibilities.
8. Briefly explain your unit mission requirements.
9. How is the PLATO/SPIRITUS system currently being used?
 - a. Identify lesson plans available.
 - b. How are the lessons currently used?
 - c. Based on your experience with the limited computer-based training system, what is the expected utility of the completed computer-based training system?

- f. How many non-operational flights do you fly (training, other specify)? What is the length of these flights?
 - g. How many students and instructors fly during a training mission? What is the student instructor ratio?
 - h. What is the cost per flying hour (of each aircraft identified)?
6. For FQ 4/85, what are the number of manpower authorizations by AFSC for radio communications operators, instructors and battle staff personnel as indicated on the Unit Manpower Document (UMD) for your squadron?
- a. What is the manning experience level of personnel assigned?
 - b. How many assignees are trained per year?
 - c. What is the average time on station per student?
 - d. How many instructors assigned per year?
 - e. What is the average time on station per instructor?
 - f. What are the recurring training requirements for radio communications operators?
 - e. What are the training requirements for the battle staff personnel?
7. Document current organizational roles and responsibilities.
8. Briefly explain your unit mission requirements.
9. How is the PLATO/SPIRITUS system currently being used?
- a. Identify lesson plans available.
 - b. How are the lessons currently used?
 - c. Based on your experience with the limited computer-based training system, what is the expected utility of the completed computer-based training system?

- d. Do you have any suggestions for improving the computer-based training system?
 - e. Have you had any problems implementing the system, if so explain?
 - f. Based on your experience, what are the advantages or disadvantages of using PLATO/SPIRITUS over the current training system?
 - g. What are the plans for integrating the computer-based training system into the current training concept?
 - h. What applications would you recommend for future expansion or development?
 - i. What unique training applications should be developed for your unit? Briefly explain each application and its benefit.
 - j. Given the PLATO/SPIRITUS system is unclassified, what limitations are placed on current and potential training?
 - k. Based on your experience with technical order changes, equipment modifications etc., how often will courseware need to be updated or modified?
 - l. What are the operational and organizational impacts of implementing this system (if any)?
10. From your experience, provide further comments regarding the PLATO/SPIRITUS computer-based system as a viable aid to your training program.

**Decision Paper for Worldwide Airborne Command Post
Radio Communications Operators**

1. Defense Communications Agency developed a computer-based training system designed to augment ground training for Airborne Radio Communications Operators at unit level. The system was funded and developed by DCA. Current plans call for the Air Force to assume responsibility as lead military department, providing follow-on support for maintenance, operation and future development.

2. JCS documented the need to improve strategic connectivity during POLO HAT exercises. DCA determined that the performance of Radio Communications Operators needed to be improved. Improved performance could be accomplished by increased equipment familiarization and procedural training. DCA provided a computer-based training program to the 1st, 2nd, 4th, 6th, 9th and 10th Airborne Command and Control Squadrons with training programs on AFSATCOM, LF/VLF, HF, UHF/ARA-60 communications systems.

3. Airborne Command and Control Squadrons must be trained on mission execution, control and operational reporting procedures to provide survivable command and control capability where mission execution and direction of SIOP forces can be effected. In a severe operational environment, inaccurate transmission wastes valuable processing and telecommunications time.

4. Based on a survey and review of ACCS training requirements the following two constraints were reported: first, a limited number of aircraft are available for in-flight and ground alert training; and second, classroom training is limited by instructor availability and inadequate training facilities. Constraints on training resources resulted in overcrowded training flights hampering mission training quality. Insufficient classroom instruction and preflight practice reduced the quality of ground training and inflight training missions. The ACCS training personnel indicated the need to improve ground training programs by providing adequate opportunity for pre-flight training, developing comprehensive continuation training for qualified operators, and standardizing lesson plans to ensure quality content and thorough delivery of training program.

5. The PLATO/SPIRITUS Training Program and supporting Airborne Radio Command Post Communications System courseware provide standardized, comprehensive equipment familiarization and procedural training on unclassified communications systems aboard EC-135 and E-4B aircraft. ACCS personnel anticipate using the training system for extensive ground training, thereby reducing in-flight training time and instructor workload. This training system is an excellent simulator for basic indoctrination of communication systems training. It provides realistic hands-on training in a safe environment without the use of an aircraft.

6. Recommend Air Force assume responsibility as lead MILDEP for the PLATO/SPIRITUS Training System. The Air Force will obtain formal agreement for organizational and resource support from participating MAJCOMs prior to continued implementation planning. Recommend ATC/TTXB be designated as Office of Primary Responsibility (OPR) and ATC/TTQE designated as Office of Coordinating Responsibility (OCR). Resource support to be provided by SAC, TAC, PACAF and USAFE on a per share basis as the functional users of the training system. In addition, recommend maintenance of existing courseware be contracted because in-house resources are not in place to support timely, accurate system updates. Maintenance requirements on existing software should be documented during the Implementation Planning Phase of this study. Recommend the Air Force develop additional courseware on communications applications generated by the PACER LINK II aircraft modification program. Recommend the Air Force submit resource requirements to support the training system for inclusion in the FY 89 Program Objective Memorandum. Finally, recommend MPP Training Programs Division continue development of a comprehensive Implementation Plan and Life Cycle Management Plans.

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