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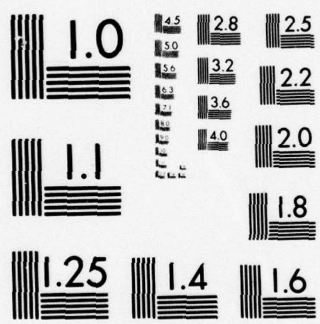
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E-2C SYSTEMS APPROACH TO TRAINING

Calspan Corporation
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20. ABSTRACT (Continued)

project followed the principles of Instructional System Design (ISD). After completing a task analysis for each position, the analysts prepared (in sequence) behavioral objectives, training support (media) requirements, and lesson specifications. To support the effort, information was collected relevant to entry level behavior of trainees, existing resources available, and external influences (constraints) that impact on the training system.

The proposed syllabi incorporate a shift in emphasis toward: earlier "hands-on" training, modified self-paced (individualized) instruction for most of the academic lessons; and a comprehensive plan for criterion-referenced performance assessment throughout the progression of cognitive (i.e., academic), practice, and sortie/scenario lessons.

After the implementation and validation process is carried out in Phase II, it is expected that significant reductions in training costs will be achieved through a shorter total course length, a greater proportion of synthetic training relative to in-flight practice, and a quality control program.

This report documents a particular implementation of ISD methods and procedures, selected by the contractor, which will be compared by the Navy to other aircrew training program developments. Data provided will allow evaluation of the methodology, definition of the constraints and operating conditions that impact on aircrew training, and acquisition of cost, scheduling and manpower data for future ISD planning.

PREFACE

This E-2C ISD Program is one of four such programs currently under development for the Naval aviation community. The overall project began in March of 1974 when the Naval Training Equipment Center awarded a contract for the design and development of an aircrew training program for the SH-2F LAMPS aircraft. This was followed in April with similar contracts for the A-6E TRAM, EA-6B ICAP and E-2C weapons systems. The contracts called for a two phased effort, Phase I of which has been completed and is described in this report.

The research and development goals of this project are to: (a) evaluate a variety of ISD methods and procedures as applied to several different aircraft systems, (b) define the constraints and operating conditions that impact aircrew training, and (c) acquire cost, scheduling and manpower data for future ISD planning. The operational goal is to develop and implement four viable aircrew training programs.

Special acknowledgement is due to Captain C. Jasper and Mr. I. May of AIR-413 and LCDR P. Chatelier of AIR-340 for their assistance and cooperation during the course of this project.

In addition, special recognition is due to RVAW-120, NAS Norfolk, which was designated model manager for the E-2C program and whose instructor personnel reviewed all interim outputs and provided invaluable technical support throughout the Phase I effort.

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SUMMARY

A revision of the instructional system for the E-2C was developed to enhance the cost-effectiveness of the training. The five-man E-2C crew consists of a pilot, copilot, combat information center officer (CICO), air control officer (ACO), and flight technician (FT), with training for these positions being conducted at RVAW-120, Norfolk Naval Air Station. This project followed the principles of Instructional System Design (ISD). After completing a task analysis for each position, the analysts prepared (in sequence) behavioral objectives, training support (media) requirements, and lesson specifications. To support the effort, information was collected relevant to entry level behavior of trainees, existing resources available, and external influences (constraints) that impact on the training system.

The proposed syllabi incorporate a shift in emphasis toward: earlier "hands-on" training; individualized instruction for most of the academic lessons; and a comprehensive plan for criterion-referenced performance assessment throughout the progression of cognitive (i.e., academic), practice, and sortie/scenario lessons.

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INTRODUCTION

STATEMENT OF THE PROBLEM

Traditionally, training programs within the military have been generated in-house by a number of instructor personnel tasked with the difficult problem of sorting through all available information and developing an approach to the classroom presentation of an assigned content area. The resulting instructor guides (outlines) and student handouts are, by necessity, based on information within each individual's realm of experience. This experience is largely based on prior instruction and specialized operational missions. Of particular significance in such an approach to training is a failure to conceptualize the entire system in perspective. This results in a piecemeal, poorly-coordinated buildup of instructional units with retrofitting as the method of necessity for curriculum development. Furthermore, the Subject Matter Experts (SMEs) approaching the task usually do not have the benefit of expertise in the principles and application of instructional technology. The problem is complicated by the rapid turnover in instructor personnel. Often too, an attempt is made to piece together the in-house training materials, typically instructor guides (outlines), with separately developed technical materials provided by a contractor to complement existing hardware. The classroom instructor is ultimately left with the task of integrating the curriculum while performing within the confines of the existing policy and procedure of the training command.

With the limited resources and increased demands which are placed upon the military training community today, the advent of a technology of instructional systems development has demanded more attention than it might have in more affluent times. The challenge for greater efficiencies in the learning process and greater cost-effectiveness in the training program has been recognized by the Research and Development (R&D) community and has resulted in the derivation of numerous instructional models. Most of these models, which are generally oriented toward individualized instruction, have been based upon a process leading from task analysis and behavioral objectives to curriculum development and evaluation. While these models are continually undergoing refinements, the need is pressing for the implementation and concurrent evaluation of the basic conceptual framework of the Systems Approach to Training (SAT) within the operational training community.

SAT is an integrative decision process wherein justification for all decisions must be apparent. This requires that attention must be paid to the broad range of external influences stemming from operational policy, economic constraints, and resource management, in addition to the internal influences of mission requirements. If the SAT process results in logical decisions which are based on complete data, then the resulting instructional system is nearly certain to be the most economical that achieves the training objectives, within the operational constraints.

STUDY OBJECTIVES

The purpose of the present contract has been to develop a comprehensive training program for the E-2C crew members utilizing an integrated systems approach to training. The ultimate goals of the SAT approach are to increase training efficiency and reliability through job-relevance and the application of advances in training technology. The final outcome of the program must await a second phase which involves: (1) development of instructional materials, (2) development of a test and evaluation program, (3) performance of training, and (4) performance of quality control procedures. During the present phase, the application of the SAT approach to the following initial objectives has been completed:

a. Perform task analysis
b. Select tasks for training
c. Perform training analysis by:
   1) determining course objectives
   2) selecting instructional methods and media
   3) determining instructional strategies
   4) sequencing of instruction
   5) organizing objectives into unit and lesson structure

Specifically, this program has resulted in the delivery of the following:

a. Task Analysis Listings. This documents the job that must be performed by each crew member. It provides the task descriptions in standardized format and terminology, along with commentary which elucidates conditions and enabling activities that are critical to the task.

b. Behavioral Objectives. The objectives synopsize, in mission-oriented terms, the information that is relevant for the specification of Training Objectives, including the performance criteria and conditions under which the behavior must be demonstrated.

c. Training Support Requirements Listing. The media specification process required an analysis to be made to determine the best mix of existing and new training resources (viz. training devices). The results of that analysis are summarized in this report.

d. Lesson Specifications. This documentation forms the basis for the implementation of Phase II activities. Each lesson is composed of the training objectives to be met, the teaching points and/or behavioral objectives which must be demonstrated to meet the lesson requirements, the medium, nominal duration, and other supporting data.

These products will be more fully described in later sections of this report.

INSTRUCTIONAL SYSTEM DESIGN

DEFINITION. Much of the Instructional System Development (ISD) methodology has been in existence for many years. However, it is only within the last few years that the methodology has been formalized into a usable, documented technology. According to a definition given in Air Force Manual 50-2, Instructional System Development (1970), ISD is a :

> "deliberate and orderly process for planning and developing instructional programs which insures that personnel are taught the knowledges, skills, and attitudes essential for successful job performance."

This is obviously not a new goal in aircrew training or educational technology, as a whole. The new aspect that ISD brings to training is the use of systems analysis techniques in an attempt to relate the training objectives to realistic job performance requirements. That is, teach the individual all of the information which is necessary.

Through the conduct of the present E-2C program and a previous program on a very different multicrew aircraft system (Air Force B-1 strategic bomber), the contractor examined, evaluated, and expanded the Systems Approach to training SAT methodology. The total "system" of information involved in the SAT methodology, as defined by Calspan, is illustrated in figure 1. This systematic approach to information accumulation and application ensures that the analysis is comprehensive and logical. The conceptualized flow of information highlights numerous interactions among facts, assertions, assumptions, and constraints. The SAT "information flow" underwent many revisions over the last three years. In this version some attempt was made to order (vertically) the blocks in a chronological manner according to approximately when they take predominance in consideration. The blocks with the same number share some common attribute. A brief description follows.

The focus of the SAT methodology is centered around making the training responsive to the mission requirements of the man-machine system. The man-machine system can be partitioned into two components, functions performed by the human operator (1a) and functions performed by the machine (1b). These functions and the interface between the man and the machine are inputs to the training analysis. In addition, there are often operational policies (1c) that impact upon the training system which must be addressed. Although these policies are input to the system initially, it is possible that the training analysis reveals information that subsequently leads to policy changes. Another set of inputs to the training analysis involves the economic information (1d) pertaining to such things as the costs of instructional material, training devices, facilities, and personnel.

The first phase of the analyses includes determining and documenting the human operator functions in terms of a task analysis (2a). The machine functions are also analyzed to establish the external influences (or constraints) (2b) that are imposed on the training program (e.g., airborne safety considerations). Another contributor to the external influences includes the policies of both the training and the operational communities. The trainees' incoming skills and knowledges (2c) are a function of the operational policy in terms of the determination of the sources of trainees. The external influences and incoming skills and knowledges can be considered as "boundary conditions" for the training analysis. Those behaviors which must be demonstrated by the trainees before graduation are logically grouped into behavioral objectives (3) along with synopses of training-relevant data pertaining to each objective.

The greatest point of departure of this SAT "model" from traditional flow charts is the iterative process indicated by the "cogwheel" supporting blocks 4a, b, and c. The training objectives (4a) may, in a simplified way, be thought of as those behavioral objectives not already in the incoming repertoire of behavior (but couched in training terms rather than operational mission terms). Methods (instructional strategies) and media (training devices) are specified (4b) which can supply the appropriate training environment. Instructional sequencing of objectives into courses (4c) provides a syllabus. Each of these blocks (4a, b, c,) are interdependent in that multi-dimensional criteria are

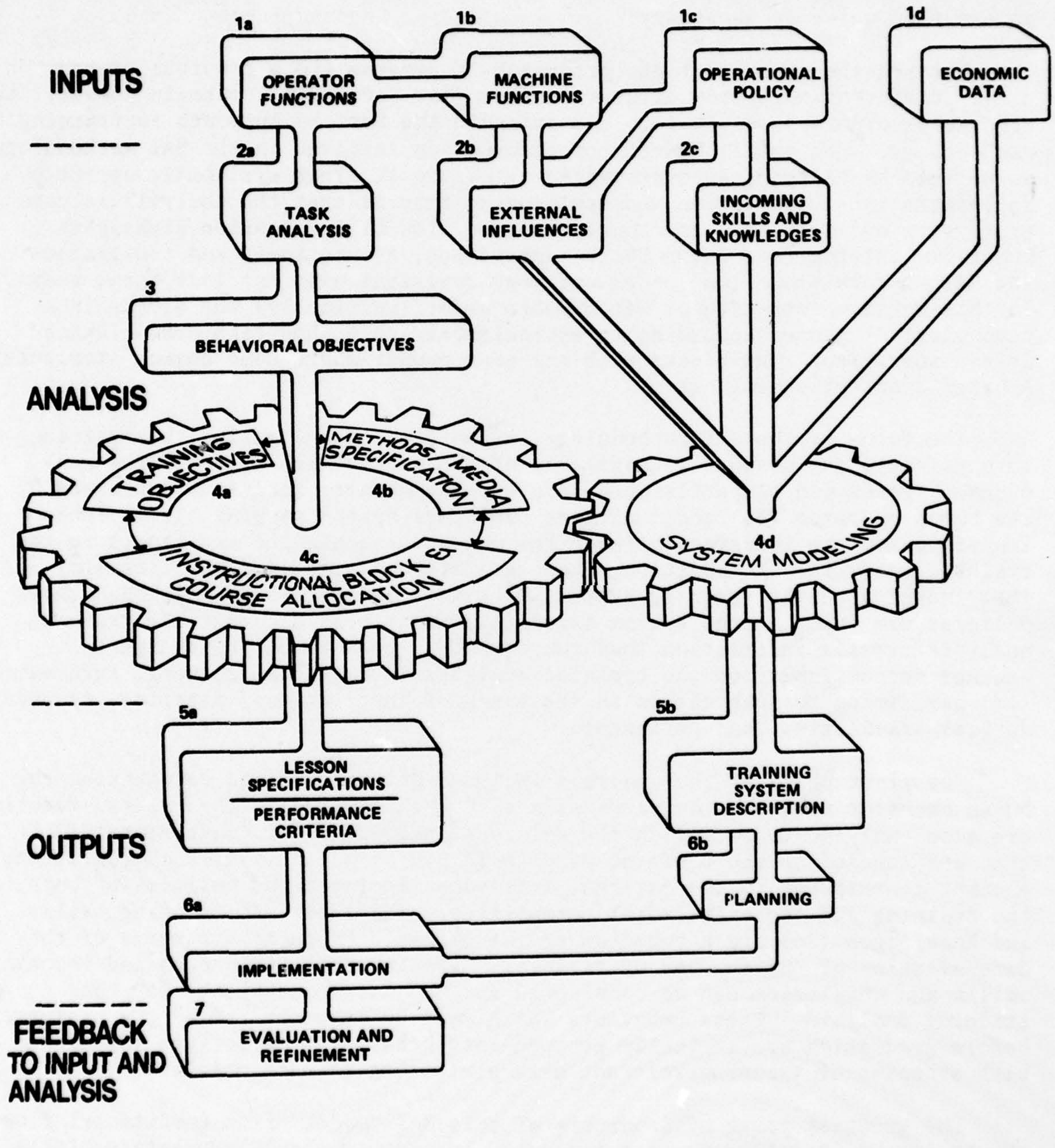

Figure 1. System Components for the Development of Training

applied. For example, the selection of a training device is dependent on economic factors, including device utilization. Device utilization, on the other hand, interacts with the training objectives via the level determined for incoming skills and knowledges. But still, the training objectives themselves are formulated with some knowledge of the devices that may be available for instructing and testing. To aid in this process of developing the syllabus, a model of the instructional system (4d) may be invaluable, depending on the degrees of freedom allowed to the training analysts. The model takes as inputs the hypothesized syllabus (4c), the external influences (2b), the incoming skills and knowledges (2c), and the economic data (1d), to determine the ramifications on the training system (5b), via critical descriptors. The detailed description of the syllabus itself is contained in the lesson specifications and performance measures (5a). Implementation (6a) of the latter provides evaluation data (7) for quality control feedback, while the training system descriptors provide planning data (6b) for major alterations in the structure of the overall instructional system.

The SAT methodology, as discussed here, is not an algorithm that "spits out" answers; but rather, it is a conceptual framework that serves as a decision aid to be used in documenting and presenting the information to decision makers. The relative emphasis on the various components of the SAT process is different depending upon whether one is developing a future training program, modifying an existing program, or investigating a particular component of the system. The contractor's approach to the E-2C program is discussed in detail in Section II.

BACKGROUND. When the majority of the aircrew training programs of the 1960's are inspected, it is apparent that a great deal of material that was taught was not information that is required for adequate job performance. The reasons for this were many and are well described in a study of the C-130 Combat Crew Training School (CCTS)[1].

Two primary influences caused a great amount of interest in attempting to eliminate the peripheral information from aircrew training. First, the aircraft systems were becoming increasingly complex to the point where time was not available to teach anything except the necessary information. Second, the cost of training programs was becoming prohibitive in terms of both finances (e.g., cost of air vehicle time) and facilities, (e.g., airspace available for aircrew training).

One of the primary goals of the ISD methodology with respect to flight training is the reduction in training costs while maintaining an effective training curriculum. One of the most sensitive areas of decreasing training costs is through a reduction in the number of hours of training in the operational aircraft. One of the first studies that illustrated the possibility of reductions in air vehicle flight time (and, therefore expense), as well as increased safety, was conducted by American Airlines[2]. At about the same time, the Boeing 747 was on the scene and an Air Transport Association (ATA)

[1]Shaw, J.B., Huether, C.W., Swah, M.E., and Smith, R.W., C-130 Phase 1 Pilot Training Program (CCTS). Tactical Air Command, TALC Study DCR-9016, 15 April 1969. (AD 700 987); Valverde, H.H., A Systems Approach to C-130E Air Crew Transitional Training. Air Force Human Resources Laboratory, Brooks Air Force Base, Texas. Report AFHRL-TR-71-4, March 1971.

[2]American Airlines, Flight Training Academy, Fort Worth, Texas; Optimized flight crew training: a step toward safer operations. April 24, 1969.

committee was formed to work with Boeing to determine the repertoire of behaviors that the respective crewmembers of the 747 must accomplish in order to perform their jobs. The term Behavioral Objectives was used to define the "who, what, where, why, and when" that make up these behaviors. The military community observed the successful accomplishments of the systems approach for the development of commercial aviation training programs and began utilizing the ISD methodology. Various military aircraft systems (e.g., C-130, A-7D, S3-A, and B-1) as well as civilian systems (Boeing 737 and 747 and McDonnell-Douglas DC-10) have been the objects of ISD efforts. The interest in the use of systems analysis techniques derived from both the obvious cost-effectiveness aspect, as well as the more fundamental aspects of the psychology of training.

As of this writing, the latest publication which reviews the history of SAT/ISD is Technical Report: NAVTRAEQUIPCEN IH-257; Instructional Systems Development: Conceptual Analysis and Comprehensive Bibliography. M.D. Montemerlo and M.E. Tennyson; Feb. 1976.

SYSTEM DESCRIPTION

THE AIRCRAFT. The E-2C is an all-weather, carrier and shore-based aircraft which can be readily identified by its large saucer-shaped rotodome and four vertical tails. The five crewmembers on board the E-2C (also referred to as the Airborne Tactical Data System,(ATDS))are segregated in two compartments. The pilot and copilot seated side-by-side are located forward in the flight deck. The remaining crewmembers called the Combat Information Center Officer (CICO), Air Control Officer (ACO), and Flight Technician (FT) operate specialized avionics systems aft in the main cabin or Combat Information Center (CIC) compartment.

The control panel and display scopes of the ATDS (Airborne Tactical Data System) are mounted in an integrated group of three consoles in the CIC compartment. The duplication of some controls at all three stations and the placement of other controls between two operators enable the operators to share control of some ATDS functions. The heart of the displays in the ATDS is the Control Indicator Group (CIG) which consists primarily of three identical displays each with the same main and auxiliary displays. All three CIC operators can select independently specific information for their displays so that each may have the same or a different perspective on any tactical situation. Besides the CIG, the primary components of the detection and display systems include the radar set, Radar Detector Processor (RDP), Identification Friend or Foe (IFF) radar set, Extended Electronic Countermeasures (EECM), IFF/EECM Detector Processor (IDP), Passive Detection System (PDS) and Computer Programmer (CP). Also, an In-Flight Performance Monitoring (IFPM) system is available to provide information on the operational status of the critical avionics.

The CIG consists of five basic units: Upper Main Display (UMD), Main Display Unit (MDU), Auxiliary Display Unit (ADU), Main Power Supply (MPS) and Auxiliary Control Unit (ACU). The MDU along with the UMD produce a composite video and symbolic display. The MDU and ADU interface with the CP to provide symbolic position data on the MDU and alphanumeric data on the ADU. The MPS furnishes power to each console. The single ACU acts as a buffer unit and performs as a system interface and a control box. The radar system is designed to detect airborne targets over sea or land. Seaborne contacts can also be detected and land mass representations can be displayed. The radar works with the rotodome antenna sending videos to the CIG and the RDP. Besides the normal mode of operation, the radar has four alternate modes and six options that are directly selectable either by the CICO or the FT. The link between the search radar and the CP is produced by the RDP. It performs the function of automatic detection and transfers digital information for automatic acquisition and tracking.

The E-2C communications systems provide two-way voice communication and data operations with voice and data relay capability during air-to-air and air-to-surface operations. Five Ultra-High Frequency (UHF) and two High Frequency (HF) radio sets make up the communications system. Two of the UHF radios can be used as a relay for either cipher or nonsecure communications. Either radio may be used for Link 11 data exchange with the option to use both for voice communications.

The IFF radar generates and transmits coded signals to airborne or surface units. In return the IFF-equipped target generates and transmits a reply. This is converted into signals for display on the CIGs. The interface between the IFF/EECM Interrogator and the CP is represented by the IDP. It detects and processes target return information and performs computations to obtain target characteristics to the CP. The EECM system detects and processes certain IFF processing. These signals are always provided to the Electronic Countermeasures (ECM) Control Panel but may be sent to the CIG for raw video display only under prescribed situations. The PDS uses two antennas per quadrant in each of four bands to provide the operators with accurate direction finding and emitter parameters. With this information it may be possible to identify the emitter platform and evaluate the potential threat. The PDS functions with a dedicated General Purpose Digital Computer (GPDC) which receives tuning information from the CP and supplies it to the PDS tuning system. The CP is a general purpose computer containing two central processors and up to ten memory modules. It provides the necessary input/output units to interface with many of the E-2C avionics systems such as the navigation, PDS, etc. The IFPM system designed to provide the crew with information on the operational status of critical avionics also utilizes the CP to report the status of individual equipment. Approximately 75 percent of the total avionics complement is continuously monitored. The IFPM operates with interface units or Signal Command Readouts and Alarm Monitor (SCRAM) which provide hardware interfaces between the CP and monitored avionics. Six SCRAMs respond to the equipment status requests primarily from the radar transmitter, RDP, IDP, communications systems, navigation systems and PDS.

The navigation system provides aircraft navigation and guidance capabilities but also reference information to associated avionics for stabilization and orientation. Operational modes of navigation include inertial-doppler, inertial, doppler and air data which can be manually or automatically selected. The navigation system primarily consists of the Carrier Aircraft Inertial Navigation System (CAINS), Heading Attitude Reference CP System (HARS), Doppler radar navigation, and the Air Data Computer (ADC) and Computer Programmer (CP). The primary systems are the CAINS and CP which compute independent solutions to the navigation problem using the best available inputs from the CAINS, HARS, doppler and ADC. Besides providing altitude, airspeed and Mach number for navigation, the ADC supplies inputs for the flight control system.

The flight controls are powered by two independent hydraulic systems referred to as the flight and combined hydraulic systems. The combined system also supplies fluid under pressure to subsystems such as the landing gear, wing flaps, etc. The E-2C's Automatic Flight Control System (AFCS) provides directional stability augmentation, three-axis attitude control and automatic flight path control of the aircraft. The AFCS also has an altitude hold mode and can be coupled to the Tactical Air Navigation System (TACAN). In a flat-turn mode, precise holding of attitude and turn rate in wings-level turns is possible. Electrical power requirements for the E-2C are supplied by three individual systems. Primary electrical power is supplied by two direct, engine-driven generators supplying power to two separate nonparalleled systems. Secondary electrical power is supplied by two nonparalleled transformer-rectifiers that receive power from the left and right generators. The emergency electrical system consists mainly of a hydraulically operated generator.

The foregoing paragraphs have explained in some detail the aircraft and onboard systems used by the crewmembers on operational flights. In the next section, the need for the great quantity of sophisticated avionics should become apparent as the various missions of the E-2C are described.

THE MISSION. The primary mission of the E-2C is to maintain continuous surveillance of the airspace surrounding the task force and provide the Officer in Tactical Control (OTC) with Airborne Early Warning (AEW) data on all targets. In performing this mission, the ATDS unit employs the search radar, IFF, EECM and PDS sensors to monitor the large spatial area for airborne and surface targets. With these systems, the detection and reporting of threats is accomplished sufficiently distant from the defended force that the threat may be adequately opposed prior to its achieving the weapon delivery point. The E-2C mission is in concert with the "defense-in-depth" philosophy which establishes three concentric zones centered on the main body of the forces. The outer or intercept zone is the area where inbound raids are opposed by radar vectored Combat Air Patrol (CAP) aircraft. The crossover zone is where CAP intercepts are broken off and the inbound raid is taken under missile and gun-fire by peripheral picket ships. The third zone is the vital area where surviving raid aircraft are opposed by concentrated main-body missile and gunnery defense. By controlling CAP aircraft the E-2C has the responsibility for outer zone defense. However, it also actively participates in the defense of the other two zones by relaying target information via Link 11 to friendly surface forces.

In its designed role as the primary source of fleet anti-air warfare, the E-2C is stationed at 20,000 to 30,000 feet and at a specified distance from the Naval Tactical Data System (NTDS). The normal airspeed maintained is 135 knots which equates to a nominal 4 degree nose-up pitch attitude. It flies an elongated figure-8 or bow tie pattern which is 50 to 60 miles long centered on a designated barrier center. The long axis of the figure-8 pattern is flown at approximately a right angle to the line of bearing from the NTDS to the cross point of the figure-8. Flat turns are flown with bank angles less than 4 degrees to avoid adverse effects on the radar coverage pattern while turning. When possible the pattern is flown so that all turns are into the wind prevailing at the leg altitude. When the NTDS is underway, the locus of the figure-8 pattern will move accordingly as the ATDS unit maintains station with respect to the NTDS. By maintaining the pattern described above, the E-2C, without changing station altitude, is capable of detecting low, medium and high fliers that might attempt penetration of the task force perimeter.

While providing AEW coverage, the ATDS controls CAP aircraft by voice or by Link 4 (one-way or two-way data link). Any aircraft flying the interceptor mission can be given vectors vocally but the F-4B/J and F-14A are the only Navy aircraft that are capable of accepting data link commands. The F-14A alone can participate in the two-way Link 4 operation which permits target tracks to be sent from the F-14A to the E-2C, as well as vice versa. In controlling CAP aircraft the ATDS may choose one of four basic types of intercepts: collision, lead collision, pursuit and lead pursuit. Whatever intercept is automatically chosen or manually selected in the ATDS depends on diverse factors such as armament to be expended, range to the bogey at pairing, speed ratio of the interceptor and bogey, etc. The determining factor in the selection process is the positioning of the CAP so as to optimize its capabilities to detect, lock-on and attack a hostile aircraft preferably at the furthest distance from the task force.

In addition to its primary AEW function, the ATDS can perform numerous secondary missions. It can provide Surface-Subsurface-Surveillance Control (SSSC), Anti-Submarine Warfare (ASW) Support, Search and Rescue (SAR), Lost Plane/Emergency Tanking, E-2C Controlled Approach, Anti-PT Boat Tactics and Command and Control. SSSC procedures involve the "sanitization" of a specific area from the carrier task force. Usually, flights of A-6 or A-7 aircraft are controlled by the E-2C via positively identifying every scope contact. After the prescribed area has been "sanitized," an airborne patrol (Bird Dog) is maintained continuously over or near all hostile contacts. For Strike Control, the ATDS vectors attack aircraft to a particular location so a point target, flak suppression, armed reconnaissance, or close air support mission can be accomplished. ATDS units have proved valuable as advisory or controlling units for strike aircraft especially at night and under IFR conditions. The E-2C can consistently vector strike aircraft to within one mile of any point target within radar range of the E-2C. There are five chronological phases in ASW; namely,

1. search
2. investigation
3. attack
4. maintenance of contact, and
5. attack analysis.

The ATDS can provide assistance for every phase, especially search, since it can more readily identify areas of probable concentration with its PDS system. However, the E-2C can only give limited assistance in mine laying and mine sweep missions because the navigational accuracy required is greater than the E-2C's Inertial Navigation System (INS) accuracy. There are seven basic search patterns that may be used during the conduct of a SAR. The E-2C is well-suited to control search aircraft flying any of the patterns. It is ideal for coordinating a SAR mission because of its communications capability and its ability to survey a large area with the search radar. For Lost Plane/Emergency Tanking, the ATDS can use many onboard systems. These include communications, ADF, IFF, PDS and TACAN. Single bearings may be combined with ones from other units to obtain a fix. It is of utmost importance that the lost plane be located expeditiously or emergency tanking be provided to preclude a SAR from developing.

For the Controlled Approach mission the E-2C can provide assistance to aircraft returning to the carrier for recovery. The ATDS can only direct air surveillance approaches and not precision approaches. An Airborne Controlled Approach (ACA) controlled by the E-2C is designed basically for Case I and Case II recoveries. Case III recoveries should be conducted in extreme emergencies only. The E-2C is capable of performing many useful functions in anti-PT boat operations. It can be an effective weapons system when directing attacks against high-speed surface threats. Skimmer-scrapper tactics should be used during daylight operations and flare tactics at night. For these operations the E-2C acts as the skimmer aircraft and attack aircraft controlled by the ATDS are used as scrapper during the day and flare-drop scrappers at night.

For the Command and Control mission, the ATDS can substitute for the OTC or Force Anti-Air Warfare Coordinator (FAAWC) located on surface vessels. Under Electromagnetic Control (EMCON) conditions, which are used to preclude task force detection by air to surface threats, the ATDS should be prepared to assume the responsibility for command and control. During such a mission, the E-2C serves as a command post in the sky through which all operations are funnelled in and commands emanated to participating units. Although only a secondary mission, this operation exemplifies the full capabilities of the ATDS and demonstrates the significance of the E-2C.

THE CURRENT TRAINING PROGRAM. The training program for Naval Flight Officer (NFO) /FTs has been characterized throughout its existence as being in a constant state of flux. Of major impact in changing the program has been the incorporation in the curriculum of Device 15F8, also referred to as the Tactics Trainer. The integration of this trainer with the academic phase has helped tremendously in the conduct of a more effective and efficient program.

Not all students in the NFO/FT course undergo the entire instructional training program. How much each receives depends upon into which one of five categories he is placed. These categories are defined as follows:

Category I :	"Basic" or "Type Transition" students, normally first tour in type with no E-2 experience.
Category II :	"Model Transition" students with expired type experience.
Category III:	Wing Staff/Squadron Transition (Model Transition) students with current model experience.
Category IV :	Miscellaneous students which include In Upgrade Training (IUT), students with current Model Naval Air Training Operating Procedures Standardization (NATOPS) qualification, or Familiarization (FAM) students whose training will not be sufficient for fleet qualification.
Category V :	Foreign/Special students with no experience required.

Trainees in Category I and Category II participate in the complete training program. Category III and Category IV students receive 50 and 25 percent of the syllabus, respectively. For Category V trainees the course length and composition is structured to suit the purpose and needs of individual students.

The NFO/FT Training Syllabus is divided into Systems, Tactical, and Flight training phases which are further partioned into academics, laboratories, or flights. The programmed number of hours scheduled for Categories I and II and Category III students are shown in table 1.

The academic part of the NFO/FT training syllabus is composed of eleven separate subjects. These are called Indoctrination, Control Indicator Group, Tactical Software, Computer Programmer, Passive Detection System, Radar System, Aircraft Systems, Navigation System, Communications, IFF System, and Operations. All academics are presented exclusively in classrooms by an instructor lecturing to the students primarily using lesson guides, wall charts, vu-graphs, and some slide presentations. In addition to the formal classroom instruction there are two other academic units called Required Reading, and Professional and General Military Training. The first is an unscheduled self study unit requiring reading, study, or perusal of selected publications. The second unit is also unscheduled and consists of 25 lessons to be completed as a class as time permits.

TABLE 1. NFO/FT SYLLABUS HOURS BY PHASES AND TRAINEE CATEGORIES

	CAT I and II Hours	CAT III Hours
System Training		
Academic	214	130
Laboratory	40	40
Total	254	170
Tactical Training		
Academic	15	4
Air Intercept Control Laboratory	12	5
Tactical Problems Laboratory	62	30
Total	89	39
Flight Training		
Preflight	5	5
Flights	23	25
Total	28	30
Training Syllabus Total	371	239

Since the training requirements for Category IV and Category V students vary widely, no specific syllabus for these categories has been defined.

In the NFO/FT training syllabus there are four distinctive laboratory phases referred to as Hardware, Operations, Air Intercept Control, and Tactical Problems. The Hardware Laboratory is conducted in the Integrated Systems Maintenance Trainer (ISMT) which is a full scale replica of the systems in the E-2C cockpit and cabin. During this phase the student becomes familiar with the hardware associated with the Passive Detection System, Radar, Radar Detector Processor, Navigation, Communications, and IFF. In addition, the trainee receives a cockpit orientation and becomes proficient in performing the systems of pre-flight and turn-on procedures.

The remaining three laboratories are all conducted in the Tactics Trainer. The Operations Laboratory consists of nine sessions devoted primarily to making the students proficient in mastering the Category and Function selections. They learn about tracking and data links and the techniques associated with the passive detection system, computer programmer, and in-flight performance monitoring system. In the Air Intercept Control Laboratory the operators learn how to manually control support aircraft. All types of intercepts, pursuit, lead pursuit, collision, lead collision, and conversions from one intercept to another are accomplished during the eleven periods scheduled in the Tactics Trainer. For the Tactical Problems Laboratory the students are given five tactical problems for which they are responsibile for the planning, briefing and performance of the scenarios. Variations on each problem are run three times with the students occupying a different position, CICO, ACO, or FT, prior to the start of the next problem or variation. At the completion of this phase, the operators will have experienced diverse tactical situations which are similar to operational missions without actually flying in the combat environment.

The final phase of the NFO/FT Syllabus is called Flight Training. It consists of three preflight periods and eight flights in the E-2C aircraft. Included in the ground phase are preflight demonstrations and procedures to be accomplished during aircraft servicing. Also, a personal equipment inventory is made and emergency drills (simulated bailout and ditching) with full equipment are conducted. Of the eight flights, the first two are aircraft and area familiarization flights and the last two are pre-standardization and standardization evaluation flights. In between, two flights are devoted primarily to radar and Link 11 and single flights scheduled using the passive detection system and the in-flight performance monitoring system.

The operation of the present E-2C training program for pilots is much less fluid than the NFO/FT program; however, in the near future an important change will occur to affect its stability when the Operational Flight Trainer (OFT) becomes available for instruction. After the transition from the present program to a newer one with the OFT integrated throughout, the effectiveness of the overall pilot training program should be considerably enhanced.

As in the NFO/FT course not all students participate in the complete instructional training program. The same category system defined earlier is also being used for the pilot trainees. Additionally, the trainees in each category receive the same percentage of the syllabus as was specified previously for the NFOs. Course length varies from 16 weeks for Categories I and II pilots to 5 weeks for Category III pilots and 4 weeks for Category IV pilots. No course length has been specified for Category V students, since it will be adjusted to meet particular objectives as dictated by higher authority.

The Pilot Training Syllabus is divided into a ground phase and a flight training phase. Cockpit Procedures Trainer (CPT) practice sessions are integrated into the flight phase with the first four sessions as prerequisites to the first transition flight. Without an Operational Flight Trainer, there is no training phase similar to the Tactical Training Phase for the NFO/FTs. The programmed number of hours scheduled for Categories I and II, Category III and Category IV pilots are shown in table 2.

The pre-flight portion of ground training is similar to training received by the NFO/FTs and includes emergency bailout and ditching drills, syllabus introduction and aircraft familiarization. Systems is composed of six individual subjects called avionics, navigation, electrical, hydraulic, engine, and propellers. Included in NATOPS are such topics as aircraft operating limits, performance charts, and emergency procedures. Under operations are the primary and secondary missions of the E-2C, and also the standard procedures that should be followed during prestart through take-off, in-flight, and post-landing. The Carrier Qualifications lectures are focused on formation flight, field carrier landing practice and carrier day, night, and instrument procedures. The academic part of the pilot training syllabus is presented exclusively in classrooms by an instructor lecturing to the students using lesson guides, wall charts, and vu-graphs. Supplemental audio-visual programs are used extensively to introduce systems information and to provide a nucleus for additional instructor presentations. A total of ten sessions are scheduled for the pilot trainees in the cockpit procedures trainer. Both normal and emergency procedures are practiced until a satisfactory level of proficiency has been demonstrated.

The transition stage of the Pilot Training Syllabus for Categories I and II students consists of 12 flights plus a NATOPS standardization check flight. A fewer number of sorties are scheduled for Category III and Category IV pilots depending on the proficiency demonstrated on previous flights. In all cases a NATOPS check flight must be completed satisfactorily. The operational stage flights can be flown after the completion of ground training and in conjunction with an NFO/FT training flight. Primary emphasis is placed on the Airborne Early Warning mission. Crew coordination, mission performance, and systems utilization are discussed and demonstrated. The Carrier Qualification stage begins with Field Carrier Landing Practice (FCLP) and ends with carrier qualification. Practice single-engine approaches are included in FCLPs. Approximately 40 day FCLPs are made prior to flying about 70 night FCLPs. Upon completion of field qualification actual carrier qualifications are conducted. This usually consists of ten, day arrested landings and two, day touch-and-goes. For those trainees who will be night carrier qualified six, night arrested landings are required.

TABLE 2. PILOT SYLLABUS HOURS BY PHASES AND TRAINEE CATEGORIES

	CAT I AND II Hours	CAT III Hours	CAT IV Hours
Ground Training			
Pre-flight	6	4	4
Systems	63	63	51
NATOPS	11	8	6
Operations	20	20	0
Carrier Qualifications	8	2	0
Instrument School	20	0	0
Cockpit Procedure Trainer	13	13	13
Total	141	110	74
Flight Training (excluding briefings)			
Transition Stage	35	18	21
Operational/Nativation-Stage	6	3	3
Standardization	3	3	3
Carrier Qualification	16	4	0
Total	61	28	27
Training Syllabus Total	202	138	101

SECTION II

OVERVIEW

ASSUMPTIONS AND CONSTRAINTS

The entire Instructional System Development (ISD) process previously described consists of decision processes based on data. The data are composed of descriptive facts, research results, assertions (the results of prior decisions), assumptions, and constraints.[3] This section will enumerate those items which fall into the last two categories (viz. assumptions and constraints). Although these "external influences" are subject to change (and in fact, have changed) the following are those that either were agreed upon by NAVTRAEQUIPCEN contract monitor to be a reasonable basis for accomplishing the work under the contract or which were implied or stated in the statement of work.

1. The proposed training program will be for all crew stations of the E-2C aircraft and will be implemented by personnel of the RVAW-120 Squadron, Norfolk Naval Air Station.

2. The trainee flow will remain constant at approximately 30 NFO/FT and 36 pilots per year and will derive from the same sources including both "nuggets" Undergraduate Pilot Training/Undergraduate Navigators Training (UPT/UNT) graduates and transitioning crews. In particular, it was assumed that the West Coast E-2C pilots will not be processed through RVAW-120.

3. The Airborne Intercept Control (AIC) course will remain at Dam Neck, i.e., it will not become part of the RVAW-120 curriculum.

4. No major equipment (simulators, trainers) will be procurred to support the proposed training program.

5. Time available on existing training equipment will not be less than currently available; simulator time will be proportioned equally between use by trainees, operational crew members, and scheduled maintenance.

In addition to these assumptions and constraints, other factors became important influences on this study. For example, the turnover rate of RVAW-120 personnel who could serve as Subject Matter Experts (SMEs) to this program was high. This caused considerable discontinuity in the SME consultation and in the rapport which needs to be established between the training analysts and SMEs. Furthermore, the Squadron did not set aside dedicated man-hours of SME time to serve in consultation. The result was that SME availability was intermittent and heavily dependent on other on-going Squadron activities.

Another influence, of course, is the existence of in-place or in-procurement training equipment. These resources are incorporated whenever appropriate to reduce acquisition and/or life-cycle costs. They are discussed in a subsequent section on media analysis and in the "Training Support Requirements Listing," submitted 24 January 1976 as part of this program.

[3] Sugarman, R.C., Johnson, S.L., Hinton, W.M., and Buckenmaier, C.C., SAT Revisited - A Critical Post-Examination of the Systems Approach to Training, Proceedings of the Ninth Annual Meeting of the Human Factors Society, October 1975.

To the extent that these assumptions and constraints must be altered in the future, the results of this program may also need to be modified. During the preparation of this final report, the contractor learned that several important assumptions will be changing. Namely:

1) The instruction of AIC course is being taken over by RVAW-120; and

2) West Coast E-2B crews will be trained by RVAW-120 (resulting in an increased student flow).

The incorporation of the AIC course falls naturally within the scope of the iterative nature of ISD. That is, changes in the training objectives, whether through feedback or operational policy, are reflected through the analytical process with required syllabus alterations carried out as an ongoing activity. The increased student flow impacts most on the resource requirements (training device availability). These implications are discussed as part of a subsequent section, Media Analysis.

APPROACH

The contractor has approached the problem of developing an E-2C SAT program by coordinating the skills and experiences of specialists in the disciplines of psychology, education, human factors engineering, and aviation. Each of these specialists was selected for the effort on the basis of prior operational and/or training experience with military aircraft. In addition, one contractor analyst (a pilot/navigation-rated engineer) received additional subject matter expertise through participation in RVAW-120's NFO transition course. The general contractor's approach to SAT programs is to put together such a team which is first and foremost a group of experts in SAT technology, but whose familiarity with the subject matter is significant so that:

1) high rapport can be established with the users;

2) subtleties of the mission requirements are not overlooked;

3) operational policy and constraints can be fully appreciated;

4) total reliance is not placed on the availability or cooperation of the user's subject matter experts; and,

5) full advantage can be taken of the SAT analysts familiarity with other relevant missions and training operations.

The combination of this type of SAT analysts, who know the questions, with an ample supply of user experts, who know the answers, ensures the highest quality possible for the results of such efforts.

Using the contractor SAT model developed during a previous program as a starting point, the corresponding methodological components were each considered in relation to the E-2C training task. After several iterations of this conceptualization, a dual integrated model, involving inputs from operator functions and machine functions on the one hand to operational policy and economic data on the other, was adopted. It was hypothesized that such a model would allow for a more comprehensive approach of integrating training into the operational Navy environment.

The development of a comprehensive data base was the first task in applying the contractor's SAT model to the E-2C training program. This was accomplished through a two-faceted analysis. One facet involved an extensive analysis of the existing training program. The second facet consisted of a task analysis. The background information for the NFO task analysis was established through firsthand observation and recording of classroom presentations conducted by the RVAW-120 squadron training personnel. While this appeared to be the most efficient in terms of obtaining information about the NFO/FT training, the contractor's previous experience with the pilot/co-pilot training task and the availability of documentation (including recently developed audio-visual presentations) for a significant portion of that training, alleviated the necessity for a corresponding approach. In both cases, however, all available training documentation was collected for analysis. The following are representative:

a. Instructor Guides (in-house)
b. Student Handouts
c. Class Lecture Notes
d. CARAEWTRARON 120 INSTRUCTION 1500.1A
e. NATOPS (NAVAIR 01-E-2AAA-1)
f. OPERATIONAL DIAGNOSTIC FLIGHT MANUAL (NAVAIR 01-E2AAA-1A.2)
g. OPERATIONAL SOFTWARE FLIGHT MANUAL (NAVAIR 01-E2AAA-1A.1)
h. CREW OPERATORS CHECKLISTS (NAVAIR 01-E2AAA-1C)
i. CHECKLIST-POCKET (NAVAIR 01-E2AAA-1B)
j. GRUMMAN Instructor Program Guides
k. Operator Manuals for Training Devices
l. EDUCATIONAL SELF-AUDIT (RVAW-120, CNETS)
m. *NAVAL FLIGHT OFFICER FUNCTION ANALYSIS:* E-2B CICO (NAMRL)

These informational sources were then supplemented by informal interviews with the RVAW-120 training personnel and direct observations of operational equipment/simulators and crews. In this procedure, heavy reliance was made on two sources, subject matter expertise and operational documentation. These sources, together with classroom lecture notes covering operational information not otherwise available, provided the contractor with the basic information for preparing the task analysis listing.

The format which was employed for the task analysis was one adopted from experience with a previous training program design. The resulting data base consisted of a detailed hierarchial breakdown of all activities required to perform the mission. Of special significance was the level of detail (task element level), the mission-performance/system-operation orientation, and the display-operator-control relationships. Furthermore, an additional effort was made to include remarks pertinent to task performance but not directly reflected in the action statement. Much attention was given to this effort, as it was designed to provide the information necessary to formulate behavioral objectives and to provide the structure of the lesson specifications later in the program. The task analysis was sent to RVAW-120 and to NAVTRAEQUIPCEN for review. Input from RVAW-120 squadron training personnel was used in revisions of the task analytic information as it was incorporated into the lesson specifications.

The next step involved the identification of training objectives. This was basically a two-stage process. First, the task analysis was partitioned into a listing of discrete behavioral components that formulate the behavioral objectives. Included in the objectives are key features such as ratings of performance criticality and difficulty, and the specification of performance limits. As will be seen later in the discussion of lesson specification development, the behavioral objectives play a key role in establishing performance assessment criteria. The behavioral objectives, the second deliverable, were sent to NAVTRAEQUIPCEN and RVAW-120 for verification. The second stage involved the "subtraction" of the incoming skills and knowledges. These incoming skills and knowledges for various trainees were established through discussions with RVAW-120 personnel as well as an analysis of documents related to their previous training. Thus, the behavioral objectives minus the incoming skills and knowledges resulted in the listing of actual training objectives. These, too, were later used in the preparation of lesson specifications as the key determinants of content areas.

The third and final task, resulting in a deliverable, was the preparation of lesson specifications. As alluded to earlier, each of the previous steps contributed directly to the product of this effort. The behavioral objectives, operational policy, availability of resources, and incoming skills and knowledges played a key role in the instructional design. Upon this information, the decision was made to develop an individualized instructional system using audio-visual presentations. Analysis of existing training devices/simulators and an additional operational flight trainer under procurement indicated that no costly hardware purchases would be necessary. It did appear, however, that training effectiveness could be enhanced by a more optimum use of these devices. The procurement of audio-visual carrels and a modification of the Cockpit Procedures Trainer (addition of audio-visual capability) were the only new hardware requirements indicated.

The instructional strategy was developed in consideration of the student flow, the incoming skills and knowledges, available training resources, training objectives, and the concept of early hands-on training. The format of the lesson specification was thus designed to reflect an individualized approach, with instruction divided into three continuous domains - the cognitive, practice, and sortie/scenario. In the cognitive domain, the sequence of instruction was designed to present in a hierarchical manner (building a network of associations upon the developing repertoire) that information which directly contributes to mission performance and/or system operation. Accordingly, the structure of the training objectives was used as the basis for the teaching points in the lesson specifications. The ordering of the objectives was permuted, however, in consonance with learning strategies.

To facilitate the media lessonware preparation, the cognitive instruction was divided into teaching points with corresponding descriptions of media support. An effort was made to segment the teaching points into the smallest units of information appropriate for evaluation. In many cases, however, a number of tape/slide combinations have been envisioned for the support of a single teaching point.

Cover sheets were developed which identify the lesson name and number, training objectives covered, evaluation criteria, prerequisite lessons, training devices required, projected training time, and any additional references. The cover sheet for a cognitive lesson is followed by the sequence of instruction. Likewise, cover sheets for practice lessons are followed by behavioral objectives. The cover sheet for a sortie/scenario includes a brief description of the activities during the session.

Finally, preliminary data banks for test item development were constructed for the pilot/co-pilot and NFO/FT training evaluation. These data will be used in evaluating the cognitive lessons using the adaptive sampling strategy described in a subsequent section. Testing for the practice and sortie/scenario lessons will be performed according to the evaluation criteria specified on the corresponding cover sheets.

RATIONALE

The individualized instructional system which Calspan has specified for the E-2C aircrew was designed to: (1) promote learning efficiencies through modified self-pacing, immediate feedback, early hands-on training, and criterion referencing; (2) to increase instructor effectiveness through direct student contact (one-to-one) as needed; and (3) to enhance training system operations through flexible scheduling. To accomplish these goals, tape/slide presentations have been selected for the primary instructional media, with self-scoring answer sheets serving the testing function. The tape/slide presentations allow for standardization of the curriculum, multiple sensory stimulation, and relative ease of incorporating changes. The self-scoring answer sheets provide immediate feedback, while maintaining a record of student performance for instructor evaluation. This approach was followed in the development of a computer managed instructional system for Navy technical training. While the small student flow rate of the present and projected E-2C program does not warrant computer support at this time, the system is amenable to that additional support, should it become appropriate in the future. A low cost Computer Managed Instruction (CMI) terminal for support of a small learning center is already on the market, and improvements are developing rapidly. While impressive advances have also been made in other technologies, such as Computer Aided Instruction (CAI), the clear advantage of CMI in its cost-effectiveness, and the lack of definitive empirical data demonstrating enhanced learning through direct interaction with the computer (CAI), point toward a greater justification for the recommended approach for handling an increase in trainee flow rate.

In developing the lesson specifications to support an individualized instructional system for the E-2C, the traditional steps of the ISD process were followed, but with a greater emphasis on a "system" orientation and an appreciation for the interactive nature of the developmental steps. Operational policy and economic data have contributed to the selection of training devices and their scheduling, as well as to training priorities. These factors have been carefully weighed against the data from the training analysis, especially the task analysis.

The task analysis employed in the E-2C SAT was heavily oriented toward operational documentation and was followed to the level of discrete perceptual-motor actions. This approach was adopted for two basic reasons. First, it resulted in a mission-related basis for the analysis, while ensuring that the necessary "conceptual" systems information was documented in the data base. Consequently, it was able to encompass many important operations which would otherwise be overlooked. Secondly, it served to educate the instructional psychologists in the E-2C subject matter domain. The contractor team was then able to expand and verify this initial data base through interactions with E-2C training personnel. While the exercise of submitting task analysis questionnaires to fleet personnel, who would subsequently quantify their experience with the suggested tasks, was considered, no justification for such an approach was found. Clearly, many tasks are seldom performed, but are nevertheless critical, and necessary for training.

The behavioral objectives were developed from the task analysis in a format that greatly expanded upon the traditional statement of behavior, condition, and standard. The additional effort required, however, greatly contributed to the system orientation and was directly applicable to the evaluation conditions and criteria. The mission/system orientation of the task analysis was maintained in the behavioral objectives as a precaution against the inclusion of unnecessary training objectives.

Finally, the lesson specifications were developed in a manner directly traceable to the task analysis and behavioral objectives. Traditionally, it has been at this point where other ISD efforts depart from their origin. In the present procedure, however, an effort was made to ensure continuity. Using a continuum from cognitive, to practice and sortie/scenario lessons, a performance orientation of training objectives and subsequently, lesson segments was assured. All of this has been presented in a format consistent with forthcoming instructional material.

SECTION III

IMPLEMENTATION

TASK ANALYSIS

PURPOSE OF THE TASK ANALYSIS. The goal of a Systems Approach to Training is the design and development of a training program that is valid with respect to the job requirements imposed by the mission to be accomplished. That is, all of the necessary skills and knowledges must be taught while ensuring that information that is never necessary is not included. The philosophy behind the systems approach is that if the crew does not "operate" upon the information, it is not necessary to teach that information. The foundation of any valid training program, therefore, must be an objective, comprehensive data base that encompasses the crew members' job requirements in an operational mission environment. Developing a crew training program on such a data base ensures that the training is relevant to the mission rather than training simply for training's sake. Through the use of a mission-oriented data base, the most cost-effective training program can be developed by reducing unnecessary time and resource requirements. Time is reduced by the elimination of unnecessary information and the specification of appropriate criterion referenced performance requirements. Resources, particularly in the form of costs, are reduced by the specification of training devices that are completely adequate for the purposes of effectively training the necessary information, while ensuring that overly-complex (costly) devices are not specified. To develop the necessary data base, the techniques of task analysis (referred to as skills analysis when dealing with task microstructure), has proved to be a useful tool.

LEVEL OF DETAIL OF THE TASK ANALYSIS. The task analysis involved a hierarchy of three levels of detail. The first level was termed, <u>mission segment</u>. This was the grossest level, with an example being the "recovery" of the aircraft. Within the mission segment, the term, task, was used to designate the second level of detail. For example, a day-Visual-Flight-Rules (VFR) recovery is a task of the former level. Finally, the last level of detail is the <u>task element</u>. The <u>task element</u> is the smallest unit of behavior which is either <u>perceptual-motor</u> or cognitive in nature. This hierarchy of levels of detail proved to be effective for collecting task analysis data for the purposes of developing the training program.

A distinction should be made between task analyses conducted for the purposes of "human factoring" a workspace layout and an analysis conducted for the purpose of developing a training system. In the former case, simple actions such as flipping toggle switches can require considerable analysis. For example, the time required to move from one switch to another has implications as to their relative location when one is designing panel layouts. However, this aspect of the task is of little importance (with rare exceptions) to the training program designer. The workspace has usually already been "human factored" prior to the training specialist's entrance on the scene, and the movement times are far less important to him than the sequence of events. An exception to this arises if the movement times influence task loading which, in turn, impacts on the training requirements. Therefore, the level of detail necessary for a task analysis for training program development is not as high as is necessary for equipment design. In fact, many SAT programs in the past have been hindered by the level of detail used.[4]

TASK ANALYSIS DATA COLLECTION TECHNIQUES. There are two facets to the mission of any military operational aircraft (whether the specific mission is early warning, attack, or electronic countermeasures). The primary facet is the wartime mission. The goal of all training is to enable the crew to successfully accomplish the combat mission. Therefore, it is necessary to include in the data base all behaviors exhibited during the combat mission. The second facet of the mission results from the fact that the trainee must possess the skills and knowledges that are needed to operate in the peacetime environment (e.g., training and operational exercises). Therefore, the data base must include these behaviors as well.

During the initial stage of this program one contractor employee was relocated to Norfolk, Virginia to participate in the E-2C NFO Transition Course (T4-75; 23 June to 15 August, 1975). Through participating in the course, along with the use of extensive reference material, the employee became highly conversant with the E-2C and its missions. Another employee, an experienced military and commercial pilot, was the principal analyst for the pilot/copilot position. He made extensive use of existing reference material on the E-2C, as well as periodic on-site visits to RVAW-120. Based on this experience, the task analysis was conducted and documented through the use of the following three data collection procedures.

The first data collection technique involved the procedure most often used in the collection of task analysis data, direct observation (and in many cases, participation). Due to the lack of feasibility of inflight observation it was cost-effective to conduct the observation on the ground in the ground-based simulator (CPT and 15F8).

The second data collection technique was used in conjunction with the observation and was an adaptation of the protocol analysis. The procedure involved instructor personnel forming a combat mission profile while recording (verbally) the behaviors exhibited. The individual operators essentially "talked through the mission" as they were performing the behaviors.

The third technique supplemented the first two techniques. This technique, personal interview, was an interactive process utilized at various times during data analysis to ensure that the data base was complete and valid. The interviewers were the contractor's analysts and the interviewees were E-2C instructors. The task analysis data collection occurred at RVAW-120, Naval Air Station, Norfolk, Virginia for the E-2C aircraft.

TASK ELEMENT ATTRIBUTES. The information in the task analysis data base included the descriptive titles for the mission segment, and task. In addition, the attributes of the smallest unit of behavior, the task element, includes both descriptive and accounting information. This information is illustrated in figure 2.

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[4]Personal communication, Clark, Air Force Project 1710, 1974.

10.0 Mission Segment Recovery

10.5 Task (1) Day IFR and all night carrier recoveries (Case III)

Task Element No. (2)	Task Element Description (3)	Initiation Cue (4)	Action Word (5)	Control or Display (6)	Completion Cue (7)	Remarks
10.5.10	Complete approach checklist	Aircraft in holding pattern			Checklist complete	(3) See task 10.1 for approach checklist
10.5.11	Initiate penetration	Aircraft over marshall point at marshall time	Apply forward pressure	Yoke	Yoke forward, IAS increasing	(3) Call Marshall: "commencing" with state.
10.5.12	Reduce power	IAS = 250 knots	Retard & adjust	power levers	Vertical velocity indicator = 4000 fpm descent rate	(7) Torque Hp ≈ 700 Hp (7) Vertical velocity will approach 6000 fpm during initial descent and will decrease. (7) Maintain 250 KIAS & 4000 fpm descent.
10.5.13	Reduce rate of descent	Altimeter = 5000'	Advance	power levers	Vertical velocity indicator = 2000 fpm descent rate	(7) Torque (Hp) ≈ 1200 Hp (7) Maintain 250 KIAS
10.5.14	Call "platform"	Altimeter = 5000'	Depress Communicate with Marshall "Platform"	M button or control wheel	"Platform" acknowledged	(5) "Platform" call to CCA if marshall has given instructions to switch to CCA.

Figure 2. Example of Task Analysis Listing.

The task element title and number are simple accounting information which allows one to identify the element and equate identical task elements that occur throughout the mission. The behavior describes the actual activity occurring in the task element.

The format of the behavioral attribute of the task analysis data base corresponded to the stimulus-response characteristics of the activity. The major components that characterize the behavioral aspect of a task element are as follows:

Initiation Cue -- Action Verb -- Control -- Completion Cue.

The Initiation Cue is the stimulus complex that informs the operator to begin the activity. The initiation cue can consist of a combination of cues. The necessity for a combination of cues results from the fact that some initiation cues consist of various situations, any of which could be met ("or" statement), or all of which must be met ("and" statement).

The Action Verb was selected from a standardized vocabulary of terms (e.g., pull, rotate, and align) that was developed as an adaptation of the work of Oller 1968).[5] The action verb has a correspondence to the control which is operated upon.

The next component of the task description is the Control. This is the grammatical direct object of the Action Verb. It should be noted that it is sometimes the case that a "display" can be operated upon (e.g., monitor the altimeter) and, therefore, becomes the "control."

The Completion Cue is of the same form as the Initiation Cue. In fact, it is often the case that the Completion Cue of one task element is the Initiation Cue of the next task element. As with the Initiation Cue, the Completion Cues can be combinations of cues. However, in the former case, there is only one conglomerate cue; whereas, in the latter case there are often two or more conglomerate cues, each of which leads to a different next task element. For example, when a decision is made by a crew member, two alternative actions might be possible, depending upon the information upon which the decision was based. A more common situation is the case where one completion cue represents the normal operation and the other completion cues represent corrective actions.

In addition to the core information, other supplemental information was collected and recorded as comments. To date, there has been no totally satisfactory method established for documenting decision making activities in task analyses. During the present program, information relating to cognitive tasks was documented as comments in the task analysis format. These comments include the knowledges that are necessary to make decisions that result in actions in the task analysis behavior. This information varies from the interaction of various pieces of equipment to tactical contingencies. Other types of supplemental information include task element difficulty and criticality. It should be noted that it is often more appropriate to assign these values to composites of elements. It is often the case that difficulty and criticality values are quite different when elements are considered in isolation as opposed to when they are performed either concurrently or consequently in rapid succession. Through the behavioral objective these values were assigned to conglomerate task elements.

[5] Oller, R.G. Human factors thesaurus (an application to task data). System Development Corporation, Santa Monica, California, for Aerospace Medical Research Laboratory. Report AMRL-TR-67-211, March 1968 (AP 670 578).

TASK SELECTION. The previous section discussed the procedure for describing the "job" (i.e., tasks) that an individual must be capable of performing after training. There are two times during the analysis in which task selection occurs. The first selection occurs during the analysis of the job. It is not feasible or necessary to document all of the possible situations that can occur during an operational mission. For example, there are combinations of malfunctions that can potentially occur, although with infinitesimally low probabilities. Similarly, there are tasks that cannot be performed even with an unlimited amount of training. During the task analysis, the contractor analysts, with consultation from Navy subject matter experts, selected tasks for documentation that had some expectation of occurrence and were amenable to training.

The second place where tasks are selected occurs after the behavioral objectives have been documented (See the next section). Selection in this context is based upon whether the incoming sources of trainees can perform the behavior (task) prior to training. That is, if the behavior is within the incoming trainee's repertoire of skills and knowledges, additional training is not necessary. This selection can only be performed after an analysis of both the behavioral objectives (including the performance limits) and the incoming abilities. Through these two task selection processes, the training time is assured to be efficient in that it is spent in the most effective areas.

BEHAVIORAL OBJECTIVES. The behavioral objectives were developed from the task analysis by partitioning the task elements into distinct behavioral components. Often behavioral objectives and tasks in the task listing coincided in terms of their task element compositions. In other instances, however, it was appropriate to divide tasks into two or more behavioral objectives on the basis of the different behaviors performed within the task. For example, the task of setting the radar video intensity controls was subdivided into separate behavioral objectives for each video: Long Pulse, Short Pulse, etc. This transformation was made to account for the suitable differences in properly adjusting each of eight unique videos.

The format of the behavioral objectives is illustrated in figure 3, and an example in figure 4. The specific attributes of the behavioral objectives are as follows:

a. Behavioral objective title
b. Behavioral objective number
c. Objective criticality
d. Objective difficulty
e. Task element behaviors
f. Performance limits
g. Initial conditions
h. Concurrent tasks
i. Interaction tasks

The behavioral objective title is simply a descriptive identification. The behavioral objective number for the pilot/copilot relates the objective for the task listing mission segment which contains the task elements included in the objective and supplies accounting and ordering information within mission segments. For the NFO/FT, the behavioral objective number refers the objective to the task analysis listing which was ordered primarily by systems into thirteen major components.

OBJECTIVE:	Title of objective
OBJECTIVE CRITICALITY:	On a three-point scale
OBJECTIVE DIFFICULTY:	On a three-point scale
TASK ELEMENT BEHAVIORS:	Behaviors from the task analysis incorporated by the objective
PERFORMANCE LIMITS:	Criteria for demonstrating proficiency
INITIAL CONDITIONS:	State of the aircraft or pertinent systems (e.g., climbing at 2000 ft/min, INDICATOR POWER AVAILABLE,ETC.)
CONCURRENT TASKS:	Overt or covert tasks conducted simultaneously with the objective behaviors (e.g., MAINTAIN CONSTANT HEADING THROUGHOUT MANEUVER)
INTERACTION TASKS:	Coordination involved with other crewmembers or interactions with personnel external to aircraft

Figure 3. Behavioral Objective Format.

OBJECTIVE: PERFORM PENETRATION (CASE II AND III RECOVERIES) P 10.18

CRITICALITY: 2 **DIFFICULTY:** 3

TASK ELEMENT BEHAVIORS:

10.5.11 Initiate penetration
10.5.12 Reduce power
10.5.13 Reduce rate of descent
10.5.14 Call "platform"
10.5.15 Turn toward final approach bearing
10.5.16 Turn toward final approach bearing
10.5.17 Intercept final approach bearing
10.5.18 Level off

PERFORMANCE LIMITS:

1. Airspeed - 250 knots ±5 knots
2. Vertical velocity - 4000 fpm ±500 fpm above 5000 ft and 2000 fpm ±500 fpm 5000 ft to beginning level-off at 1700 ft
3. Final approach bearing intercepted ±3 degrees
4. Aircraft leveled-off at 1200 ft ±50 ft

INITIAL CONDITIONS:

1. Cruise configuration
2. Assigned marshall altitude

CONCURRENT TASKS:

1. Adjust wheel and rudders to maintain desired heading

INTERACTION TASKS:

1. Call Marshall when commencing penetration
2. Call Marshall when at "platform"

Figure 4. Example of Behavioral Objective.

Objective criticality is referenced to the importance of the most likely results of incorrectly performing the behavioral objective. A minimum level of criticality (1) is assigned when no important effect is evident or the mission is degraded slightly. The second level of criticality (2) occurs when the mission is compromised or degraded significantly or equipment is damaged. The highest level of criticality (3) is assigned when personnel injury or catastrophe is the result of noncompliance with the specific behavioral objective.

Objective difficulty refers to the degree to which training time or resources may need to be devoted for the attainment of a specific level of proficiency. Like criticality, it is graded on a three-point scale. The minimum level (1) means it is not difficult, the middle level (2) refers to moderate difficulty and the highest level (3) relates to a very difficult task, with each judgment being made with respect to the totality of tasks.

Task element behaviors are the same behaviors delineated by the task element descriptions in the task data analysis. The number associated with each task element behavior is identical to the corresponding task element number. All task elements have been included within the behavioral objectives.

Performance limits provide standards against which trainee performance can be evaluated. They are the criteria that must be demonstrated to show successful accomplishment of the objective. Individual performance limits often are traceable to specific task elements while others refer to performance on the objective as a whole.

Initial conditions give the state of the aircraft or system prior to the operator performing the first task element behavior. An example of initial condition information is that the vertical velocity of an aircraft is at a particular value prior to conducting a level-off. The initial condition information is derived from the previous task elements of each of the behaviors.

Concurrent tasks are those tasks which the operator must perform at the same time he is executing the behaviors contained in the objective. For example, during level-off, the pilot must also maintain a desired heading. This information is necessary in determining the criticality and difficulty of the objective.

Interaction tasks identify those portions of the objective that involves the other crewmembers that the operator must coordinate with or receive information from. In addition to the crewmembers on the operator's own aircraft, crew interaction includes the interactions with groundcrew and crewmembers of other aircraft.

MEDIA ANALYSIS

An important product of any SAT analysis is the determination of training device requirements. The specification of training devices is based on the training objectives identified during the SAT process and is oriented toward obtaining the best possible trainee performance at the least possible cost. Increased efficiency through the use of training devices has been one of the greatest impacts on the training system's effectiveness and cost over the life-cycle of a training program. Further detail of the analysis for this program is contained in the "Training Support Requirements Listing" submitted 24 January 1976.

Two general principles were followed in determining the training media support requirements for the pilot and NFO/FT training courses. The first principle was to make the maximum possible use of existing media and those currently under procurement. This involved the mapping of training objective media requirements into the available training media capabilities to evaluate how effectively the training objectives identified during the SAT process can be taught using those media. During the mapping process, particular emphasis was placed upon evaluating the hands-on capabilities of the devices.

The second principle involved a trade-off analysis to determine the need for the procurement of new devices or modifications to existing devices. Factors considered in this analysis were: (1) deficiencies in the current devices as determined by the mapping of media requirements into media capabilities, (2) the cost of procurement of new devices, (3) the demand on existing and new devices as a function of trainee flow rate, and (4) the degree of improvement in training effectiveness to be expected by procuring new devices or modifying existing ones. The degree of improvement expected was based on a consideration of some of the basic principles of learning, e.g., hands-on learning facilitates the acquisition and retention of psychomotor skills; individualized, instruction enhances cognitive learning; and testing is most effective when it immediately follows instruction to allow timely feedback and remediation.

AVAILABLE MEDIA. Currently, in both the pilot and NFO training programs the classroom lecture is the primary medium used for cognitive (i.e. academic) instruction. Also available for pilot instruction, to supplement classroom lectures, is a series of audio-visual programs, which are presented in the classroom. These supplemental programs, which are machine-paced, form the nucleus of those cognitive lessons for which the programs are available, with individual instructors determining the content of the remainder of each lesson.

Hands-on training devices are utilized for both NFO/FT and pilot training. Two such devices are available for NFO/FT training. The Integrated Systems Maintenance Trainer (ISMT) which is primarily used for maintenance training is also used for CIC console familiarization. The primary ground-base training device is the 15F8 Tactics Trainer. The Tactics Trainer, which is a fully operational CIC compartment is used to instruct all aspects of operation of the ACO/CICO/FT stations. Three students may be instructed at any one time, with individual or team training possible.

Three ground-based training devices are available or will be available for pilot training. The Suitcase Emergency Procedures Trainer (SCEPTR) is a portable trainer/tester device for use in the instruction/practice of normal and emergency procedures. It is a one-half scale replica of the pilot's instrument panel and consoles and is available for use on a voluntary basis by single pilot trainees. The Cockpit Procedures Trainer (CPT) is a fixed-base cockpit replica with no visual attachment. It is used for the practice/evaluation of normal and emergency procdures. It can accommodate two trainees and has an external instructor's station. The Operational Flight Trainer (OFT), which is scheduled for delivery in the Spring of 1977, will consist of a cockpit replica mounted on a six degree-of-freedom motion base and will contain a point-lights visual system. The OFT will be used to supplement training currently carried out in both the CPT and the aircraft.

EVALUATION OF AVAILABLE MEDIA. The spectrum of training devices that are currently being employed or are under procurement provides extensive capabilities for hands-on, interactive learning for both the NFO and pilot trainees. The ISMT and Tactics Trainer for the NFO/FT's and CPT and OFT for the pilot, due to their different levels of complexity, give training personnel the flexibility to schedule the training of objectives as a function of the complexity of the objective. Those training objectives that do not require extensive dynamic interaction between the trainee and the training devices (e.g., normal checklists) can be practiced in the ISMT or CPT. Those objectives that do require extensive dynamic interaction between the trainee and the training device (e.g., flight maneuvers, and tactical problems) can be practiced in the Tactics Trainer or the OFT.

A comparison of the stimulus characteristics inherent in the available devices with the stimulus characteristics judged by SAT analysts to be essential for the training of procedure-oriented objectives, indicated that the CPT, OFT, ISMT, and Tactics Trainer as they are currently configured, provide ample capabilities for hands-on learning. The main function of the SAT process with respect to these devices was to ensure their effective utilization as a function of instructional strategies and sequencing (Section 3.5).

From the plethora of educational research that has been conducted in recent years, three instructional principles which increase learning speed and enhance retention of academic material have emerged. These principles involve: (1) modified student-paced instruction; (2) individualized presentation; and (3) immediate knowledge of results. The use of an individualized instructional medium accounts for individual differences in learning time and learning style, and when supplemented with a testing session at the end of each lesson, provides the student and instructor with immediate feedback of student performance. This immediate knowledge of results allows the student to review the content of the lesson for remediation while lesson content and problem areas are still fresh in his mind and also assists the instructor in offering prompt remediation guidance. The testing and guidance in a moderately competitive environment yield motivation to close any gaps which may have opened between the individual and the syllabus.

The results of this SAT analysis are particularly appropriate for implementation in an individualized training medium. Through the structured steps of a SAT analysis only those teaching points which will impinge upon subsequent trainee performance are selected for instruction. Those selected teaching points are further ordered into a logical sequence of discrete steps which can be readily converted to an individualized instructional format. Thus, through this selection and ordering process the need for student-instructor interaction is minimized in duration, but optimized for utility.

Within an instructional sequence in which the teaching of psychomotor and cognitive skills is integrated (see next section) the implementation of an individualized system for cognitive instruction allows for more efficient use of student time. In such a system the training technique for cognitive skills is consistant with that for psychomotor skills, i.e., both cognitive and psychomotor skills are taught individually. By using an individualized approach to cognitive training, as well as to psychomotor training, there is much more flexibility available for the scheduling of psychomotor lessons, because device utilization times are not determined as a function of times when classroom lectures are scheduled. Rather, the scheduling of training devices can be arranged so as to make the most efficient use of all available resources. For example, with an integrated, totally individualized system one student may be engaged in cognitive training at the same time another student in the same convening class is engaged in psychomotor training in a simulator.

The effectiveness of classroom versus individualized instruction was recently compared for two Navy training courses, the Aviation Familiarization Course (AFAM) and the Aviation Fundamentals Course (AMFU)[6]. The results indicated that learning time was 30% to 60% less for the individualized instruction, while immediate and delayed test performance (retention) was essentially the same for the two instructional techniques.

Individualized instruction should not be implemented independent of a consideration of the media requirements of each training objective. For example, some objectives are amenable to individualized instruction, while other objectives can more effectively be taught in a group setting.

On the basis of an evaluation of the subject content of the pilot and NFO/FT cognitive training objectives, SAT analysts determined that an individualized, instructional medium should replace the traditional classroom lecture as the preferred medium for cognitive instruction. To supplement this medium, classroom lecture/discussion was retained for those objectives which require interaction/discussion between instructors and students, and among students. A discussion of the proposed student-centered instructional medium follows.

THE GENERAL PURPOSE CARREL. The general purpose audio-visual carrel was selected as the most cost-effective medium to implement individualized, modified self-paced instruction. (For more details see Training Support Requirements Listing.) Since the basic carrel and its audio-visual components are off-the-shelf items, no custom design problems will be encountered in the transfer from a predominantly classroom orientation to an individualized presentation orientation.

Cognitive lessons for both the pilot and NFO/FT trainees are predominantly oriented toward the teaching of the knowledge necessary to operate the aircraft systems. The function of the general purpose carrels is to provide student-centered individualized instruction that does not require the active manipulation or monitoring of controls and displays by the trainee. It incorporates an audio-visual presentation, a workspace for writing, and a reduced scale photograph of the cockpit or CIC layout. The audio-visual presentation involves a student-paced, narrated, slide presentation that is linearly programmed (i.e., without branching logic) but with a student-initiated synchronized review capability. The linearly programmed attribute is recommended due to the homogeneity of the incoming population and the current low trainee flow rate (36 pilots and 30 NFOs per year). These factors indicate that the implementation of a more complex system incorporating branching logic or Computer Aided Instruction (CAI) would not be cost-effective. Compensation for differences among trainees in incoming skills and knowledges will be provided by the pre-testing procedure discussed in a subsequent section.

[6]Carson, S., Salop, P., Johnson, K., Grawban, L., An Evaluation of Computer Managed Instruction in Navy Technical Traning (Preliminary Draft), Navy Personnel Research and Development Center, April 1975.

The discrete visual presentation capability of the carrels will be used to supply the trainees with the visual attributes necessary to enhance basic cognitive learning of systems operation. Since the strategy of teaching systems operation centers on operator manipulation and interpretation of controls and displays rather than on detailed instructions of systems mechanics, visual presentations will most often feature pictures of controls and/or displays. Schematics and block diagrams will be limited to those teaching points in which context information necessary for systems operation is presented.

The environment of visual presentation of control and displays combined with the reduced photograph of the CIC or cockpit layout will facilitate trainee transfer of training to the other training devices and will enable students to adapt to hands-on-training more readily. Thus, instructors will be able to expect a higher level of initial performance in a practice session and a higher level of attainment at the termination of the session.

MODIFICATION OF THE CPT. To enhance pilot trainee learning of normal and emergency procedures a minor modification to the CPT is recommended. The modification will involve the installation in the CPT of the same tape/slide devices that are used in the general purpose carrel. The viewing screen for visual presentation will be positioned between the emergency panel and the top of the instrument panel where it is clearly visible from both cockpit seats. Depending on projector size and focal length, the projector may be mounted above the instrument panel to the right of the screen or outside the windshield with an accompanying modification to the windshield. A location under consideration for the cassette tape player is on the center pedestal where the non-functional CAINS and computer programmer control panels are currently located.

By providing the basic instructional capability in the CPT the trainee will be able to execute the normal and emergency procedures in the cockpit environment as he receives the initial instruction without the necessity of an instructor being present. Following the lesson presentation the trainee can be tested as in the general purpose carrel.

Since the sound-slide devices in the carrel and CPT will be compatible, instruction in normal and emergency procedures can also be executed in the carrel in the event that the CPT is unavailable. Remedial instruction on procedures may also be carried out in the carrel.

The use of the CPT as a basic instructional device, as well as a practice/evaluation device (rather than a practice/evaluation device only) is feasible for two reasons: (1) learning speed, retention, and transfer of training are enhanced for procedural (psychomotor) objectives when initial learning is presented in an environment closely resembling the operational environment; and (2) the availability of the OFT will allow normal and particularly emergency procedure practice sessions to be conducted in a more dynamic environment than it is now possible to obtain in the CPT. This modified role of the CPT allows a fuller utilization of the training devices available for pilot instruction by more effectively matching device capabilities with objective training requirements. For example, in the CPT since the flight controls are nonfunctional an actual take-off can not be effectively simulated; therefore, an emergency during take-off can not be practiced in an appropriate dynamic environment. In the OFT, the trainee will be able to practice take-off and can be trained to react to a take-off emergency in a highly-realistic environment. By using the OFT for such training the CPT will be made more available for basic instruction and for earlier phases of practices/evaluation. This recommended modification in the utilization of the CPT increases the overall student learning/practice time in the CPT and effectively matches the nature of the training in the CPT with the actual capabilities of the device.

The addition of a sound-slide device to the ISMT or Tactics Trainer was briefly examined by SAT analysts; but, such an addition to either device was determined to be unwarranted at this time. Two factors preclude the use of the ISMT as a basic audio-visual presentation device for NFO training: (1) the configuration of the device is not amenable to the incorporation of the sound-slide equipment without major modifications; and (2) use of the ISMT in the proposed NFO training course is limited; therefore, such a modification would not be cost-effective. Incorporation of audio-visual devices into the Tactics Trainer would also involve a major modification to the device and as such would not be cost-effective.

Since neither of the available NFO/FT hands-on training devices readily lends itself to the incorporation of audio-visual presentation devices, contractor analysts evaluated the feasibility of procuring a device specifically designed for the instructor/evaluation of early hands-on learning. Such a device (costing on the order of $100K) would be roughly comparable to the CPT for pilot training and would be designed to include an audio-visual presentation capability. However, contractor analysts concluded that the procurement of a simplified hands-on training device could not be justified at this time for two reasons: (1) the low student flow rate (30 NFO/FT trainees per year) combined with the adequate availability of the Tactics Trainer plus limited use of the ISMT for hands-on learning would not make such a procurement cost-effective; and (2) transfer of training from the general purpose carrel, in which the visual support will be oriented toward the presentation of pictures of CIC console segments, is expected to be good.

USE OF THE CLASSROOM. Although the primary medium for cognitive presentation is the general purpose carrel, certain lessons will remain in the classroom. As discussed earlier, not all training objectives lend themselves to individualized instruction, primarily because extensive student-instructor interaction will enhance the learning process and will supply student motivation. Additionally the classroom sessions provide the student with a forum in which he may pose questions on problem areas which may have arisen during other portions of the training sequence.

Within the recommended NFO/FT training sequence, a block of classroom instruction has been allocated as a transition phase between the instruction on basic systems and software knowledge and operation and the use of this knowledge in tactical scenarios. This block of instruction will be used for review, discussion, and summary to ensure that NFO/FT trainees are prepared for the future integration of system knowledge and operation in the final operational scenarios. Instructors will present information on and will answer general questions about operations and tactics, and will present "sea stories" to assist students in understanding the operation of the E-2C weapons system.

Similarly, in the pilot training sequence, classroom instruction is recommended for those topics which cover basic operational procedures. The teaching of such procedures will be enhanced by the full use of instructor experience in an interactive forum.

Other topic areas which remain in the classroom are instruction on basic Naval officer training and pilot instrument school. The instruction in basic Naval officer training is particularly suited to the classroom since there is no testing, no remediation, and no specific behavioral objectives related to the E-2C mission. In such a situation, student motivation can be enhanced by effective instructor presentation. It is recommended that the basic Naval officer lessons be scheduled as time permits during the course sequence.

The pilot instrument school is a large block of instruction (20 hours) that must be completed by each trainee according to Navy regulation. Instrument school, while conducted by RVAW-120, is often taught in conjunction with other units. At this time instrument school should continue to be taught in the classroom; however, if in the future a standardized set of audio-visual lessons is made available by the Navy, instrument school could then be presented in the general purpose carrel.

The determination of media requirements is an integral part of the overall process of implementing instructional strategies and sequencing instructional blocks. Commonalities among media selected for different training objectives may impact on instructional block content and sequencing, or alternatively the logical groupings of training objectives into instructional blocks may impact upon media selection and utilization. The strategies used by contractor SAT analysts to determine the contents of and the sequencing of instructional blocks are discussed in the next section.

FUTURE REQUIREMENTS

A previous section of this report discussed the assumptions and constraints which formed the basis for the analyses. One of the most critical assumptions deals with the trainee flow, since the resource requirements are a direct function of that factor. In its simplest form, the number required of each type of device or equipment is determined by the availability per unit (in hours per year), the number of trainees accommodated simultaneously, the number of hours in that device required per trainee, the number of hours in that device required per trainee, and the number of trainees per year. For example, if a simulator is available 2000 hours per year and is to be used by two trainees at a time, and if each trainee must spend 50 hours in the device and 20 trainees a year must be processed, one can easily calculate that only 25% of one simulator will be needed. As the 100% limit is exceeded then a more complicated situation exists. Namely one has the choice of specifying the procurement of an additional trainer, <u>or</u> re-working the instructional block sequencing (and corresponding lesson specifications) to re-assign training objectives to other alternative media if they are available. Obviously, the latter course of action is often preferred.

The training program recommended herein is yet to be validated (a Phase II function). It is, therefore, not appropriate at this time to correlate exact device requirements to specific trainee flows. That will depend on the final utilizations arrived at during Phase II for the currently recommended devices. A more generalized discussion, however, will be offered.

As a general rule, an apparent need for additional devices should be met first with the assurance that existing devices are fully utilized. In a previous Calspan review of military training facilities[7], it was found that for maximum utilization, most training devices are operated 16 hours per day, 6 days per week, with the remaining 8 hours per day set aside for scheduled maintenance and the seventh day allocated to make-up in the event of unscheduled maintenance. Additional allocations for periodic modifications and updates need to be made if required. Of the 16 hours of operational time per day, a proprotioning between transition training and refresher training may be negotiated based on need.

If the devices are fully utilized, then one must further ensure that the best mix of media is available before concluding that more of the same types of devices should be procured. Again, re-examination of the instructional block sequencing may show that many training objectives could be met on less costly devices, if any were available. As a case in point, over-commitment of the Tactics Trainer, Device 15F8, might lead to the procurement of a second such device. However, because many of the objectives currently assigned to that device are procedural in nature and do not require complex decision making, a new tactics procedure trainer with much less capability could also resolve the over-commitment problem at a small fraction of the price (on the order of $100K). If so, such a procedures trainer would yield a great cost savings; if not, then the procedures trainer would not be warranted with the addition of the second 15F8. This type of decision process is an embodiment of the iterative interaction between training objectives, media specification, and instructional block sequencing discussed in Section 1.3.

A last consideration, while often considered contrary to the general SAT philosophy, may be cost-effective in certain cases. It can happen, for a number of reasons, that transient peak requirements are encountered in the use of training devices. This may happen in start-up periods (e.g., new source of trainees is "turned on"), major delays caused by lengthy down-time, and so forth. If these peaks cannot be smoothed out by scheduling changes (particularly by delaying graduation dates, scheduled maintenance, or refresher training), the best solution may be the increased utilization of more complex devices -- including the aircraft itself! On a purely cost basis, an occasional increase in flying hours may be significantly cheaper than the purchase of an additional operational flight trainer or a tactics trainer. If this necessitated the purchase of an additional aircraft for training purposes, then ovbiously the reverse is true.

A SAT analysis is designed to accommodate change so that it is responsive to the evolution that every training program encounters throughout its life cycle. Since assumptions and constraints may be treated as data in the analysis, changes in them lead to a logical chain of events. The future configuration of the program proposed by this study will need to be altered to reflect the evolution that is taking place, even before completion of this initial phase.

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[7] Johnson, S.L., Knight, J.R., and Sugarman, R.C., Simulation Technology Assessment report. B-1 Technical Memorandum SAT-3, July 1975; Reif, H., and Ring, W.H., B-1 Systems Approach to Training, Final Report. Appendix A: Cost Details. B-1 Technical Memorandum SAT-1, Vol. 2, July 1975. Calspan Report No. FE-5558-N-1.

INSTRUCTIONAL STRATEGIES AND SEQUENCES

The first two steps of SAT, the task analysis and the identification of behavioral objectives from the task analysis, are the means to the end product, which is an effective training system at the least cost. In between the first two steps and the end product is the iterative process of identifying training objectives, specifying the methods/media required to support the training objectives, and determining instructional block allocation and sequencing. In the previous section the rationale for media specification and utilization, based on training objective requirements and principles of learning, was presented. Integral to the specification and utilization of media is the process of sequencing instructional blocks. This sequencing of blocks is based both on learning principles and effective resource (device) utilization.

INSTRUCTIONAL STRATEGY. Strategies within instructional blocks in which cognitive learning takes place were presented in the previous section (i.e. student-paced instruction, individualized presentation, and testing with immediate knowledge of results). Within practice and sortie/scenario blocks the primary strategy is hands-on learning with immediate knowledge of results available either through instructor feedback or the automated performance measuring capability of the OFT. Pacing in practice and sortie/scenario lessons is based on instructor evaluation of trainee performance.

Guidelines used in the sequencing of instructional blocks were derived from the principles of learning. These guidelines pertain across the spectrum of training objectives, and when implemented, provide for the logical ordering of instructional blocks to produce an efficient and cost-effective learning sequence. One of these guidelines, which was discussed above, is early hands-on learning. This philosophy of active participation results in superior training effectiveness through increased attention and motivation and by giving the trainee the opportunity to integrate cognitive training with hardware experience.

The principle of presenting new information that is associated with previously learned concepts is well-documented in the literature. The general result of adhering to this principle is that a context is provided within which the new information becomes more meaningful. A term used within the SAT methodology is the enabling objectives hierarchy. Prerequisite (enabling) skills and knowledges are usually acquired in simple devices (e.g., a carrel) and are later integrated into a more complex skill in a more complex device (e.g., the Tactics Trainer).

By interspersing hands-on lessons among cognitive lessons, retention of both the knowledge and the skills exercised in implementing the knowledge is enhanced (i.e., one learns by doing). Practice lessons are spaced within the course sequence so that, whenever possible, the knowledge learned in the immediately preceding cognitive lesson(s) is implemented. Sortie/scenario lessons generally build on the preceding practice lessons and provide the trainee with the opportunity to integrate the knowledge and skills acquired in the cognitive and practice lessons.

There is an apparent conflict between the sequencing philosophy in which device utilization is integrated throughout the course sequence and the sequencing philosophy in which the complexity of devices used increases as an ordered training sequence proceeds from cognitive, to practice, to sortie/scenario. This is particularly true with respect to aircraft utilization during pilot training. If the building philosophy were strictly followed, aircraft sorties could not begin until all cognitive training and early hands-on training in ground-based devices were completed. Such a sequencing strategy would be based on the argument that efficient aircraft utilization is a function of the completeness of prior cognitive learning and practice. The benefits to be derived from integrating aircraft sorties into the total training sequence, however, clearly indicate that an integrated training sequence is superior to the sequential ground-then-flight phase approach which is currently being used in the E-2C training program. The rationale for integration of aircraft sorties into the total instructional sequence is based upon three learning guidelines. One such guideline is that training requiring the most practice should start early in the training sequence. Certainly learning to control the aircraft in a wide variety of situations is the most difficult aspect of any pilot training program; and, therefore, experience "at the wheel" should begin early in the training sequence.

A second guideline relates to the fact that learning and retention generally increase as the fidelity of the framework in which the learning is used increases. That is, as knowledge and practice in the ground-based portions of the training sequence are accumulated, they can be utilized in the "real-world" environment, thus facilitating the acquisition of new skills and knowledge and enhancing the retention of previously-learned skills and knowledges.

A third guideline involves the effect of motivation on trainee performance. For a pilot trainee there is no motivational substitute for allowing him to do what he came into the program to do, fly the airplane. By scheduling sorties throughout the training sequence, trainee motivation will be enhanced during all portions of the training program. Motivational considerations also apply to the integration of "real-world" experience into the NFO training sequence; however, the desirability of a totally integrated sequence, in which the E-2C is extensively used, is reduced due to the high degree of fidelity attainable in the Tactics Trainer.

Fidelity refers to the realism of the simulation. Even though the specifications for the OFT call for a high degree of realism in all aspects of the simulation, integration of sorties into the training sequence is necessary to ensure transfer of training to the aircraft, and for instruction in phases of flight that can not be adequately handled in the OFT. The high fidelity of simulation in the Tactics Trainer results in the capabilities for the simulation of tactical situations superior to that in the aircraft. For this reason Tactics Trainer practices and scenarios are integrated into the instructional sequence with aircraft missions being incorporated toward the end of the NFO/FT training course. These aircraft missions will acquaint the trainees with the intricacies of Airborne Tactical Data (ATDS) operation in the "real-world" environment (e.g. radar presentations).

Another guideline that results in increased trainee motivation and facilitates learning is spaced practice (as opposed to massed practice). This guideline pertains to both material and devices. That is, trainee boredom, accompanied by a resultant decrease in performance, can result from a long exposure to the same material or a long period of time in the same device. Hence, every opportunity was taken to ensure that the student is exposed to a varied media mix.

The guidelines discussed above apply as general sequencing rules across the entire instructional program and, on a smaller scale, to sequencing within modules. The sequencing among modules is based upon the factors of difficulty, criticality, and frequency of occurrence. Essentially, difficulty of the learning involved, criticality of the learning to mission success, and the probability of occurrence of an event impact upon the placement of different modules within the overall course sequence. For example, instruction on engine operations should occur early in the training sequence, because (1) understanding engine operation and learning the normal and emergency engine procedures is a difficult topic area, (2) proper engine operation and responses to abnormalities are critical to the mission, and (3) the knowledge of engine operation is frequently used in both normal and emergency situations. On the other hand, instruction on the Automatic Flight Control System (AFCS) may come later in the sequence because (1) operation of the AFCS is relatively simple (2) the AFCS is not critical to mission performance, and (3) the training orientation is not to use the AFCS during the most of the sorties.

ASSIGNMENT OF DEVICES TO INSTRUCTIONAL BLOCKS. As discussed earlier, the preponderance of cognitive lessons will be presented in the general purpose carrel with the classroom used as a supplemental medium for certain topic areas. In the NFO/FT training course the Tactics Trainer (plus limited ISMT usage) will be the medium used for ground-based, hands-on learning and evaluation. As a simulator the Tactics Trainer is superior to flight in the aircraft in its ability to present trainees with realistic tactical scenarios. The aircraft will be used near the end of the instructional sequence to provide the trainees with experience in the operational environment.

In the pilot training course, the CPT will be used as the presentation medium for cognitive lessons in which a large hands-on component is involved. "Wheel time" will be divided between the OFT and the aircraft with the division based partly upon the relative characteristics of the two training media. Emergency procedure practice in sorties will primarily be carried out in the OFT. For emergency procedure practice the aircraft is limited, relative to the OFT, since the practice of certain emergency procedures may require the aircraft to be placed in potentially hazardous situations (e.g., engine failure on takeoff). These situations can be simulated in the OFT while monitoring safety requirements.

A feature of the OFT and Tactics Trainer which is particularly applicable to the practice of maneuvers and tactical problems is the ability to "slew" the simulator to a desired position. For example, using this feature, takeoffs and landings can be practiced without the necessity of making a complete traffic pattern. During the early stages of practice the trainers will be heavily used for practice of such situations.

The NFO/FT and pilot-course structures to be described next have made maximum use of the capabilities of the training devices and have been based upon the learning guidelines discussed earlier. The essential training of skills and knowledges takes place in the simplest device, the general purpose carrel or classroom, with practice taking place in the more sophisticated devices, the ISMT, Tactics Trainer, CPT, OFT, and E-2C.

PILOT AND NFO/FT COURSE STRUCTURES. The basic structure of the pilot and NFO training sequences is one of "systems within mission context". That is, systems knowledge is integrated into the sequence as the trainee is learning and performing the E-2C mission. As discussed earlier this approach involves early hands on learning in which the trainee first learns operating procedures, then practices the procedures, and finally performs the procedures in more complex situations in which decisions and integration with other systems procedures are required.

The basic sequencing of instructional blocks (lessons) is presented in Appendix A for the Pilot course and in Appendix B for the NFO/FT course. Each sequence is broken down into modules. Modules were determined on the basis of general content areas. The numbering system above each block indicates the module number (left of the decimal) and the instructional block number within the module (right of the decimal). These block number correspond with the lesson specification numbers and as they ascend provide the numerical ordering of the (existing) complete courses.

Figure 5 shows a sample segment from a pilot module. On the top of each block is its designating number. Within the block are the block (lesson) title, training device utilized for the lesson (lower left), and the nominal time, in hours, required for lesson completion. Those instructional blocks which are grouped on the lower line within a module can be interchanged (i.e., lesson content does not dictate a strict ordering). The blocks on the upper line within a module, however, should be presented to trainees in the specified order since the effectiveness of trainee learning of subsequent lessons is based upon associations mode with the content of previous lessons. For example, in Figure 5, Block 11.1 should precede Blocks 11.2 and 11.3; however, Block 11.3 can precede Block 11.2 if necessary. Such a change in ordering might be necessary if all Hydraulic Subsystems 1 audio/visual materials are in use, but Hydraulic Subsystem 2 materials are available. Finally, the presentation of Block 11.4 must be preceded by the presentation of Blocks 11.1, 11.2, and 11.3.

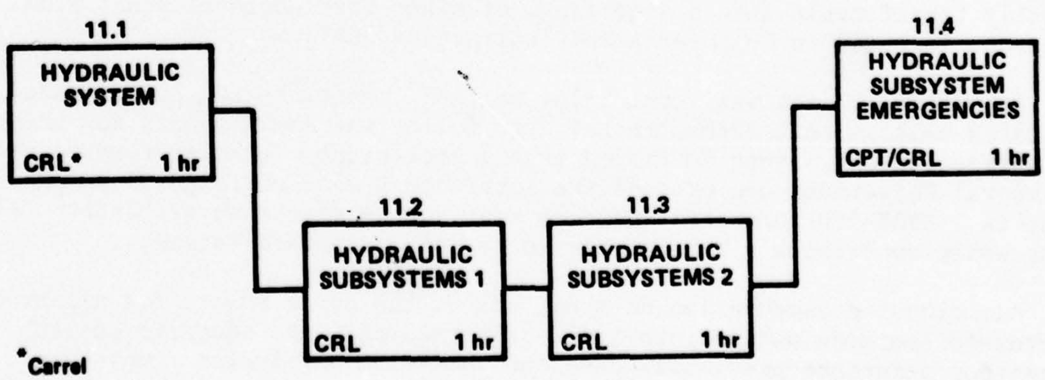


Figure 5. Sample Instructional Block Sequence

In the pilot training instructional block sequence in Appendix A, E-2C training sorties are numbered as module 19, but are not shown as a separate module. Rather the sorties are interspersed within the other modules and are designated by a dashed-line block.

LESSON SPECIFICATION FORMAT. Lesson specifications for the E-2C curriculum have been designed to support three basic types of instruction--cognitive, practice, and sortie (pilot)/scenario (NFO/FT). Each lesson is represented by a cover sheet (see Figure 6) consisting of (1) a numerical and, when useful, a descriptive designation of the module and lesson, (2) a listing of training objectives (developed from the behavioral objectives and supporting systems information), (3) an estimate of the average time (including testing) for the trainee to achieve the criterion indicated, (4) the lesson(s) immediately prerequisite, (5) additional references pertinent to the content presented, and (6) the training device(s) in which the instruction is to take place. Cover sheets for the cognitive, practice, and sortie/scenario lessons differ only in the statement of the learning objectives. Cognitive lesson cover sheets state that the trainee will perform to a criterion of 100% (after remediation, if necessary) on a multiple choice test assessing knowledge of the objectives covered. Practice and sortie lesson cover sheets state that upon completion of the lesson, the trainee will perform the specified behaviors within the indicated limits. Corresponding behavioral objectives (with performance limits) are then referenced as appropriate. Cover sheets for the scenarios contain a descriptive paragraph in lieu of a formal listing of training objectives.

The "Sequence of Instruction" follows the cover sheet for all cognitive lessons which are designed to be developed into sound-slide presentations. This form presents a content outline which is segmented into "teaching points" (analogous to enabling objectives) for development into narrative presentations with supporting visuals. A description of the visual (slide) presentation is given beside each teaching point. Indentations are used to indicate the hierarchical relationship of the teaching points within lesson segments and within broader context areas. One additional format strategy has involved the use of "bullets" to indicate specific notes for inclusion in the narrative presentation. Although this format is cast in terms of a sound-slide presentation, it is directly transferable into a wide range of other instructional modes from classroom lectures to Computer Aided Instruction (CAI).

Behavioral Objectives, containing initial conditions and performance limits as well as task element behaviors, follow the cover sheets for practice and sortie lessons. When developed into a convenient checklist format, these Behavioral Objectives can provide the instructors with useful evaluation criteria. RVAW-120 personnel indicate that such performance evaluation checklists would contribute significantly to training standardization.

Additional documentation does not follow the cover sheets for classroom (lecture/discussion medium), text (outside reading), and scenario lessons since they reference previously developed RVAW-120 curriculum components determined to be appropriate in their present form. In many cases, formal instructor guides are already available for these lessons. Figure 7 illustrates the format of "Sequence of Instruction."

E-2C LESSON SPECIFICATION

18.1

MODULE: Carrier Qualifications

LESSON: Carrier Maneuvers/Qualifications

TYPE: Cognitive

TRAINING OBJECTIVE(S):

Upon completion of this lesson, the trainee will perform to a criterion of 100% on a multiple choice test assessing knowledge of the following:

Preparation for catapult launch
Catapult launch
Case I recovery
Case II recovery
Case III recovery
Waveoff/bolter
Touch and go (carrier)
Carrier qualifications

TIME: 2 hr.

PREREQUISITE LESSONS:

Module XVII (FCLP)

ADDITIONAL REFERENCE MATERIALS:

NAVAIR 01-E2AAA-1

TRAINING DEVICE(S):

Carrel

Figure 6. Example of Cognitive Lesson Cover Sheet.

SEQUENCE OF INSTRUCTION

TEACHING POINTS	MEDIA SUPPORT
Initiate penetration at expected approach time on marshall radial inbound. • Penetrate at 250 KIAS and 4000 fpm descent. • Descent will approach 6000 fpm during initiation and will decrease • Torque Hp will be about 700 Hp.	Pictures of airspeed indicator and vertical velocity indicator
Reduce rate of descent to 2000 fpm at 5000 ft. • Torque Hp will be about 1200 Hp. • Maintain 250 KIAS. • Call marshall or CCA, "Platform."	Picture of altimeter and vertical velocity indicator. Diagram of typical approach with platform parameters indicated.
Turn toward final approach bearing if marshall radial and final approach bearing are different. • Make 30° turn if difference is 10° or more; otherwise make smaller turn. • Initiate turn when 20 miles from carrier.	Diagram of approach with difference between marshall radial and final approach bearing with insert of BDHI distance window showing 20 miles.
Track along 12-mile arc if final approach bearing not intercepted when aircraft 12 miles from carrier.	Same as above with 12-mile arc indicated and insert of BDHI distrance window showing 12 miles.
Level off at 1200 ft. • Maintain 250 KIAS. • Torque Hp will be about 2500 Hp.	Diagram of approach with level off parameter indicated and insert of altimeter showing 1200 ft.
Call marshall or CCA when 10 miles from carrier.	Diagram of approach with 10 miles indicated and insert of BDHI distance window showing 10 miles.

Figure 7. Portion of a Sequence of Instruction for Carrier Qualification Lesson.

TESTING

Individual performance evaluation has been addressed as a key component in the contractor's E-2C training program. Accordingly, a testing procedure has been devised which directly corresponds to the instructional strategy of cognitive, practice, and sortie/scenario lessons. The cognitive testing has been designed to provide diagnostic information, as well as criterion assurance. A preliminary data bank for test item development (see Appendix E for examples) has been composed for the purpose of ultimately evaluating each training objective in the cognitive domain. Likewise, the behavioral objectives provide evaluation criteria which can be formulated into pocket checklists for the instructors to use while assessing student performance in practice and sortie/scenario sessions.

Appendices B and D provide summaries of the above described testing strategy, with its emphasis on behavioral objectives. Appendix D presents each of the behavioral objectives for the NFO/FT training course and indicates the number of the lesson in which it is taught and subsequently assessed. This assessment is categorized by cognitive, practice, and scenario type lessons. "Initial" and "Final" columns in the latter two categories further trace the process from the assessment of a trainee's first experience in performing a behavioral objective to his final performance within a scenario.

Appendix B presents corresponding information for the pilot training course, but in a slightly different format. While the behavioral objectives listing and the cognitive assessment column have remained in the same format, the remaining three columns are devoted to "CPT Practice," "OFT Sortie," and "E-2C Sortie" lesson types. For ease of interpretation, these categories have been coded to correspond to lessons by device. Accordingly, the trainee's instruction and assessment within a particular device can be easily traced throughout the program. While the original behavioral objective listing, derived from the task analysis, forms the basis for this table, additional objectives, which have emerged as essential to a comprehensive pilot training curriculum, have also been included.

Viewing the cognitive testing procedure from the students' perspective, the process is as follows:

a. The student proceeds at his own pace in learning the information presented in a sound-slide lesson.

b. When the student is satisfied that he has mastered the objectives covered, he checks out a form of the corresponding cognitive test (either on slides or printed page).

c. The student then attempts to answer a series of multiple choice questions by selecting the correct response on a self-scoring answer sheet.

d. As the student marks the chemically treated coating of the answer sheet, he is given immediate feedback.

e. If he chooses an incorrect alternative, he continues to respond until correct.

f. The student reviews his errors and the corresponding instructional material.

g. Finally, he consults with the learning center supervisor who prescribes remediation and/or tutors him until he reaches the criterion performance level.

The above described testing procedure is augmented by two additional strategies. The first of these startegies involves pre-testing. While the relative homogeneity of trainees in terms of incoming skills and knowledges characterizing the current E-2C pipeline has not justified the development of multiple instructional tracks, some allowance for individual differences is essential. To meet this need, the proposed testing stragegy relies upon the well established individualized instructional concept of pre-testing. Accordingly, alternate forms of each end-of-lesson cognitive test will be developed. Trainees will thus have the opportunity to "test out" of any cognitive lesson consisting of previously mastered objectives. If the trainee reaches the 100% criterion within a specified number of errors, he may then proceed to the next lesson for either pre-testing or instruction. If the trainee fails to meet the 100% criterion within a specified number of errors, he must proceed through the corresponding cognitive lesson and its post-test. Within this strategy, it is recommended that the Learning Center Supervisor permit the pre-testing option on an individual basis only when a high probability of success is predicted. Thus, the trainee can be guided in the optimum use of his learning time and be prevented from using the pre-test as a short-cut study aid. When used in this manner for cognitive testing (and similarly by the instructor for practice testing), the pre-test strategy can result in significant time savings and motivation without a sacrifice in quality assurance.

The second additional strategy in the cognitive evaluation scheme involves an adaptive testing procedure. Its purpose, as is that of the pre-test, is in time-savings. To accomplish this, it has been determined that sampling techniques can be employed. By administering test items for each training objective to a large sample of trainees during the validation process, the best discriminators can be identified. These items will then be used in the construction of a short form of each lesson post-test. In actual use, the short form will always be the method of choice (except when the pre-test option is taken). The trainee will proceed through these tests using the self-scoring answer sheets in the manner previously specified. If he reaches the 100% criterion within a specified number of errors (to be determined during the test validation phase), he will proceed to the next lesson. If not, the Learning Center Supervisor will direct him to an alternate form of the test, containing items evaluating all the learning objectives. This will result in a more comprehensive diagnostic assessment to assist the Learning Center Supervisor in remediating the trainee. One further advantage inherent in this adaptive testing strategy is an increase in the reliability of the trainee's score.

SECTION IV

COST ANALYSIS

At the request of the Sponsor, an estimate has been made of the breakdown of Contractor and Navy man-hours spent on each task of the program. The contractor labor is summarized (Table 3) for Professional hours and for Administrative and Support hours.

The tasks of the study were:

a. Planning. This included the program plan development, a kick-off meeting, and recurring planning effort throughout the program.

b. Task 1: Perform Task Analysis. This first formal task resulted in the preparation of the Task Listing documents, including an extended TDY for a contractor analyst to attend an NFO Transition Course and other conferences between contractor and RVAW-120 personnel.

c. Task 2: Identification of Training Objectives. This task was directed at the preparation of Behavioral Objectives from the task analysis data base.

d. Task 3: Development of Instructional Objectives. This final task has as its goal:

(1) The specification of methods and media (the latter based on current and projected availability);

(2) The allocation of training objectives to lessons; and

(3) The preparation of lesson specifications.

Words of caution are in order before proceeding to the data. First, Task 1 is confounded by the attendance of a contractor analyst at the seven-week NFO course. Navy subject-matter-expert hours can not be reasonably estimated for that task. Second, the tasks are cumulative in a manner that makes their distinction difficult. One cannot state that the preparation of behavioral objectives takes x-many man-hours, since the information that they contain was generated during the educational process of performing the task analysis. That is to say, if a task analysis were handed to a training analyst for the first time, it would not take them x hours to complete the behavioral objectives. It would require a considerable number of additional hours for the analyst to "learn" the task analysis to the point where a sensitivity is developed to the complexities and interactions of the E-2C "job." An analogous discussion holds for the preparation of lesson specifications. The labor distribution is likely to vary widely from one SAT study to another, depending on such factors as prior availability of data, subject-matter-expert availability from the user and within the contractor's team, requirements for computer-based modeling of resource life-cycle costs and availability, quantity and quality of an existing training curriculum and supporting equipment, and so forth.

TABLE 3. MANPOWER DISTRIBUTION

	Report Delivery	Professional Man-Hours Contractor	Navy	Administrative and Support Man-Hours	Totals
	start date 24 April 1975				
Planning	24 May	224		204	428
Task 1					
Task Analysis					
Pilot	24 Sept.	603	40	250	893
NFO/FT	31 Oct.	1137	*	447	1584
Task 2					
Training Objectives					
Pilot 24	24 Nov.	603	10	130	743
NFO/FT	24 Nov.	362	9	202	572
Task 3					
Instructional Objectives **					
Pilot	24 May	1157	10	315	1482
NFO/FT	24 May	2495	18	361	2874
Totals		6581 m-h	86 m-h †	1909 m-h	8576 m-h

* Plus time while a Contractor Analyst attended the NFO Transition Course

** Figures projected to the end of program.

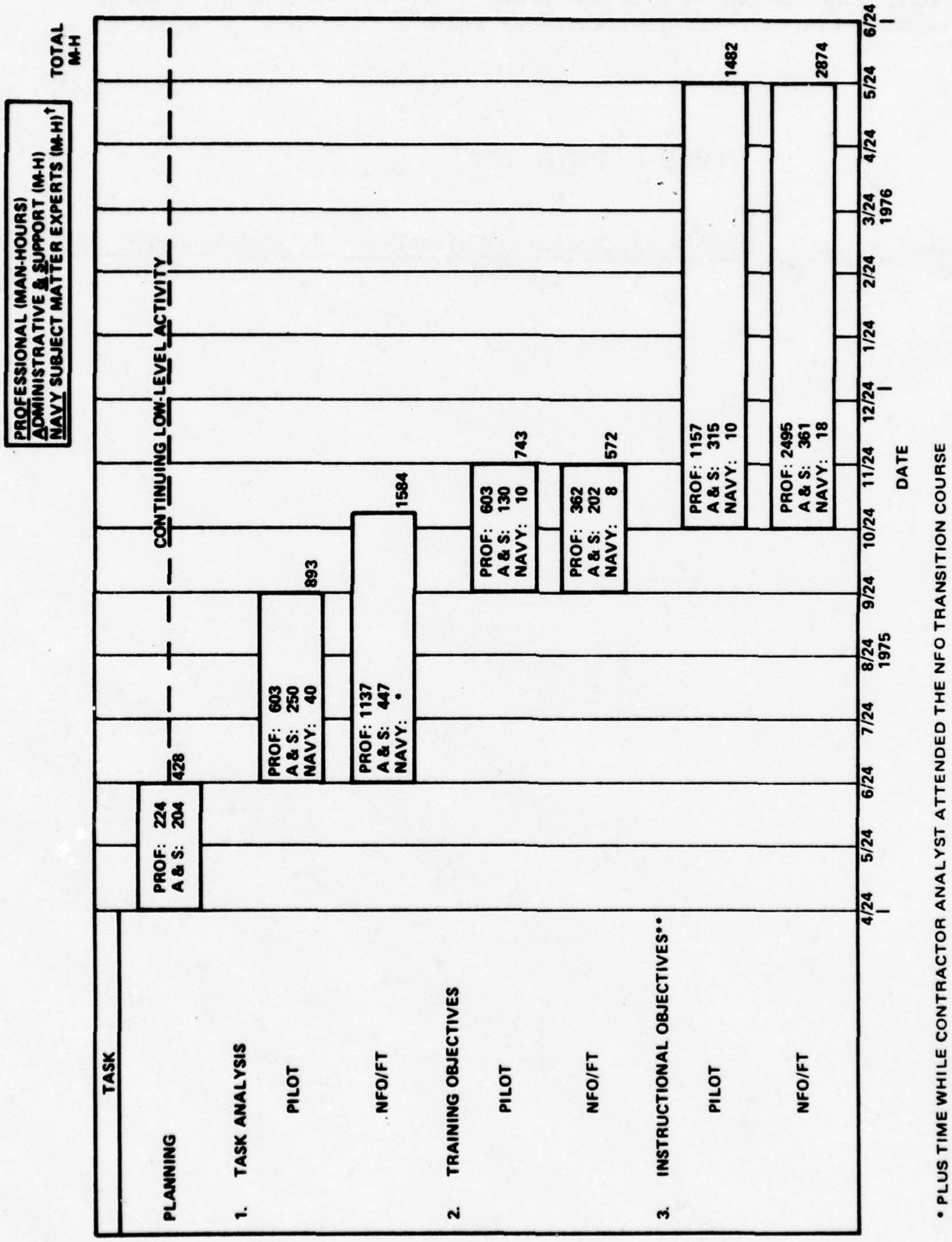
† Consultation time, not including independent review of supporting documentation (duration not determinable).

Figure 8 shows, in addition, the approximate intervals during which these tasks were performed.

The only other major cost to the program was travel. Table 4 shows the approximate travel costs (no labor) by task.

TABLE 4. TRAVEL COSTS

Task	Planning	1. Task Analysis	2. Training Objectives	3. Instructional Objectives
Cost	$700	$3700	$1200	$1500



* PLUS TIME WHILE CONTRACTOR ANALYST ATTENDED THE NFO TRANSITION COURSE

** FIGURES PROJECTED TO THE END OF PROGRAM

† CONSULTATION TIME, NOT INCLUDING INDEPENDENT REVIEW OF SUPPORTING DOCUMENTATION (DURATION NOT DETERMINABLE).

Figure 8 MANPOWER DISTRIBUTION

SECTION V

CONCLUSIONS

This program encompasses just the first few of the several steps that lead to the implementation of a SAT-derived training program (cf. Section I). Even after implementation (in Phase II) a continual quality control program must be maintained to ensure the validity of the syllabus and the cost-effectiveness of the instructional system. There are, therefore, no results of this program from which conclusions, per se, can be drawn. There are, however, hypotheses that have been generated; those which describe the proposed E-2C crew training system, those which describe the lesson content, and so forth. These hypotheses (documented in the body of this report and in the other deliverables of this contract) will be "tested" in Phase II and updated in the out-years.

It is possible to discuss as conclusions the proposed utilization of resources that are hypothesized in the proposed instructional system in contrast to the current training syllabus. What is most important in such a comparison is the change in emphasis which is indicated. The following tables show the comparisons of training device utilization for the Pilot course and the NFO course, respectively. These data are derived from the course structures contained in Appendices A and C.

TABLE 5. E-2C PILOT CURRICULUM ESTIMATED DEVICE UTILIZATION

(HOURS)

DEVICE [1]	CURRENT	PROPOSED
CARREL	-	48.5
CLASSROOM	128	28.5
CPT /CARREL	-	19
CPT	13	9
OFT	-	32
E-2C	61	38
	202	175

[1] CPT = Cockpit Procedures Trainer
OFT = Operational Flight Trainer

TABLE 6. E-2C NFO CURRICULUM ESTIMATED DEVICE UTILIZATION

DEVICE	(HOURS) CURRENT	PROPOSED
CARREL	-	126
CLASSROOM	273	62.5
TACTICS TRAINER / ISMT	7	7
TACTICS TRAINER	107	127.5
E-2C	23	11
	410	334
REQUIRED READING	80	80

It may be noted that the emphasis (relative proportion of time spent) has shifted towards hands-on-training and toward increased usage of synthetic training (i.e., simulators rather than aircraft). Once again it is vital to point out that these figures are subject to the validation process (Phase II and beyond). If the training objectives are not met, or if they are not responsive to the mission objectives, then the components of the instructional system must be re-examined to rectify the discrepencies.

Because programs of this type are relatively new and much literature is being propagated regarding the best procedures for their conduct, a comment on the methodology used here is in order. The contractor's approach is to create a team of training experts, including among them a significant amount of subject matter expertise. Working as closely as possible with the user's experts, a progression along a continuum of analysts' education (via the task analysis) and a training analysis provides the final output. A variety of techniques are considered, including computerized task analyses and economic modeling, but only those that are warranted are employed. This approach allows the greatest flexibility in meeting and dealing with unexpected problems and provides a certain amount of "robustness" with regard to the availability and scheduling problems of the user subject-matter-experts. It was successfully employed in a previous SAT study for the US Air Force[8] and, in its adopted form, has served equally well in this E-2C SAT study.

As alluded to in the previous paragraph, SAT is a continuum of activity, not a series of discrete steps. As an examination of the deliverables for this contract will show, each output incorporates the information of the prior outputs. The level of effort put into each output (especially the task analysis) should be adjusted to eliminate unnecessary detail, but should ensure that the documentation of the processes is available for future users to educate themselves in a minimum time. The contractor would not take the position that what was done for this contract is appropriate for all such efforts, but would encourage SAT analysts to start with an examination of the system components (see figure 1) to ensure that the "systems approach" is used to its fullest advantage.

[8] Sugarman, R.C., Johnson, S.L., Ring, W.F.H., "B-1 Systems Approach to Training," Technical Memorandum SAT-1, Final Report, Calspan Report No. FE-5558-N-1, July 1975.

This study represents an application of the ISD/SAT methodology to an existing training system. Among the important general findings and accomplishments resulting from the program are the following:

a. ISD/SAT methodology can be implemented in a number of ways and by ISD teams of various compositions. This particular application has demonstrated that a Contractor team, having sufficient internal technical expertise in the weapon system, can carry out the methodology even if only minimum man-hours of Navy experts are available for assistance and review of outputs. In this case, Contractor personnel audited the regular academic courses while simultaneously interacting with instructors and trainees, in order to supplement existing documentation relevant to crew tasks.

b. Only a modest addition to the current training device inventory is required to satisfactorily meet the training objectives.

c. Through analysis of the assignment of training objectives to training media, the ground-based training has been optimized, with a concurrent reduction in airborne training.

d. Alternate training devices and scheduling options have been identified which can be exercised in the event that the nominal trainee flow is exceeded (before major new procurements are required).

e. The learning efficiency has been enhanced through the individualization of instruction and the integration of skills acquisition with academics.

f. Testing techniques are recommended which provide useful feedback to the instructors to facilitate their management of trainee progress, and to provide the necessary data for the quality control program. These techniques provide many of the benefits of computer-aided-instruction (CAI) but without the budget commitments demanded by CAI which are not warranted for the low E-2B trainee flow.

g. An E-2C training program is recommended that meets rigorously documented training requirements at least costs, and which, after implementation and evaluation, can be smoothly transitioned to the Training Squadron for course operation and maintenance.

SECTION VI

RECOMMENDATIONS

This effort is to be followed by a second phase which has as its product the production, implementation, and evaluation of the E-2C training course proposed herein. Most of the recommendations are, therefore, geared to the effort to come.

Although every opportunity was taken to have the working data (e.g., task analysis, behavioral objectives) and outputs (lesson sequences) reviewed by RVAW-120 instructor personnel, it becomes even more imperative to have sufficient consultation from the users during Phase II. This is for two reasons. First, the content of the lessons and tests must be valid. Second, the users must feel that this is their program, one that they helped bring about, so that the effort will be made in the out-years to maintain the quality control program. It is, therefore, recommended that:

a. A commitment be made by RVAW-120 to supply the necessary man-months of expert pilot and NFO consultation;

b. RVAW-120 consulting personnel be available to vist the contractor for review of preliminary storyboards and related materials (which cannot be easily transported to NAS Norfolk);

c. RVAW-120 consulting personnel sign-off on all material reviewed, but with a turn-around time sufficiently short as to not impede the program; and

d. In addition to involving the Training Officer and heads of the Pilot and NFO/FT training, the program should bring about interaction with the NATOPS examiners in those areas which impact on testing and evaluation.

As noted in the previous section, the contractor's approach has been to rely on a minimum of Navy Subject Matter Expert (SME) assistance during Phase I by creating a team which is capable of technical understanding of the E-2C operations. It is felt that this approach is particularly beneficial when the following conditions exist:

a. Navy SMEs cannot be dedicated full-time to the program;

b. A high turn-over rate exists for Navy SMEs; and,

c. If for these or other reasons, inordinate contract resources are required to train Navy SMEs to carry out SAT functions.

It is possible, however, to meaningfully integrate SMEs into a SAT analysis in the absence of those conditions. In fact, one of the contractor's senior SAT analysts, first joined the team during a prior program in the role of a SME, but since then has become proficient in the decision making aspects of many of the SAT processes. It should be understood, for the purposes of future programs, that, in addition to contractor (in-house) expertise, there are two types of Navy SMEs and several possible roles depending on the type. The first type of SME comes from the operational personnel who do not have instructional experience. The second type, the most useful SME, comes from the instructor personnel. Not only is he thoroughly proficient in the operation of the aircraft (enough to teach it to others!), but he also has a vested interest in the structure of the training course and an understanding of the course content from a pedagological point of view. This second type of SME, after completion of an instructor's training course, should be fully capable of maintaining and revising, as needed, the results of a SAT study.

The first type of SME can be used in such processes as:

a. conducting a task analysis;

b. developing behavioral objectives;

c. defining many of the "external influences" (i.e., incoming skills and knowledges, operational policy and requirements, resource availability, etc.).

The second type of SME (the instructor), in addition, can:

d. assist in the development of lesson specifications;

e. assist in the preparation of test items and performance measures;

f. assist in the collection of validation data;

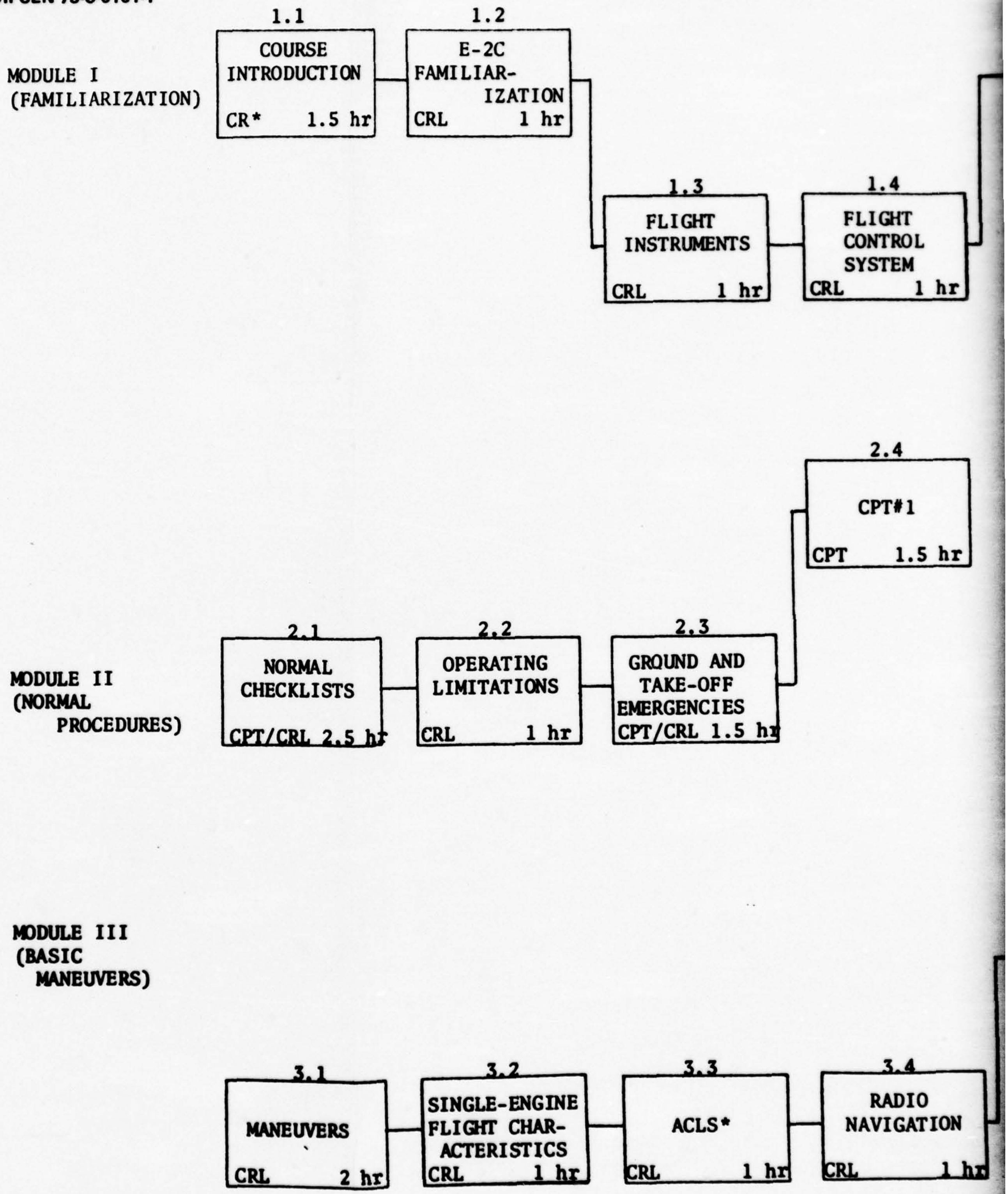
g. implement the recommended training course.

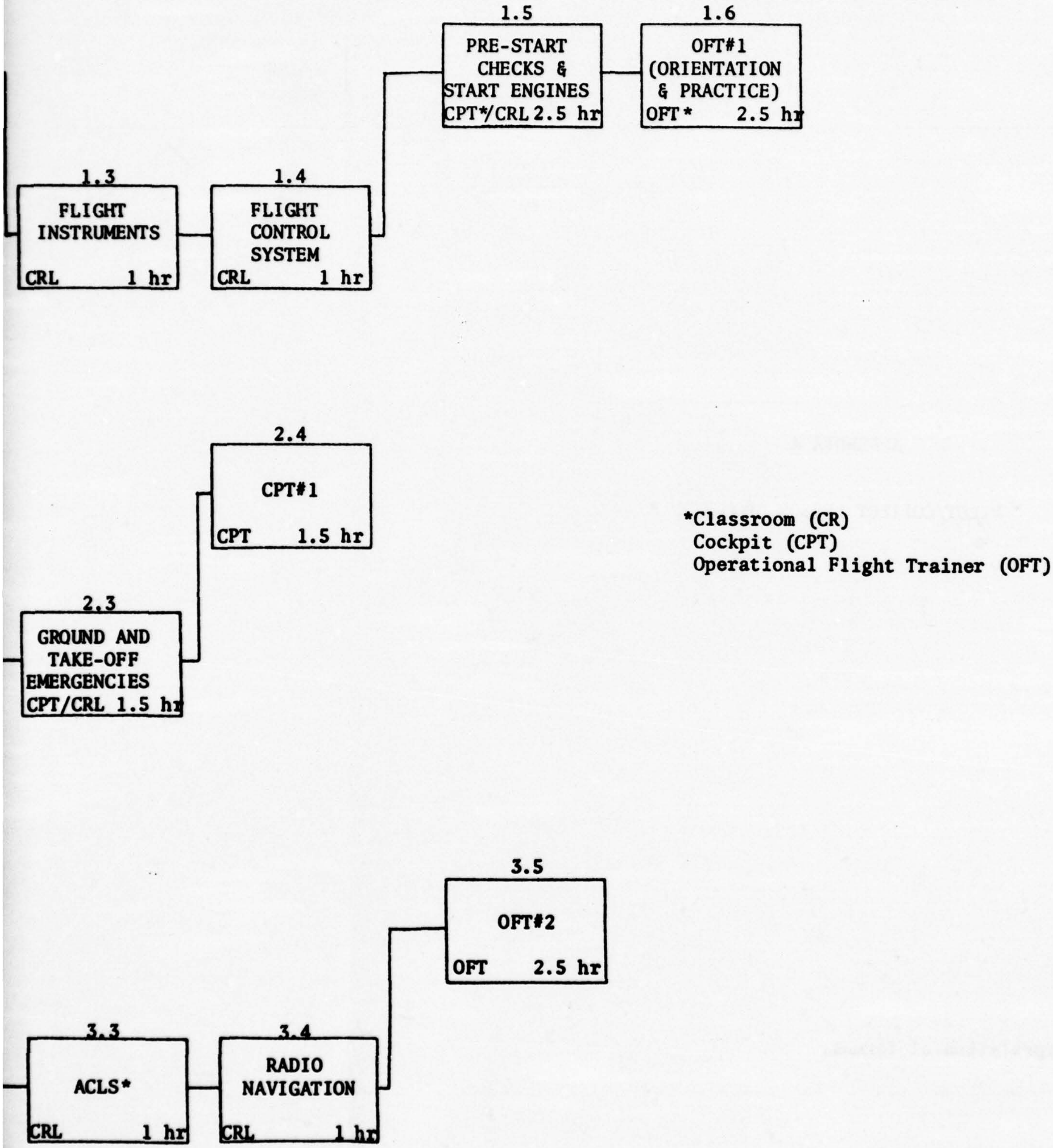
In either case, the man-hour contributions that can be made by SMEs is significantly greater in Phase I activities than in Phase II activities, although it is in the latter that a more significant role is played in user acceptance of the SAT product.

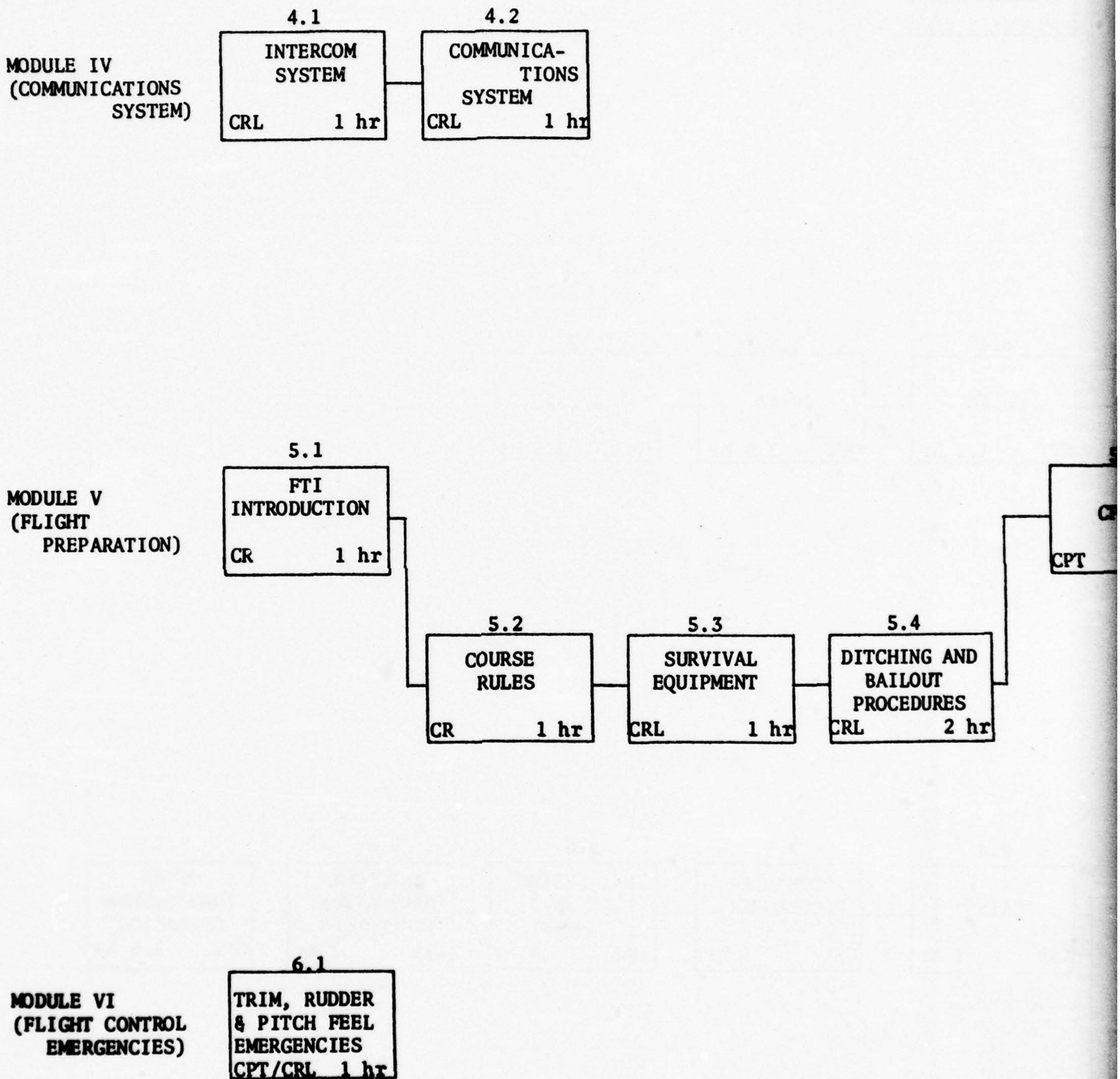
APPENDIX A

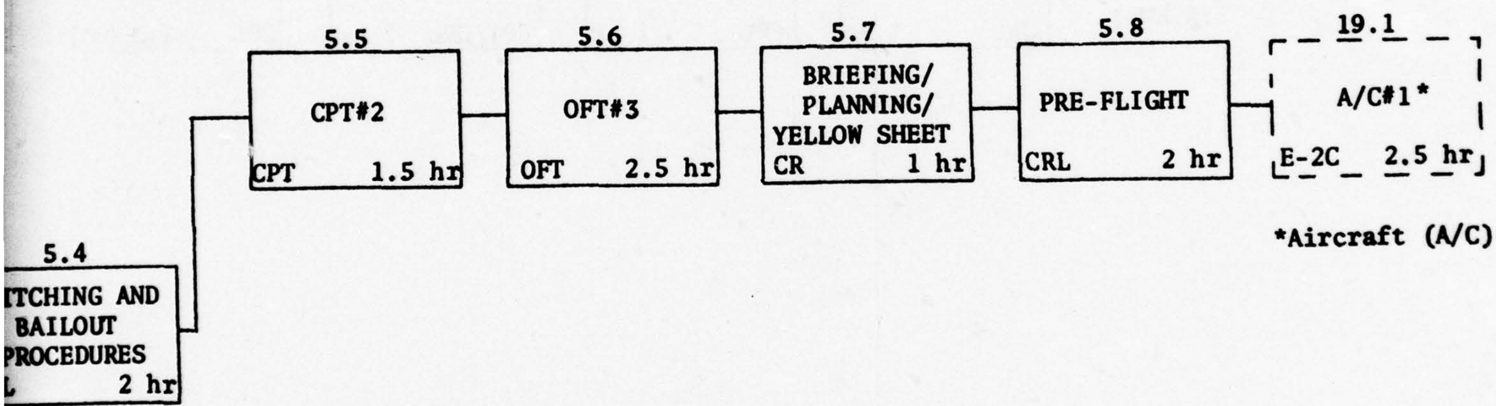
PILOT/COPILOT LESSON SEQUENCE *

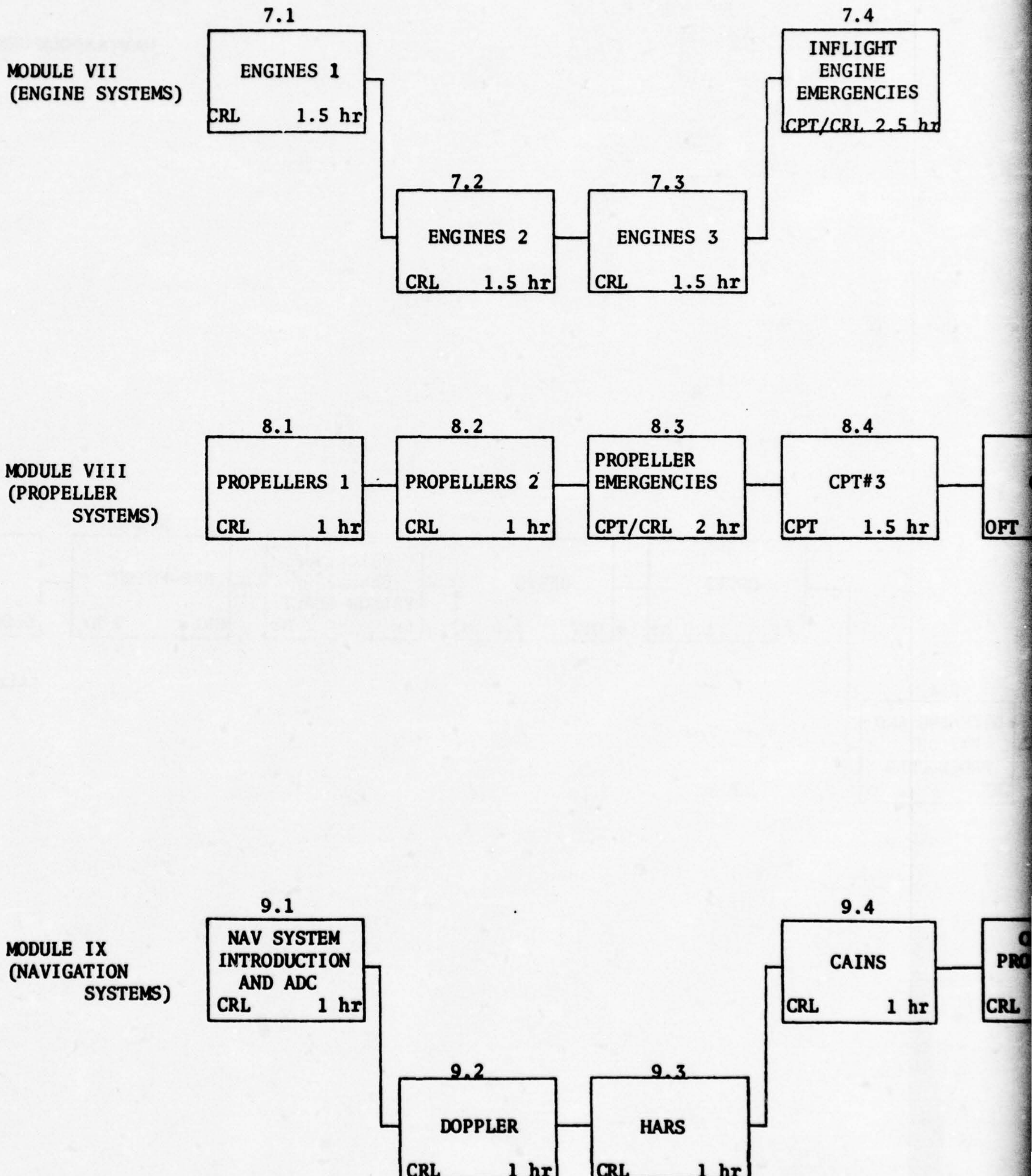
* See p. 42 for interpretation of format.

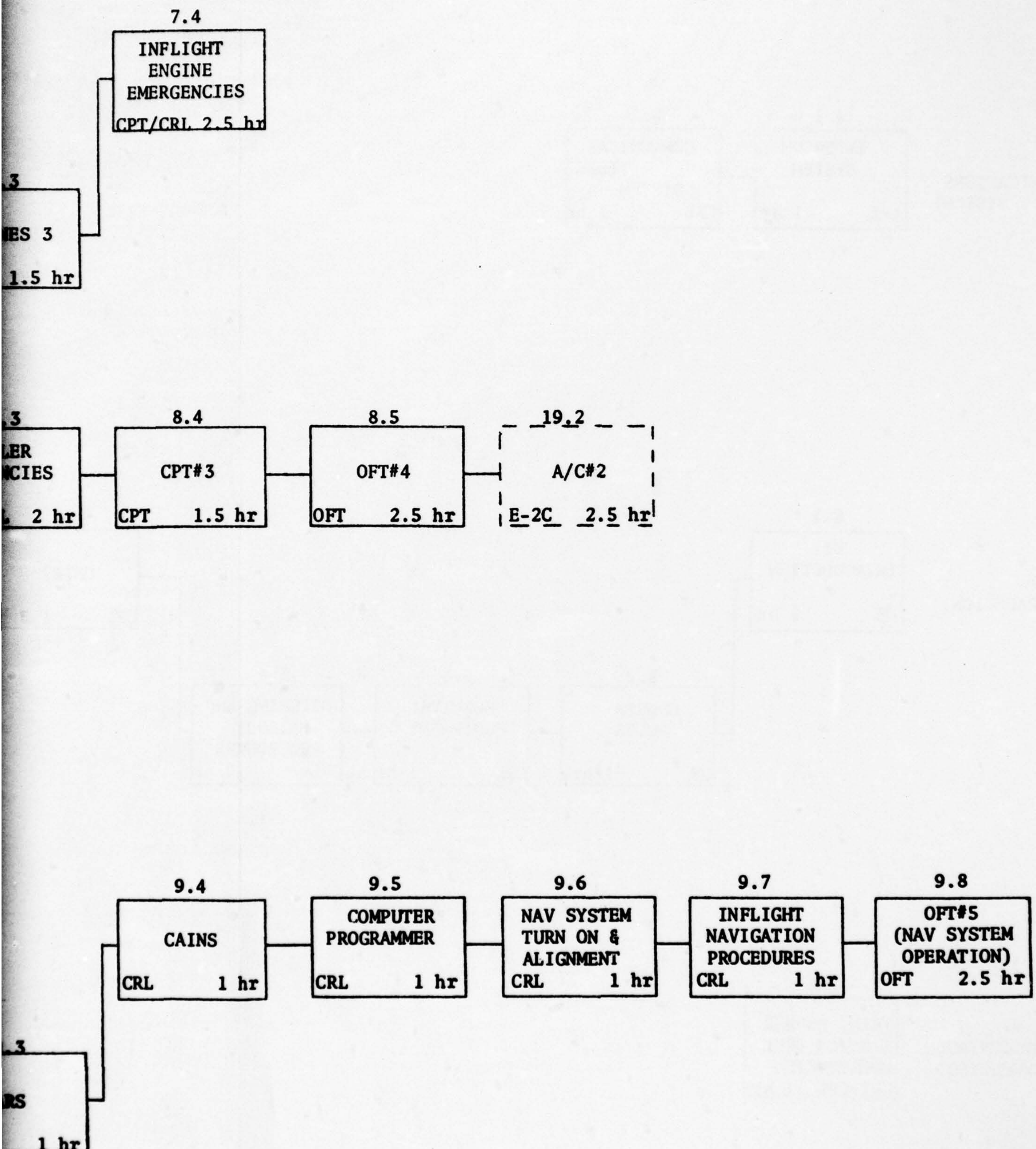

MODULE I
(FAMILIARIZATION)
1.1
COURSE INTRODUCTION
CR* 1.5 hr
1.2
E-2C FAMILIAR-IZATION
CRL 1 hr
1.3
FLIGHT INSTRUMENTS
CRL 1 hr
1.4
FLIGHT CONTROL SYSTEM
CRL 1 hr
MODULE II
(NORMAL PROCEDURES)
2.1
NORMAL CHECKLISTS
CPT/CRL 2.5 hr
2.2
OPERATING LIMITATIONS
CRL 1 hr
2.3
GROUND AND TAKE-OFF EMERGENCIES
CPT/CRL 1.5 hr
2.4
CPT#1
CPT 1.5 hr
MODULE III
(BASIC MANEUVERS)
3.1
MANEUVERS
CRL 2 hr
3.2
SINGLE-ENGINE FLIGHT CHAR-ACTERISTICS
CRL 1 hr
3.3
ACLS*
CRL 1 hr
3.4
RADIO NAVIGATION
CRL 1 hr

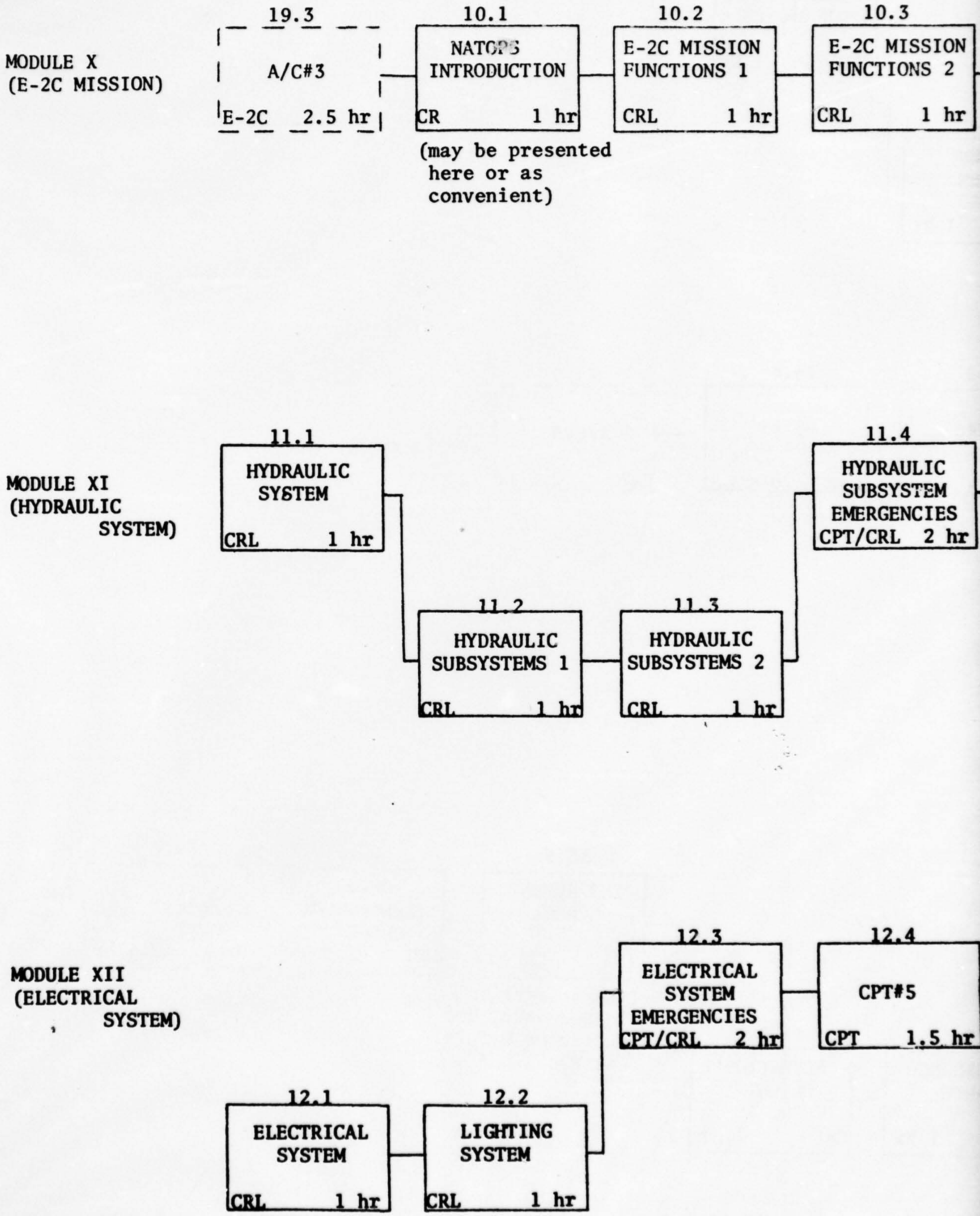

1.3
FLIGHT INSTRUMENTS
CRL 1 hr
1.4
FLIGHT CONTROL SYSTEM
CRL 1 hr
1.5
PRE-START CHECKS & START ENGINES
CPT*/CRL 2.5 hr
1.6
OFT#1 (ORIENTATION & PRACTICE)
OFT* 2.5 hr
2.3
GROUND AND TAKE-OFF EMERGENCIES
CPT/CRL 1.5 hr
2.4
CPT#1
CPT 1.5 hr
3.3
ACLS*
CRL 1 hr
3.4
RADIO NAVIGATION
CRL 1 hr
3.5
OFT#2
OFT 2.5 hr
*Classroom (CR)
Cockpit (CPT)
Operational Flight Trainer (OFT)

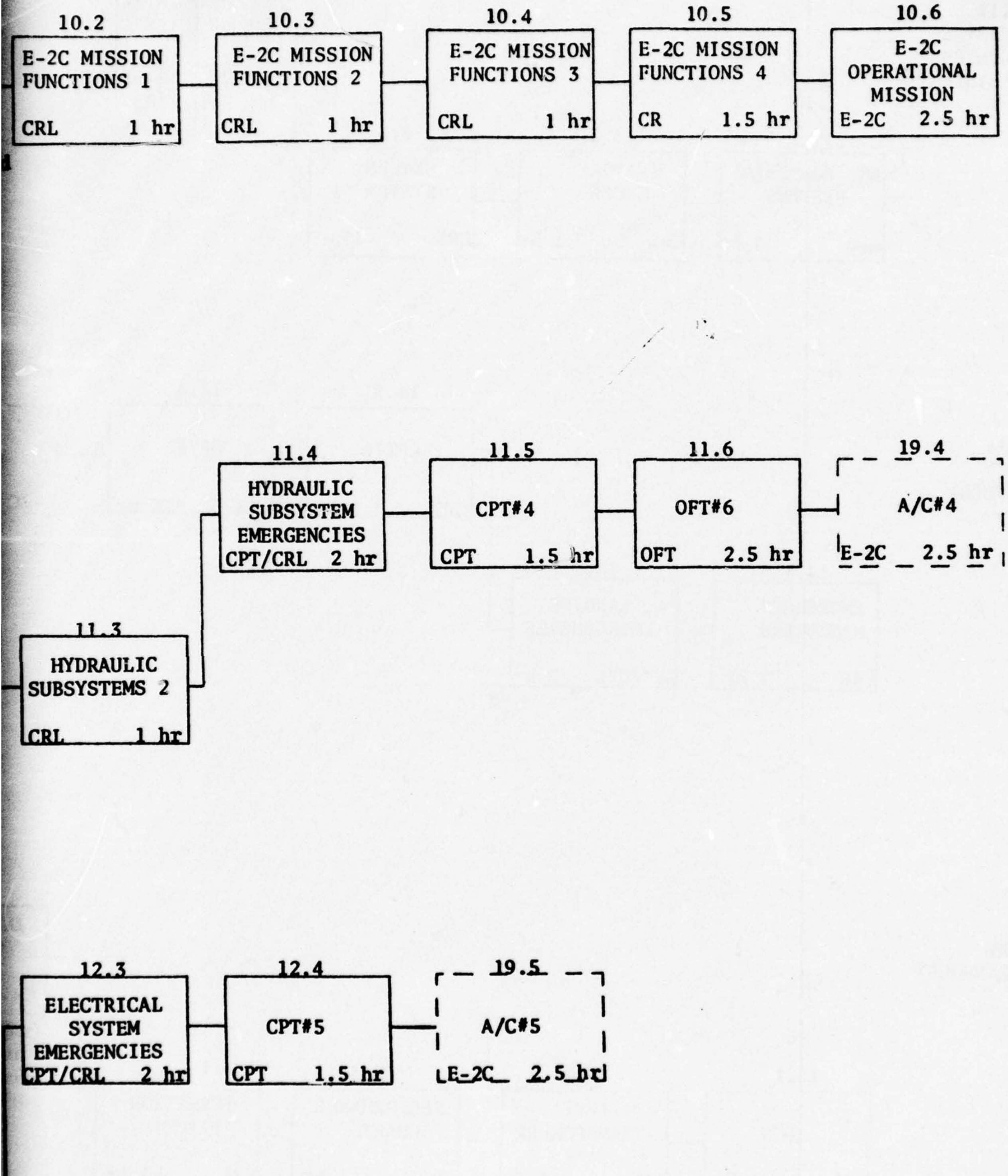

MODULE IV
(COMMUNICATIONS SYSTEM)
4.1
INTERCOM SYSTEM
CRL 1 hr
4.2
COMMUNICATIONS SYSTEM
CRL 1 hr
MODULE V
(FLIGHT PREPARATION)
5.1
FTI INTRODUCTION
CR 1 hr
5.2
COURSE RULES
CR 1 hr
5.3
SURVIVAL EQUIPMENT
CRL 1 hr
5.4
DITCHING AND BAILOUT PROCEDURES
CRL 2 hr
CPT
MODULE VI
(FLIGHT CONTROL EMERGENCIES)
6.1
TRIM, RUDDER & PITCH FEEL EMERGENCIES
CPT/CRL 1 hr

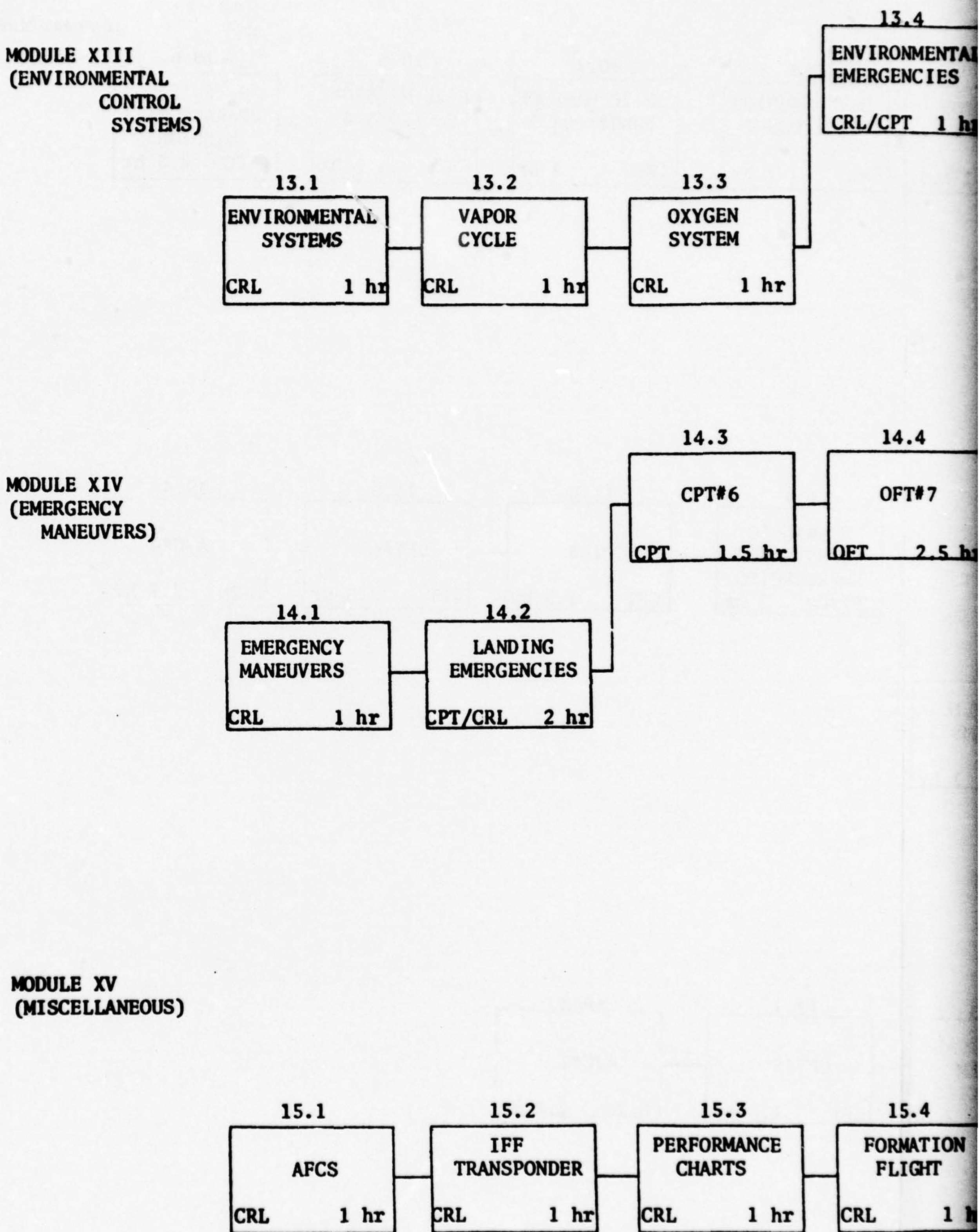

5.4
ITCHING AND BAILOUT PROCEDURES
L 2 hr
5.5
CPT#2
CPT 1.5 hr
5.6
OFT#3
OFT 2.5 hr
5.7
BRIEFING/ PLANNING/ YELLOW SHEET
CR 1 hr
5.8
PRE-FLIGHT
CRL 2 hr
19.1
A/C#1*
E-2C 2.5 hr
*Aircraft (A/C)

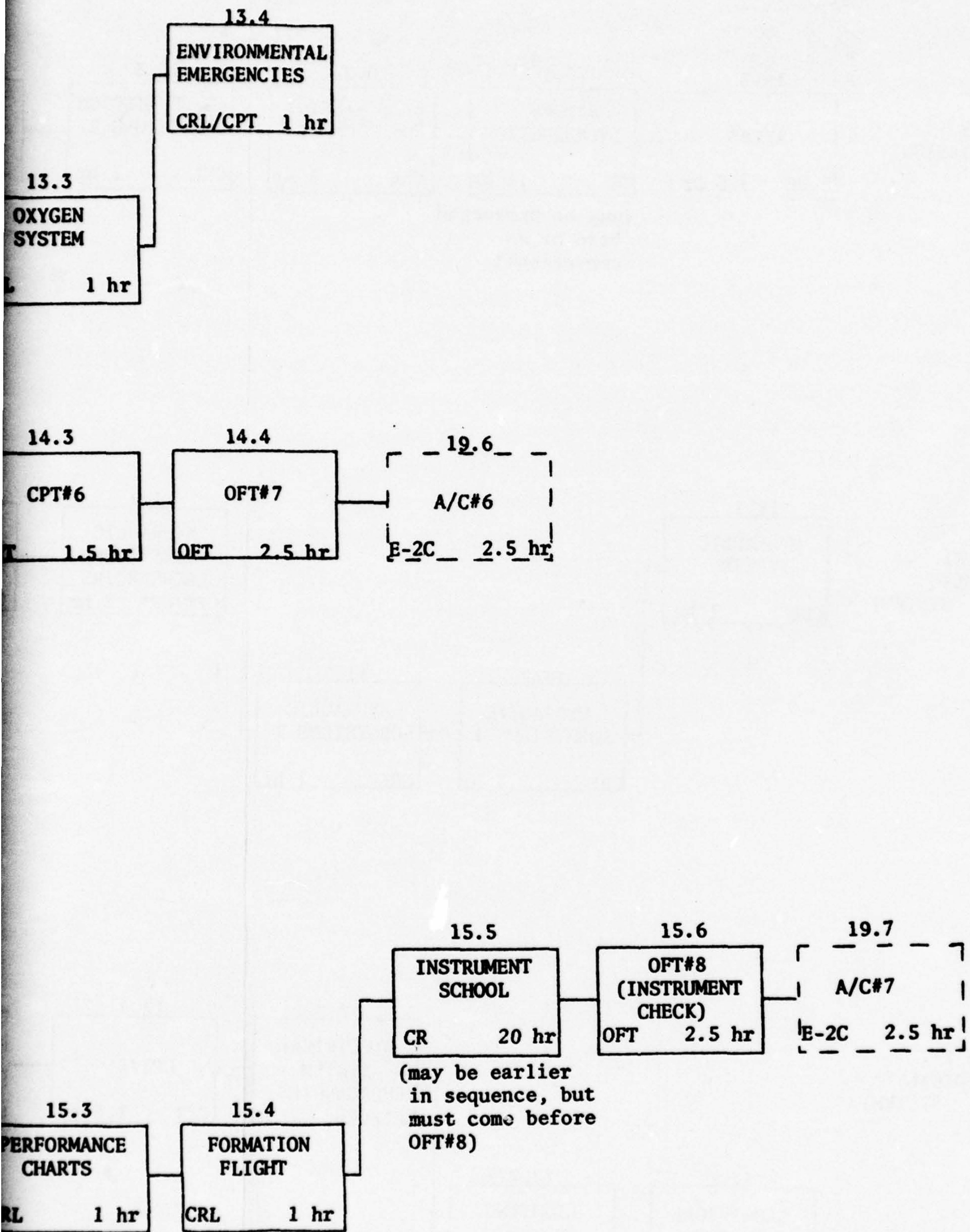

MODULE VII
(ENGINE SYSTEMS)
7.1
ENGINES 1
CRL 1.5 hr
7.2
ENGINES 2
CRL 1.5 hr
7.3
ENGINES 3
CRL 1.5 hr
7.4
INFLIGHT ENGINE EMERGENCIES
CPT/CRL 2.5 hr
MODULE VIII
(PROPELLER SYSTEMS)
8.1
PROPELLERS 1
CRL 1 hr
8.2
PROPELLERS 2
CRL 1 hr
8.3
PROPELLER EMERGENCIES
CPT/CRL 2 hr
8.4
CPT#3
CPT 1.5 hr
OFT
MODULE IX
(NAVIGATION SYSTEMS)
9.1
NAV SYSTEM INTRODUCTION AND ADC
CRL 1 hr
9.2
DOPPLER
CRL 1 hr
9.3
HARS
CRL 1 hr
9.4
CAINS
CRL 1 hr
CRL


7.4
INFLIGHT ENGINE EMERGENCIES
CPT/CRL 2.5 hr
.3
ES 3
1.5 hr
.3
LER
CIES
2 hr
8.4
CPT#3
CPT 1.5 hr
8.5
OFT#4
OFT 2.5 hr
19.2
A/C#2
E-2C 2.5 hr
9.4
CAINS
CRL 1 hr
9.5
COMPUTER PROGRAMMER
CRL 1 hr
9.6
NAV SYSTEM TURN ON & ALIGNMENT
CRL 1 hr
9.7
INFLIGHT NAVIGATION PROCEDURES
CRL 1 hr
9.8
OFT#5 (NAV SYSTEM OPERATION)
OFT 2.5 hr
.3
RS
1 hr


MODULE X
(E-2C MISSION)
19.3
A/C#3
E-2C 2.5 hr
10.1
NATOPS
INTRODUCTION
CR 1 hr
(may be presented here or as convenient)
10.2
E-2C MISSION
FUNCTIONS 1
CRL 1 hr
10.3
E-2C MISSION
FUNCTIONS 2
CRL 1 hr
MODULE XI
(HYDRAULIC SYSTEM)
11.1
HYDRAULIC
SYSTEM
CRL 1 hr
11.2
HYDRAULIC
SUBSYSTEMS 1
CRL 1 hr
11.3
HYDRAULIC
SUBSYSTEMS 2
CRL 1 hr
11.4
HYDRAULIC
SUBSYSTEM
EMERGENCIES
CPT/CRL 2 hr
MODULE XII
(ELECTRICAL SYSTEM)
12.1
ELECTRICAL
SYSTEM
CRL 1 hr
12.2
LIGHTING
SYSTEM
CRL 1 hr
12.3
ELECTRICAL
SYSTEM
EMERGENCIES
CPT/CRL 2 hr
12.4
CPT#5
CPT 1.5 hr

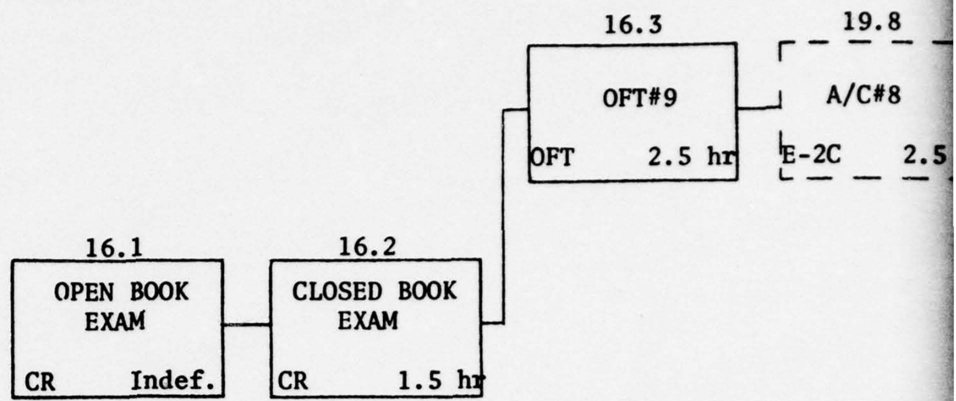

10.2
E-2C MISSION FUNCTIONS 1
CRL 1 hr
10.3
E-2C MISSION FUNCTIONS 2
CRL 1 hr
10.4
E-2C MISSION FUNCTIONS 3
CRL 1 hr
10.5
E-2C MISSION FUNCTIONS 4
CR 1.5 hr
10.6
E-2C OPERATIONAL MISSION
E-2C 2.5 hr
11.3
HYDRAULIC SUBSYSTEMS 2
CRL 1 hr
11.4
HYDRAULIC SUBSYSTEM EMERGENCIES
CPT/CRL 2 hr
11.5
CPT#4
CPT 1.5 hr
11.6
OFT#6
OFT 2.5 hr
19.4
A/C#4
E-2C 2.5 hr
12.3
ELECTRICAL SYSTEM EMERGENCIES
CPT/CRL 2 hr
12.4
CPT#5
CPT 1.5 hr
19.5
A/C#5
E-2C 2.5 hr


MODULE XIII
(ENVIRONMENTAL CONTROL SYSTEMS)
13.1
ENVIRONMENTAL SYSTEMS
CRL 1 hr
13.2
VAPOR CYCLE
CRL 1 hr
13.3
OXYGEN SYSTEM
CRL 1 hr
13.4
ENVIRONMENTAL EMERGENCIES
CRL/CPT 1 hr
MODULE XIV
(EMERGENCY MANEUVERS)
14.1
EMERGENCY MANEUVERS
CRL 1 hr
14.2
LANDING EMERGENCIES
CPT/CRL 2 hr
14.3
CPT#6
CPT 1.5 hr
14.4
OFT#7
OFT 2.5 hr
MODULE XV
(MISCELLANEOUS)
15.1
AFCS
CRL 1 hr
15.2
IFF TRANSPONDER
CRL 1 hr
15.3
PERFORMANCE CHARTS
CRL 1 hr
15.4
FORMATION FLIGHT
CRL 1 hr

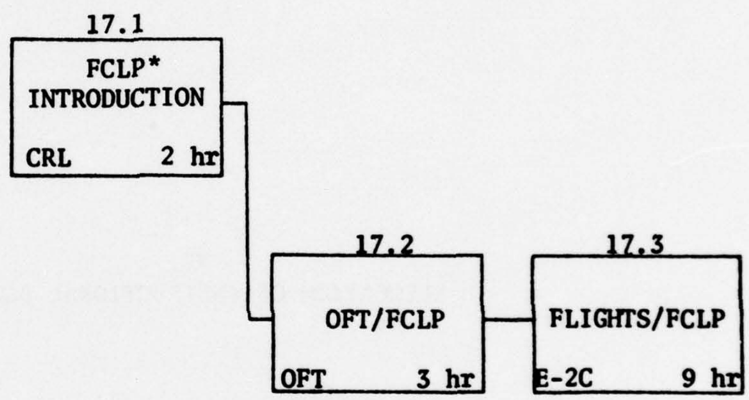


13.4
ENVIRONMENTAL EMERGENCIES
CRL/CPT 1 hr
13.3
OXYGEN SYSTEM
1 hr
14.3
CPT#6
1.5 hr
14.4
OFT#7
OFT 2.5 hr
19.6
A/C#6
E-2C 2.5 hr
15.3
PERFORMANCE CHARTS
1 hr
15.4
FORMATION FLIGHT
CRL 1 hr
15.5
INSTRUMENT SCHOOL
CR 20 hr
(may be earlier in sequence, but must come before OFT#8)
15.6
OFT#8 (INSTRUMENT CHECK)
OFT 2.5 hr
19.7
A/C#7
E-2C 2.5 hr

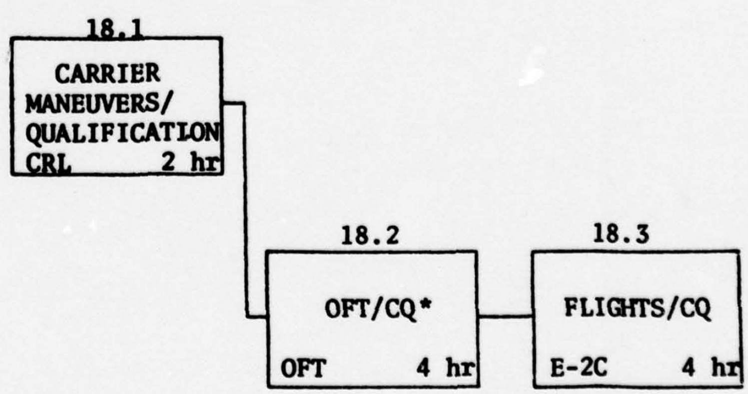
MODULE XVI
(NATOPS
EVALUATION)

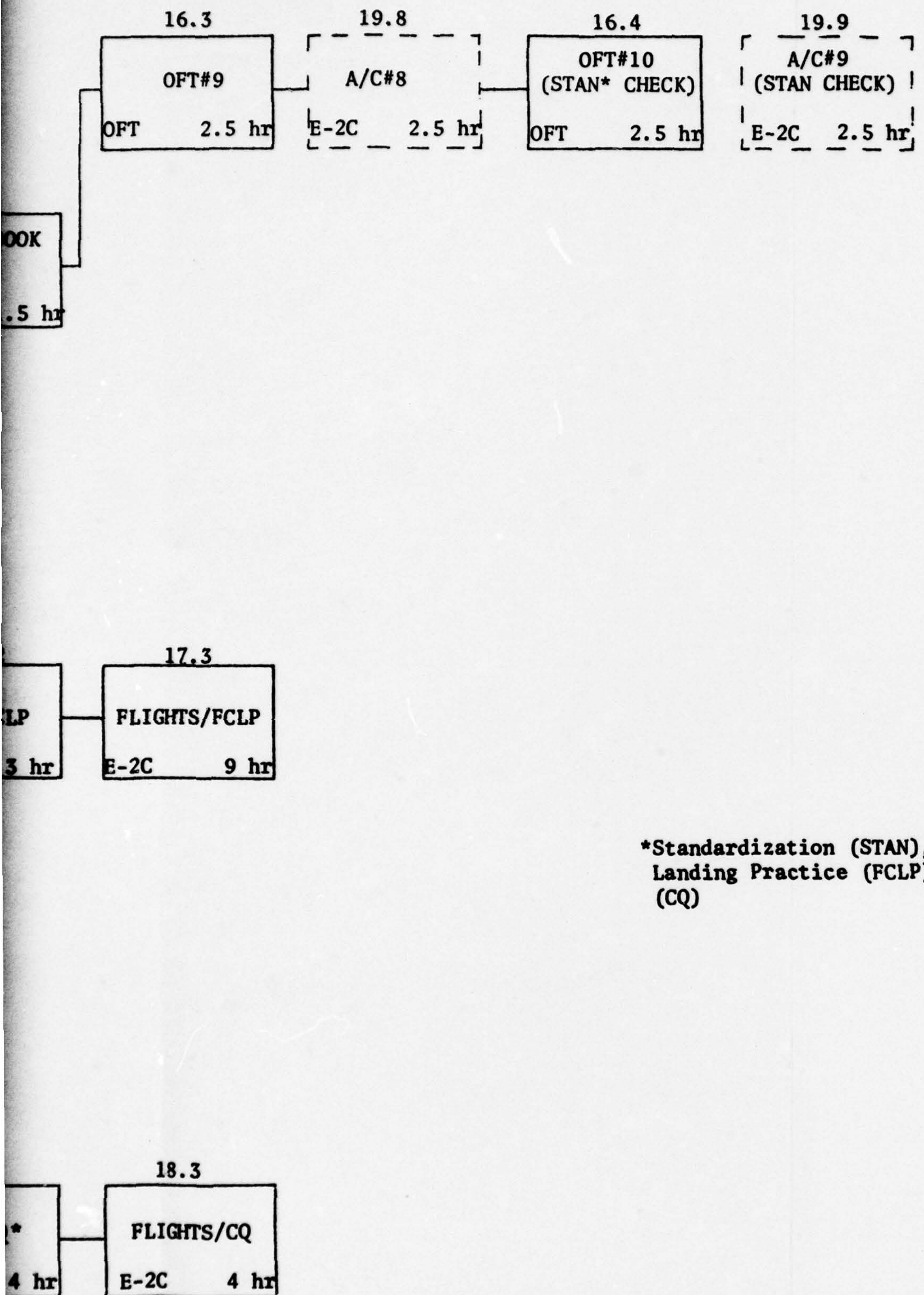


MODULE XVII
(FCLP)



MODULE XVIII
(CARRIER
QUALIFICATIONS)





*Standardization (STAN), Field Carrier Landing Practice (FCLP), Carrier Qualification (CQ)

APPENDIX B

ALLOCATION OF INSTRUCTIONAL BLOCKS TO PILOT BEHAVIORAL OBJECTIVES ACCORDING TO LESSON TYPE

This appendix provides a summary of the presentation and testing strategy employed in the pilot training program, with its emphasis on behavioral objectives. Each of the behavioral objectives is keyed to the number of the lesson/block in which it is taught and subsequently assessed. In addition, a number of behaviors which were not included in the earlier Behavioral Objective Listing, but knowledge and performance of which are essential to thorough pilot training, are included at the end of the table.

The lesson numbers entered in the cognitive column indicate when cognitive information relevant to each objective is presented and trainee knowledge is assessed. Entries in the CPT Practice, OFT Sortie, and E-2C Sortie columns denote by lesson name those lessons in which the behavioral objectives are practiced. For example, a "2" in the CPT Practice Column indicates that the behavioral objective is to be practiced in the lesson entitled CPT #2. The key at the head of the three columns identifies the instructional block/lesson number corresponding to each number entered in the practice and sortie sections of the table. In this case, CPT #2 is the title of Lesson 5.5.

Referring to the table Behavioral Objective 4.1, Shore-based CAINS Turn-on and Alignment, is presented and trainees are tested in Lesson 9.6. There is no practice in the CPT, but the objective is practiced and performance is assessed in OFT #5 (Lesson 9.8) and in E-2C #M (Operational mission, Lesson 10.4).

In addition to identifying when trainee performance on each behavioral objective is assessed, the table provides a mapping of the behavioral objectives into the pilot instructional block sequence (see Appendix A) and into the pilot lesson specifications. That is, by referring to the instructional block sequence it can be determined when in the overall scheme of the pilot course a behavioral objective is presented and performance is assessed. By referring to the lesson specifications it can be determined in what context the behavior objective is presented and performance is assessed, i.e., what other behavioral objectives are presented and/or assessed in the same lesson.

TABLE B-1 ALLOCATION OF INSTRUCTIONAL BLOCKS TO PILOT BEHAVIORAL OBJECTIVES ACCORDING TO LESSON TYPE

Key

CPT #	Lesson #	OFT #	Lesson #	E-2C #	Lesson #
1	2.4	1	1.6	1	19.1
2	5.5	2	3.5	2	19.2
3	8.4	3	5.6	3	19.3
4	11.5	4	8.5	4	19.4
5	12.4	5	9.8	5	19.5
6	14.3	6	11.6	6	19.6
		7	14.4	7	19.7
		8	15.5	8	19.8
		9	16.3	9	19.9
		FCLP	17.2	M	10.4
		CQ	18.2	FCLP	17.3
				CQ	18.3

Beh. Obj.	Title	Lesson Type: Cognitive	CPT Practice	OFT Sortie	E-2C Sortie
	PRE-FLIGHT				
1.1	COCKPIT PRE-FLIGHT	5.8			all
1.2	EXTERNAL PRE-FLIGHT	5.8			all
1.3	AFT EQUIPMENT COMPARTMENT PRE-FLIGHT	5.8			all
1.4	CIC PRE-FLIGHT	5.8			all
1.5	FORWARD EQUIPMENT COMPARTMENT PRE-FLIGHT	5.8			all
	ENGINE STARTING PROCEDURES				
2.1	PRE-START CHECKS	1.5	all	all	all
2.2	PROCEDURES BEFORE STARTING ENGINES	1.5	all	all	all
2.3	START ENGINES	1.5	all	all	all
	TAXI				
3.1	PRE-TAXI CHECKS	2.1	all	all	all
3.2	TAXI GPERATIONS	3.1			all
	NAVIGATION SYSTEM PROCEDURES				
4.1	SHORE-BASED CAINS TURN ON AND ALIGNMENT	9.6		5	M
4.2	CARRIER-BASED CAINS TURN ON AND ALIGNMENT	9.6		CQ	CQ
4.3	CAINS INFLIGHT ALIGNMENT	9.7		5	

TABLE B-1 ALLOCATION OF INSTRUCTIONAL BLOCKS TO PILOT BEHAVIORAL OBJECTIVES ACCORDING TO LESSON TYPE (Cont.)

Beh. Obj.	Title	Lesson Type: Cognitive	CPT Practice	OFT Sortie	E-2C Sortie
4.4	DATA ENTRY PROCEDURES	9.5		5	M
4.5	C-P DATA DISPLAY	9.5		5	M
	TAKE-OFF				
5.1	PRE-TAKE-OFF CHECKS	2.1	all	all	all
5.2	TAKE-OFF CHECKS	2.1	all	all	all
5.3	TAKE-OFF	3.1		all	all
5.4	PREPARE FOR CATAPULT LAUNCH	18.1		CQ	CQ
5.5	CATAPULT LAUNCH	18.1		CQ	CQ
	CLIMB				
6.1	CLIMB CHECKS	2.1	all	all	all
	LEVEL-OFF				
7.1	LEVEL-OFF	3.1		all	all
	CRUISE				
8.1	CRUISE	3.1		all	all
	BARRIER				
9.1	ENTER AND FLY BARRIER	3.1,9.7		5	M
9.2	DEPART BARRIER	3.1		5	M
	RECOVERY				
10.1	APPROACH CHECKS	2.1	all	all	all
10.2	BREAK (ASHORE)	3.1		1,2,4,9	1,2,3,5,6,8
10.3	BASE TURN (ASHORE)	3.1		1,2,4,9	1,2,3,5,6,8
10.4	FINAL APPROACH (ASHORE)	3.1		1,2,4,9	1,2,3,5,6,8
10.5	TOUCHDOWN (ASHORE)	3.1		1,2,4,9	1,2,3,5,6,8
10.6	DECELERATE ON LANDING ROLL (ASHORE)	3.1		1,2,4,9	1,2,3,5,6,8
10.7	PROCEED TO MARSHALL POINT (CASE I RECOVERY)	18.1		CQ	CQ
10.8	HOLD OVERHEAD (CASE I RECOVERY)	18.1		CQ	CQ
10.9	SPIRAL DESCENT (CASE I RECOVERY)	18.1		CQ	CQ
10.10	BREAK (CASE I AND II CARRIER RECOVERIES)	18.1		CQ	CQ

TABLE B-1 ALLOCATION OF INSTRUCTIONAL BLOCKS TO PILOT BEHAVIORAL OBJECTIVES ACCORDING TO LESSON TYPE (Cont.)

Beh. Obj.	Title	Lesson Type			
		Cognitive	CPT Practice	OFT Sortie	E-2C Sortie
10.11	DOWNWIND (CASE I AND II CARRIER RECOVERIES)	18.1		CQ	CQ
10.12	BASE TURN (CASE I AND II CARRIER RECOVERIES)	18.1		CQ	CQ
10.13	FINAL APPROACH (CASE I AND II RECOVERIES)	18.1		CQ	CQ
10.14	CLEAR TOUCHDOWN AREA	18.1		CQ	CQ
10.15	ENTER SLOT (CASE II RECOVERY)	18.1		CQ	CQ
10.16	PROCEED TO MARSHALL POINT (CASE II AND III RECOVERIES)	18.1		CQ	CQ
10.17	HOLD AT MARSHALL POINT (CASES II AND III RECOVERIES)	18.1		CQ	CQ
10.18	PENETRATION (CASE II AND III RECOVERIES)	18.1		CQ	CQ
10.19	PREPARE FOR CCA (CASE III RECOVERY)	18.1		CQ	CQ
10.20	CCA (CASE III RECOVERY)	18.1		CQ	CQ
10.21	SHORT FINAL APPROACH (CASE III RECOVERY)	18.1		CQ	CQ
10.22	LANDING CHECKS	2.1	all	all	all
	POST-FLIGHT PROCEDURES				
11.1	POST-LANDING CHECKS	2.1	all	all	all
11.2	SECURE CHECKS	2.1	all	all	all
	TRAINING MANEUVERS				
12.1	DIRTY APPROACH TO STALLS (POWER ON & OFF)	3.1		1,3,9	1,8
12.2	CLEAN APPROACH TO STALLS (POWER ON & OFF)	3.1		1,3,9	1,8
12.3	PERFORM DIRTY (APPROACH TURN) APPROACH TO STALLS	3.1		1,3,9	1,8
12.4	INITIATE TOUCH AND GO (FIELD)	3.1		1,2,3	1
12.5	ESTABLISH CLIMB (FIELD AND CARRIER TOUCH-AND-GO, FCLP)	3.1,17.1 18.1		1,2,3,FCLP,CQ	1,FCLP,CQ
12.6	TURN TO DOWNWIND (FIELD TOUCH AND GO PATTERN)	3.1		1,2,3	1
12.7	DOWNWIND (FIELD AND CARRIER TOUCH-AND-GO, FCLP)	3.1,18.1		1,2,3,FCLP,CQ	1,FCLP,CQ
12.8	INITIATE TOUCH AND GO (CARRIER)	18.1		CQ	CQ
12.9	TURN TO DOWNWIND (CARRIER TOUCH AND GO PATTERN)	18.1		CQ	CQ

TABLE B-1 ALLOCATION OF INSTRUCTIONAL BLOCKS TO PILOT BEHAVIORAL OBJECTIVES ACCORDING TO LESSON TYPE (Cont.)

Beh. Obj.	Title	Lesson Type			
		Cognitive	CPT Practice	OFT Sortie	E-2C Sortie
12.10	BREAK (FCLP)	17.1		FCLP	FCLP
12.11	DOWNWIND (FCLP AFTER INITIAL BREAK)	17.1		FCLP	FCLP
12.12	BASE TURN (FCLP)	17.1		FCLP	FCLP
12.13	FINAL APPROACH (FCLP)	17.1		FCLP	FCLP
12.14	INITIATE TOUCH AND GO (FCLP)	17.1		FCLP	FCLP
12.15	TURN TO DOWNWIND (FCLP)	17.1		FCLP	FCLP
12.16	TRANSITION TO LANDING CONFIGURATION (SLOW FLIGHT)	3.1		1,3	1,8
12.17	MANEUVER IN SLOW FLIGHT	3.1		1,3	1,8
12.18	SIMULATED WAVEOFF	3.1		1,3	1,8
	EMERGENCY PROCEDURES				
13.1	ENGINE FIRE DURING START	2.3	1,2,3	3,9	
13.2	CONTINUE TAKE-OFF AFTER ENGINE FAILURE, UNSOLICITED AUTO-FEATHER, OR PROPELLER MALFUNCTION	2.3	1,3	3,7	
13.3	ABORT TAKE-OFF AFTER ENGINE FAILURE, UNSOLICITED AUTO-FEATHER, OR PROPELLER MALFUNCTION	2.3	1,2	3	
13.4	CONTINUE TAKE-OFF AFTER ENGINE FIRE	2.3	1,2	2,9	
13.5	ABORT TAKE-OFF AFTER ENGINE FIRE	2.3	1,5	4,5	
13.6	EMERGENCY ENGINE SHUTDOWN (FIRE)	7.4	4	9	
13.7	EMERGENCY ENGINE SHUTDOWN (NO FIRE)	7.4	3	6	2
13.8	POST-ENGINE SHUTDOWN PROCEDURES	7.4	3	6	2
13.9	AIR START	7.4	3	4	2
13.10	ENGINE FAILURE IN LANDING CONFIGURATION	7.4		4	
13.11	RPM/HP/TIT/FUEL FLOW FLUCTUATIONS	7.4	3,4	4	
13.12	DOUBLE ENGINE FAILURE DURING FLIGHT	7.4			
13.13	PROPELLER PITCHLOCK PROCEDURES	8.3	3	4,9	
13.14	ONE PROPELLER PUMP LIGHT IS ILLUMINATED	8.3	4		
13.15	SUSTAINED UNDERSPEED CONDITION	8.3		6	
13.16	OVERSPEED-LOSS OF PROPELLER GOVERNING	8.3		4	
13.17	SINGLE-ENGINE FIELD LANDING	3.2		2,3,4,9	2,3,5,6,8
13.18	SINGLE-ENGINE CARRIER RECOVERY	3.2			

*Revolutions per minute (RPM), Horsepower (HP), Turbine Inlet Temperature (TIT)

TABLE B-1 ALLOCATION OF INSTRUCTIONAL BLOCKS TO PILOT BEHAVIORAL OBJECTIVES ACCORDING TO LESSON TYPE (Cont.)

Beh. Obj.	Title	Lesson Type			
		Cognitive	CPT Practice	OFT Sortie	E-2C Sortie
13.19	EMERGENCY DESCENT	14.1		7,9	8
13.20	BAILOUT	5.4	2,5,6	7	1,3,4,6
13.21	DITCHING	5.4	2,5,6		2,5,7
13.22	ELECTRICAL FIRE	12.3	5,6		
13.23	FUSELAGE FIRE	12.3			
13.24	WING FIRE	12.3			
13.25	SMOKE AND FUME ELIMINATION	12.3	5		
13.26	SINGLE GENERATOR FAILURE	12.3			
13.27	SHORTED BUS/DUAL GENERATOR FAILURE	12.3	5	9	
13.28	DELETED				
13.29	FLIGHT OR COMBINED HYDRAULIC FAILURE	11.1	4	6,9	
13.30	COMPLETE HYDRAULIC SYSTEM FAILURE	11.1			
13.31	LANDING GEAR EMERGENCY EXTENSION	11.1	4	6	
13.32	BRAKE EMERGENCY OPERATION	11.4	4	6	
13.33	FLAP HYDRAULIC SYSTEM FAILURE	11.4	4	6	
13.34	FLAP ELECTRICAL CONTROL SYSTEM FAILURE	11.4	5		
13.35	ASSYMETRICAL FLAP POSITIONING	11.4		6	
13.36	STICKING FLAPS	11.4	4		
13.37	FAILURE OF ONE BLEED AIR SYSTEM	13.4	6		
13.38	DUAL BLEED AIR SYSTEM FAILURE	13.4			
13.39	ELIMINATION OF SMOKE OR FUMES FROM AIR CONDITIONING SYSTEM	13.4	6		
13.40	RUNAWAY LONGITUDINAL TRIM	6.1	3	4	
13.41	MAXIMUM RUDDER SYSTEM FAILURE-20° TRAVEL AVAILABLE WHEN 6° - 2° SELECTED	6.1			
13.42	MAXIMUM RUDDER SYSTEM FAILURE-2° STOP DOES NOT ENGAGE	6.1			
13.43	MAXIMUM RUDDER SYSTEM FAILURE-2° STOP DOES NOT DISENGAGE	6.1		5	
13.44	PITCH FEEL SYSTEM FAILURE - "Q" ACTUATOR RUNAWAY OR FAILURE	6.1	4		
13.45	PRECAUTIONARY APPROACH	14.1		7,9	
13.46	ENGINE OIL CHIP DETECTOR WARNING SYSTEM	7.4			

TABLE B-1 ALLOCATION OF INSTRUCTIONAL BLOCKS TO PILOT BEHAVIORAL OBJECTIVES ACCORDING TO LESSON TYPE (Cont.)

Beh. Obj.	Title	Lesson Type: Cognitive	CPT Practice	OFT Sortie	E-2C Sortie
13.47	FUEL SYSTEM FAILURE - RAPID DECREASE IN BOTH TANKS	7.2			
13.48	FUEL SYSTEM FAILURE - DECREASE IN ONE TANK, NO CHANGE IN OTHER TANK	7.2			
13.49	FUEL SYSTEM FAILURE - INCREASE IN ONE TANK, DECREASE IN OTHER TANK	7.2		5	
13.50	AIRCRAFT FUEL BOOST PUMPS FAILURE	7.2			
13.51	OXYGEN SYSTEM FAILURE	13.4	6	7	
13.52	EXPLOSIVE DECOMPRESSION	13.4			
13.53	UNSAFE ROTODOME	11.4	4		
13.54	HOOK EMERGENCY OPERATION - HOOK FAILS TO EXTEND	11.4	5		
13.55	HOOK EMERGENCY OPERATION - HOOK FAILS TO RETRACT	11.4	5		
13.56	LANDING EMERGENCY PROCEDURES	14.2	6	7	
13.57	NOSE GEAR TIRE FAILURE	14.2			
13.58	MAIN GEAR TIRE FAILURE	14.2			
13.59	MAIN GEAR UNSAFE INDICATION	14.2	6	7	
13.60	ONE MAIN GEAR UP OR UNLOCKED AT FIELD	14.2	6	7	
13.61	BOTH MAIN GEAR UP OR UNLOCKED	14.2			
13.62	NOSE GEAR, UNSAFE, UP, OR UNLOCKED	14.2	6	7	
13.63	WHEELS-UP LANDING	14.2			
	ADDITIONAL OBJECTIVES				
	NAVIGATION				
1	BASIC INSTRUMENT FLIGHT	1.3		2	
2	TACAN APPROACH	3.4,5.2		2,4,8,9	2,3,M,4,5,6,7,8
3	GCA*	3.4		2,8	7,8
3	UHF/ADF APPROACH*	3.4,5.2		2,8	2,3,M,5,6,7,8
4	PARTIAL PANEL	1.3		4	2,3,4
6	GCAS: NORMAL, NO GYRO, LOW FUEL, NO FLAP, SINGLE ENGINE	3.4		6	4
7	ACLS APPROACH	3.3		2,5	3,M,7,8

*Ground Control Approach (GCA), Automotive Direction Finder (ADF)

TABLE B-1 ALLOCATION OF INSTRUCTIONAL BLOCKS TO PILOT BEHAVIORAL OBJECTIVES ACCORDING TO LESSON TYPE (Cont.)

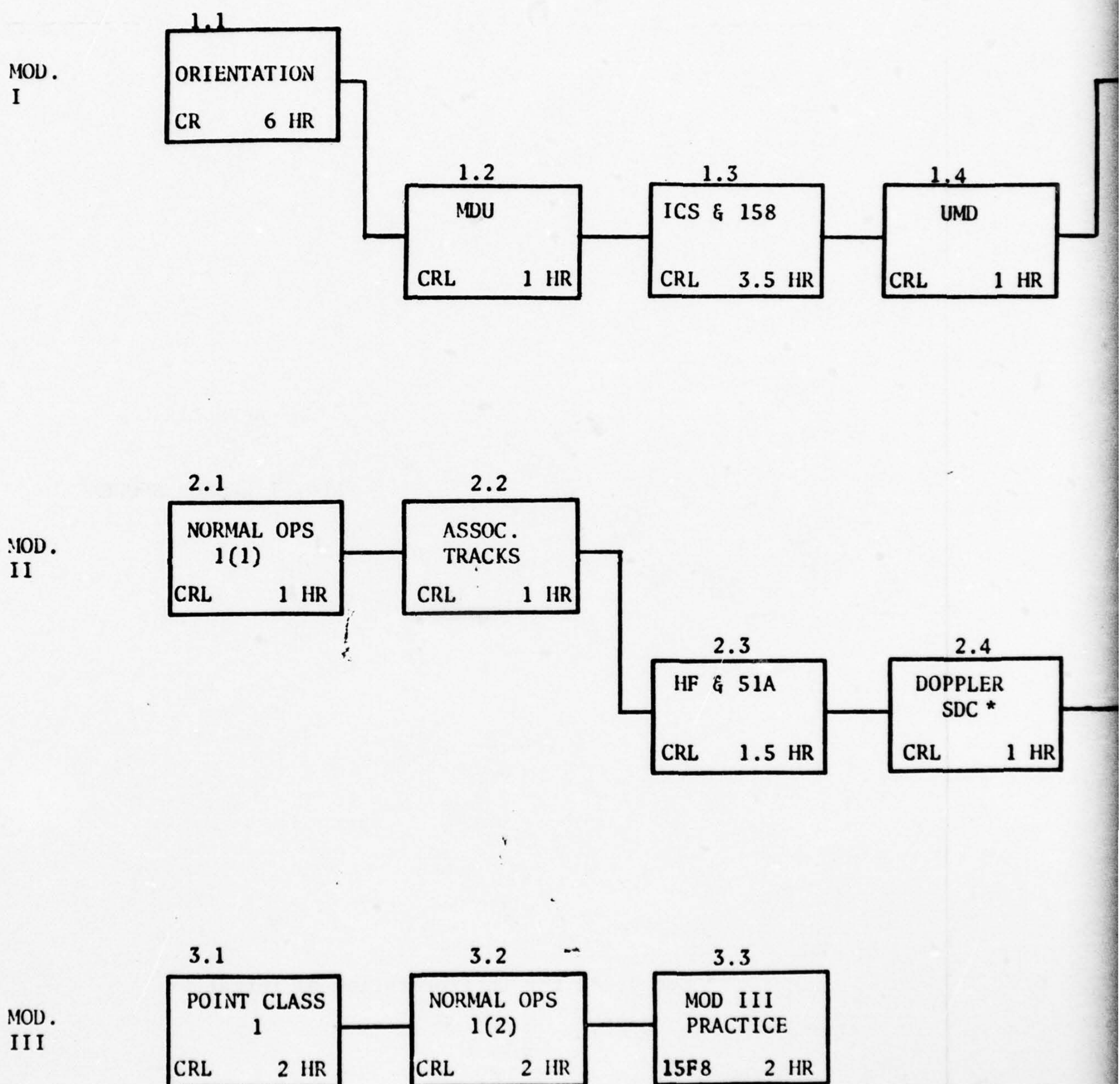
Beh. Obj.	Title	Lesson Type: Cognitive	CPT Practice	OFT Sortie	E-2C Sortie
8	COMMUNICATION/NAVIGATION FAILURES	11.5		6	6
9	PARTIAL PANEL TACAN APPROACH	1.3,3.4		7	
10	SINGLE ENGINE TACAN APPROACH	3.2,3.5		7	
11	PARTIAL PANEL UHF/ADF APPROACH	1.3,3.4		7	
12	SINGLE ENGINE UHF/ADF APPROACH	3.2,3.5		7	
13	INSTRUMENT FLIGHT PLAN	5.2			all
14	AIRWAY NAVIGATION	5.2			7
15	UNUSUAL ATTITUDES	1.3		4	3
16	POSITION UPDATE	9.7		5	M
17	NAVIGATION SYSTEM CLOSE OUT	9.7		5	M
18	NAVIGATION IN DEGRADED MODES	9.4,9.5		5	
19	PLAN INSTRUMENT FLIGHT	5.2		8	
20	ENROUTE CHANGE OF FLIGHT PLAN	5.2		8	
	OTHER				
21	WAVEOFF/BOLTER	18.1		CQ	CQ
22	HUNG START	1.5	2		
23	UHF AND ICS * SET-UP AND OPERATION	4.1,4.2	2		
24	NO OIL PRESSURE ON START	1.5	5		
25	SINGLE ENGINE FLIGHT	3.2		2,3	1
26	COORDINATE WITH CIC	10.5			M
27	AIRCRAFT SERVICING	5.8,7.2 11.1			7
28	SECURE AIRCRAFT	2.1,5.1			7
29	SINGLE ENGINE WAVEOFF	3.2		2	

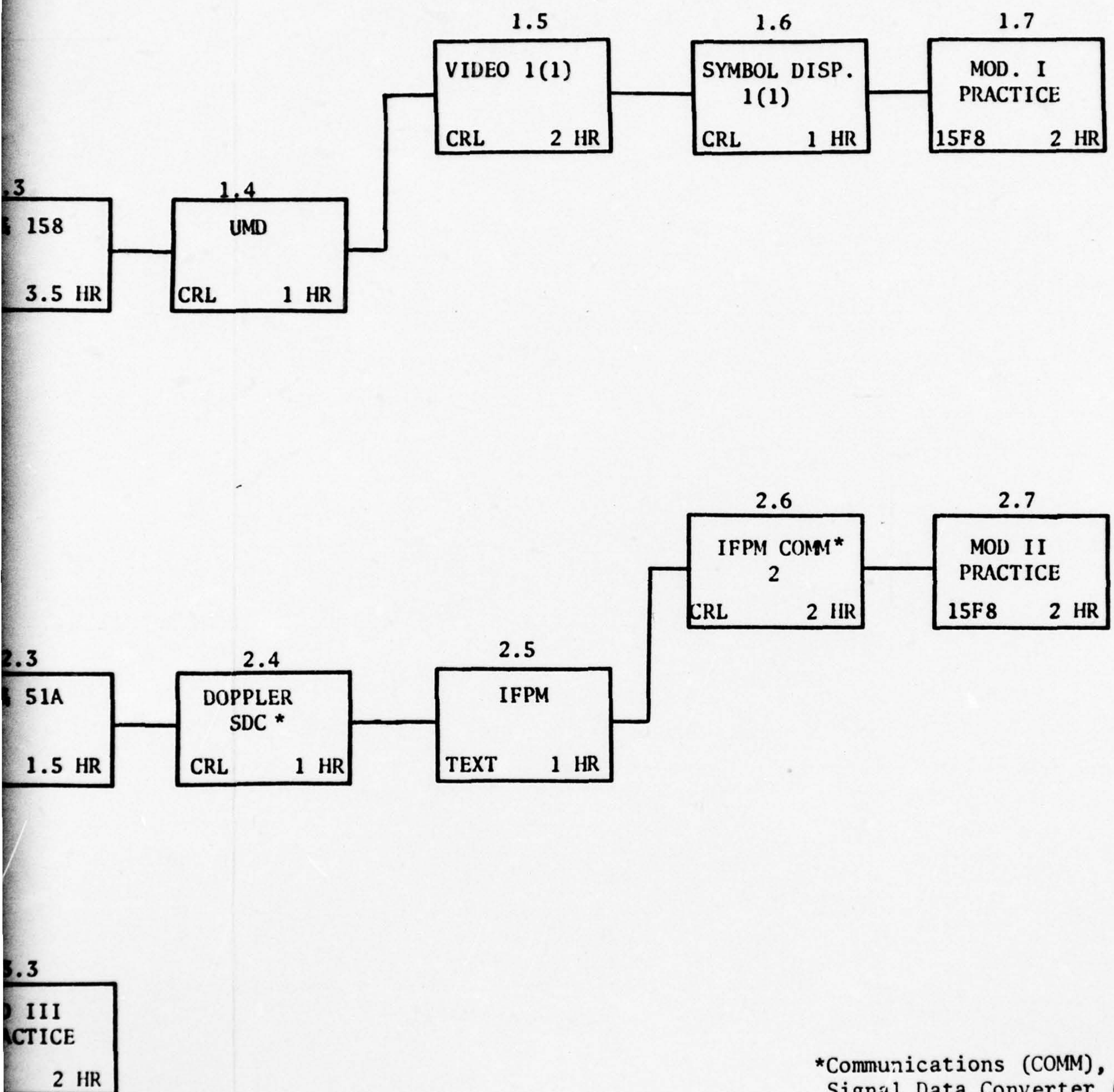
*Intercom System (ICS)

APPENDIX C

NFO/FT LESSON SEQUENCE*

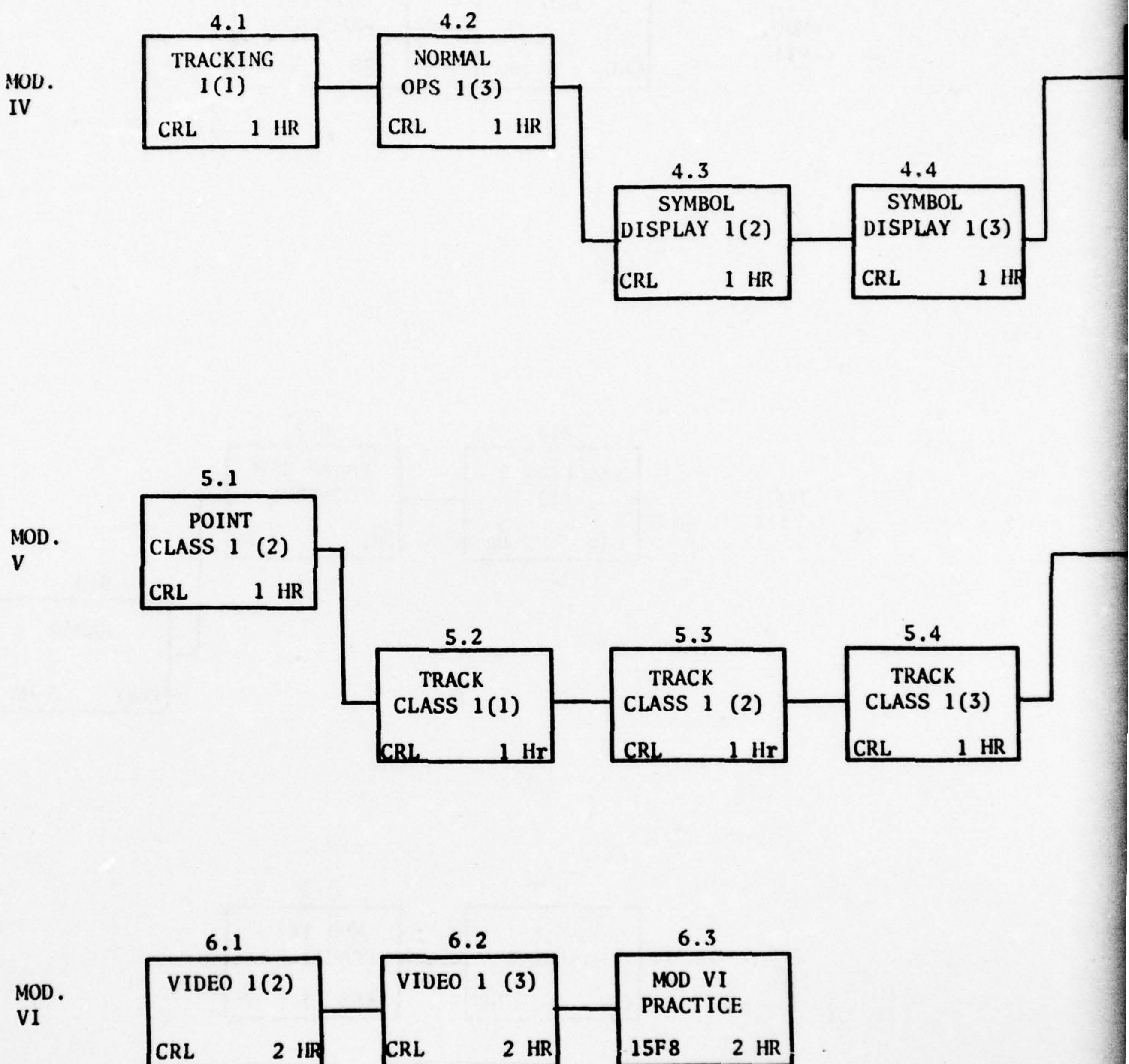
* See p. 42 for interpretation of format.

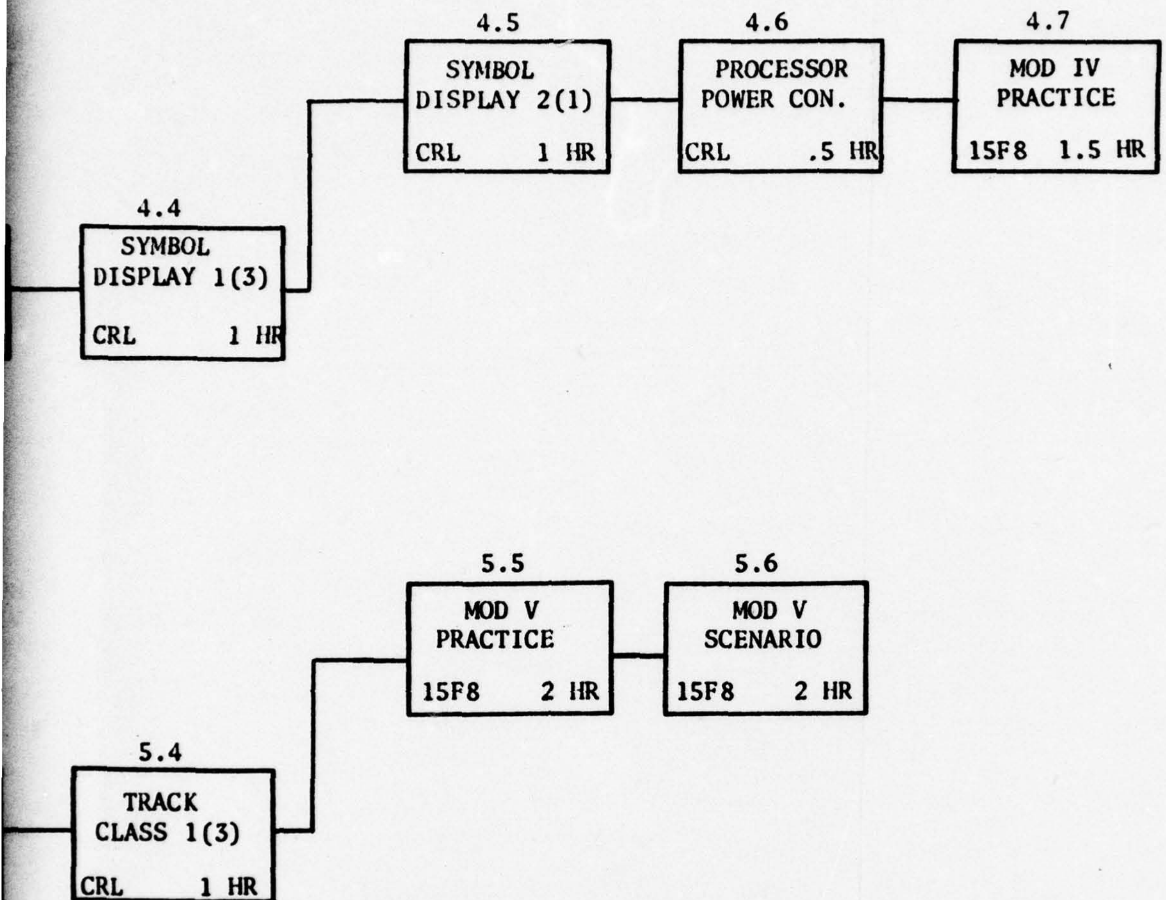

MOD.
I
1.1
ORIENTATION
CR 6 HR
1.2
MDU
CRL 1 HR
1.3
ICS & 158
CRL 3.5 HR
1.4
UMD
CRL 1 HR
MOD.
II
2.1
NORMAL OPS
1(1)
CRL 1 HR
2.2
ASSOC.
TRACKS
CRL 1 HR
2.3
HF & 51A
CRL 1.5 HR
2.4
DOPPLER
SDC *
CRL 1 HR
MOD.
III
3.1
POINT CLASS
1
CRL 2 HR
3.2
NORMAL OPS
1(2)
CRL 2 HR
3.3
MOD III
PRACTICE
15F8 2 HR

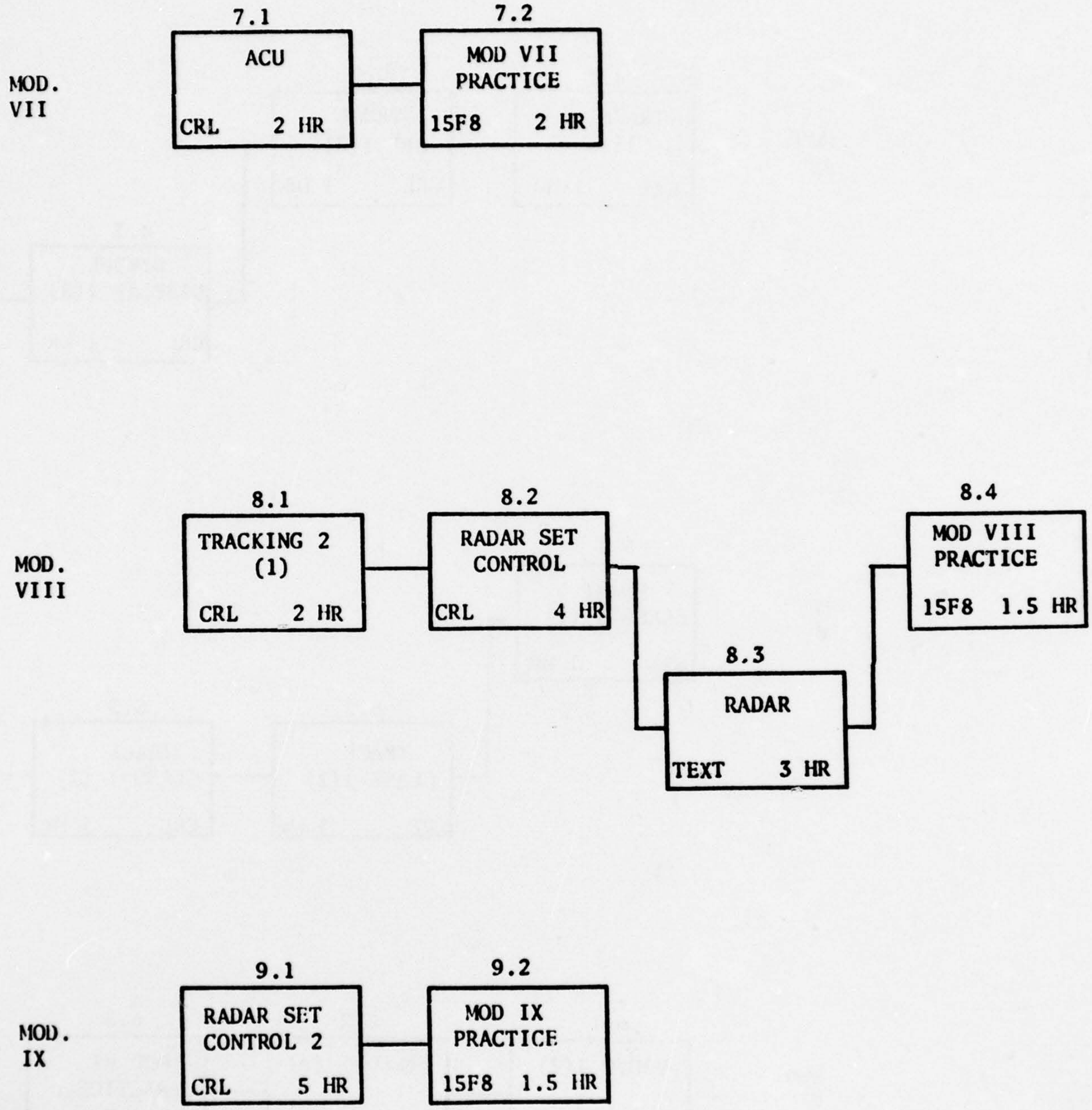


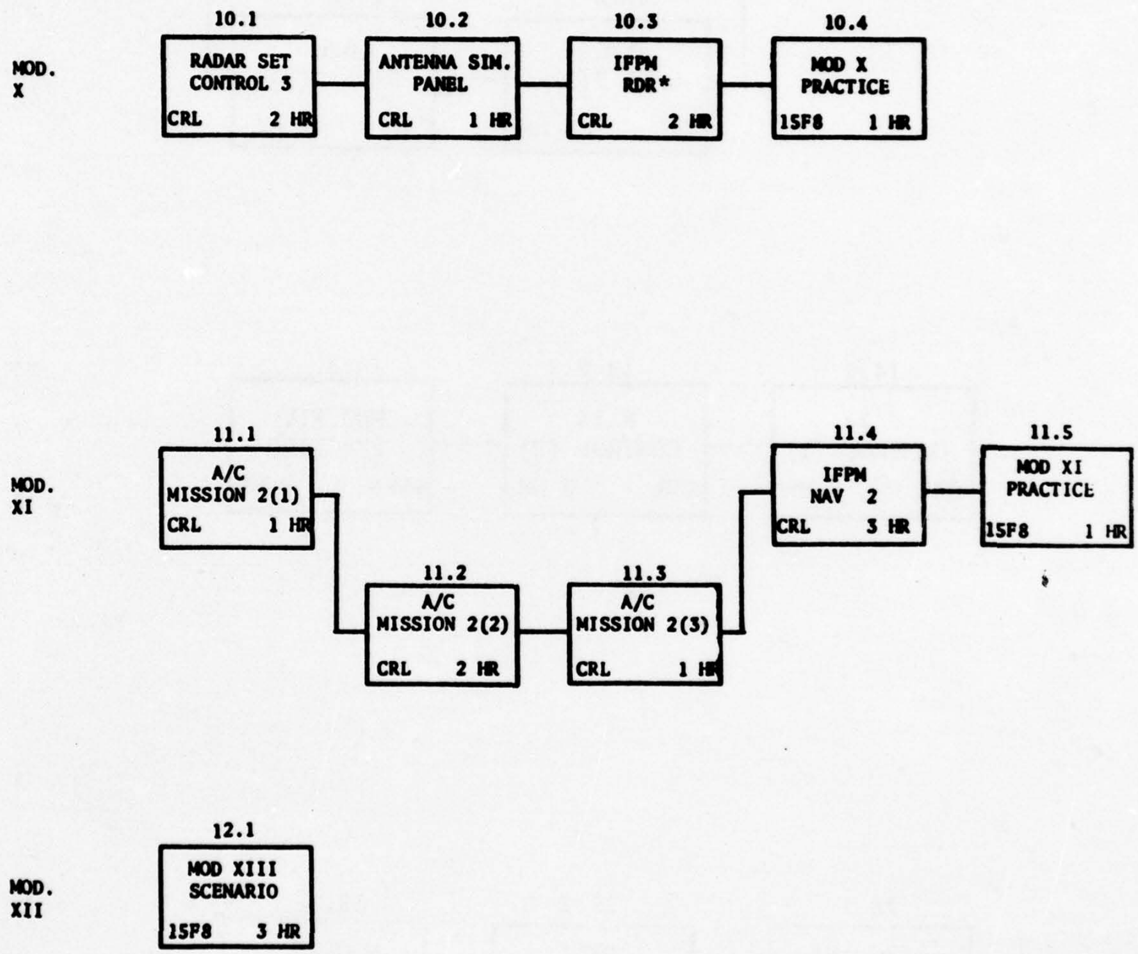
*Communications (COMM),
Signal Data Converter (SDC)

2

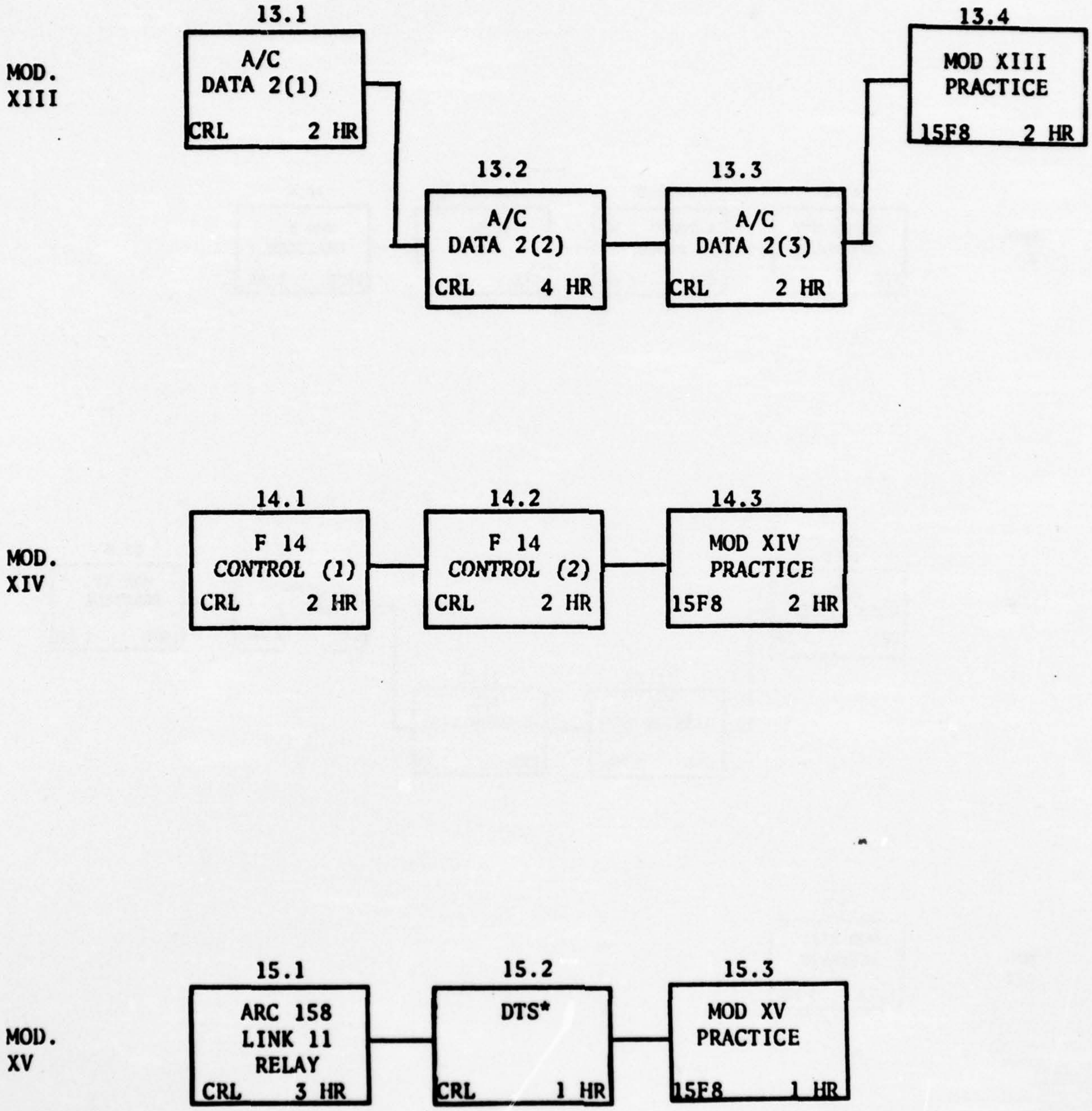

MOD. IV
4.1
TRACKING 1(1)
CRL 1 HR
4.2
NORMAL OPS 1(3)
CRL 1 HR
4.3
SYMBOL DISPLAY 1(2)
CRL 1 HR
4.4
SYMBOL DISPLAY 1(3)
CRL 1 HR
MOD. V
5.1
POINT CLASS 1 (2)
CRL 1 HR
5.2
TRACK CLASS 1(1)
CRL 1 Hr
5.3
TRACK CLASS 1 (2)
CRL 1 Hr
5.4
TRACK CLASS 1(3)
CRL 1 HR
MOD. VI
6.1
VIDEO 1(2)
CRL 2 HR
6.2
VIDEO 1 (3)
CRL 2 HR
6.3
MOD VI PRACTICE
15F8 2 HR


4.5
SYMBOL DISPLAY 2(1)
CRL 1 HR
4.6
PROCESSOR POWER CON.
CRL .5 HR
4.7
MOD IV PRACTICE
15F8 1.5 HR
4.4
SYMBOL DISPLAY 1(3)
CRL 1 HR
5.5
MOD V PRACTICE
15F8 2 HR
5.6
MOD V SCENARIO
15F8 2 HR
5.4
TRACK CLASS 1(3)
CRL 1 HR

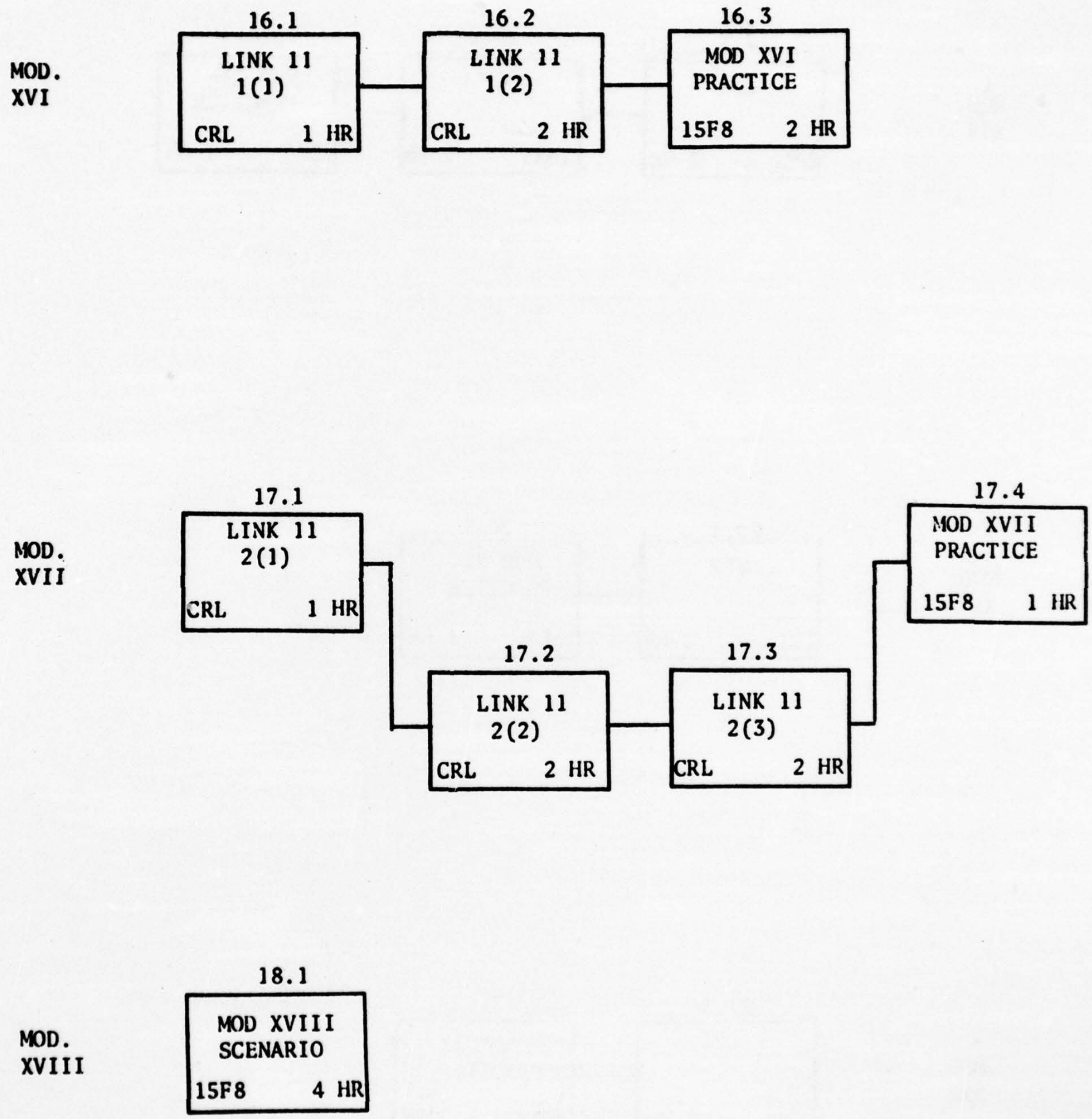

MOD. VII
7.1
ACU
CRL 2 HR
7.2
MOD VII PRACTICE
15F8 2 HR
MOD. VIII
8.1
TRACKING 2 (1)
CRL 2 HR
8.2
RADAR SET CONTROL
CRL 4 HR
8.3
RADAR
TEXT 3 HR
8.4
MOD VIII PRACTICE
15F8 1.5 HR
MOD. IX
9.1
RADAR SET CONTROL 2
CRL 5 HR
9.2
MOD IX PRACTICE
15F8 1.5 HR

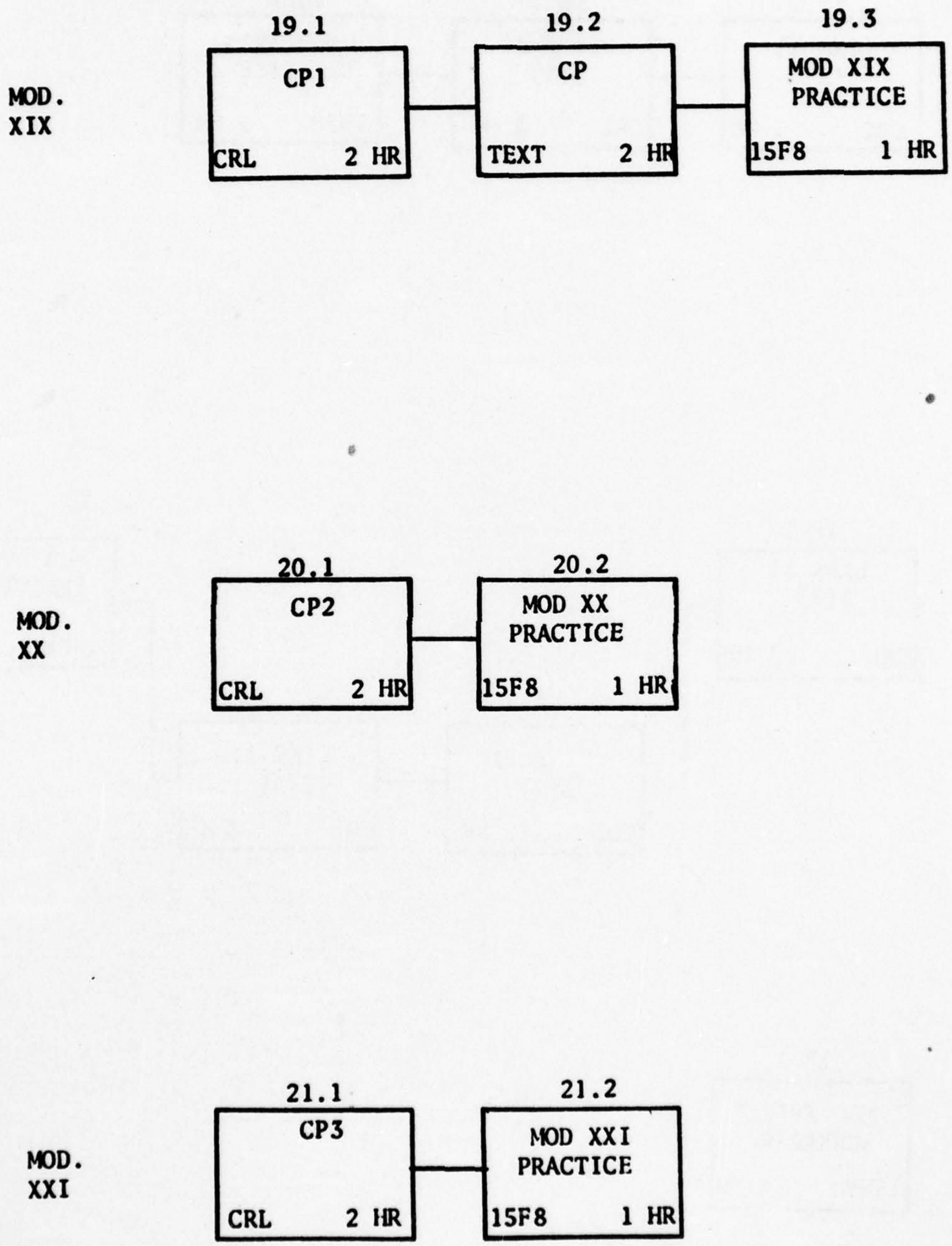

MOD. X
10.1
RADAR SET CONTROL 3
CRL 2 HR
10.2
ANTENNA SIM. PANEL
CRL 1 HR
10.3
IFPM RDR*
CRL 2 HR
10.4
MOD X PRACTICE
15F8 1 HR
MOD. XI
11.1
A/C MISSION 2(1)
CRL 1 HR
11.2
A/C MISSION 2(2)
CRL 2 HR
11.3
A/C MISSION 2(3)
CRL 1 HR
11.4
IFPM NAV 2
CRL 3 HR
11.5
MOD XI PRACTICE
15F8 1 HR
MOD. XII
12.1
MOD XIII SCENARIO
15F8 3 HR

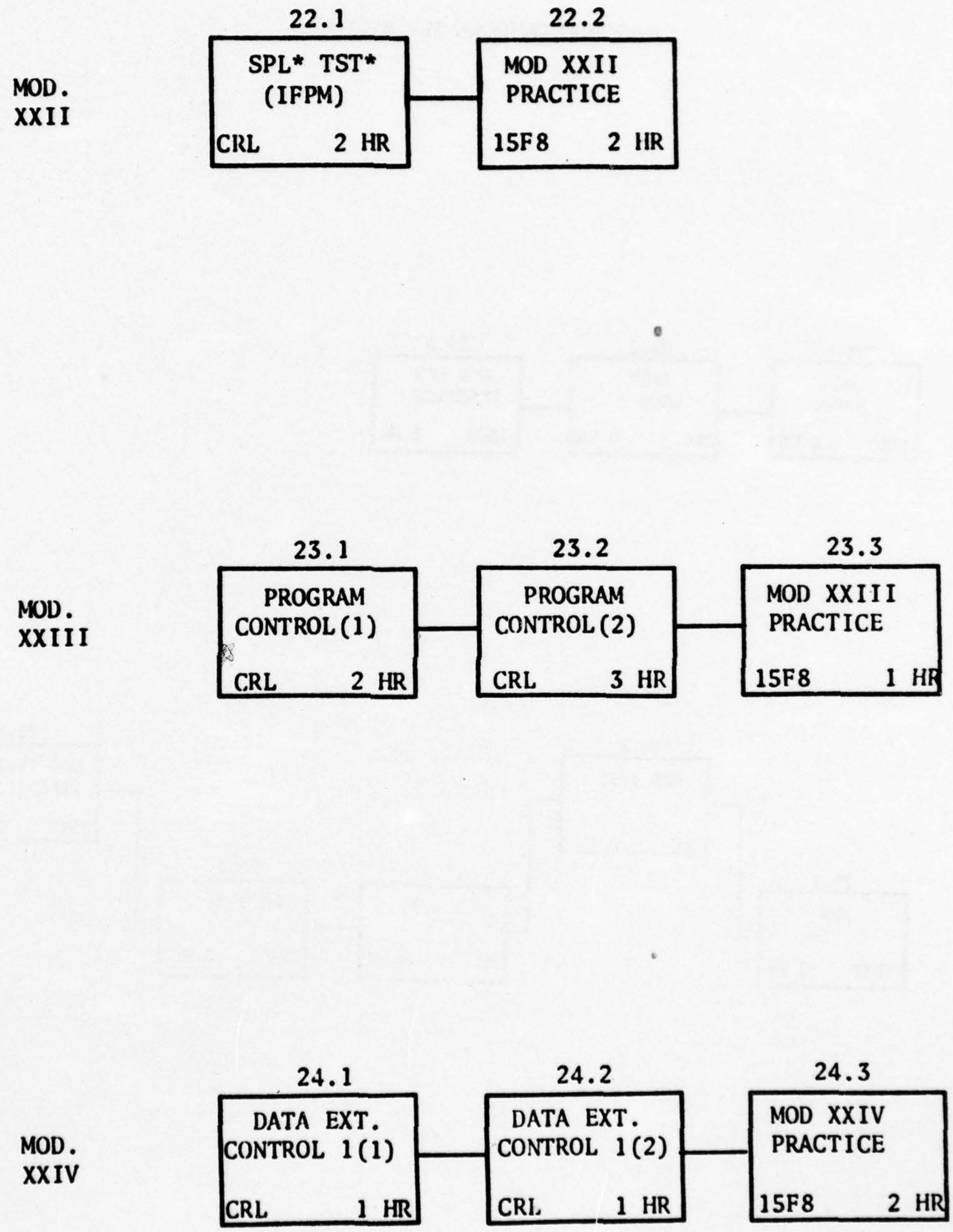
*Radar (RDR)



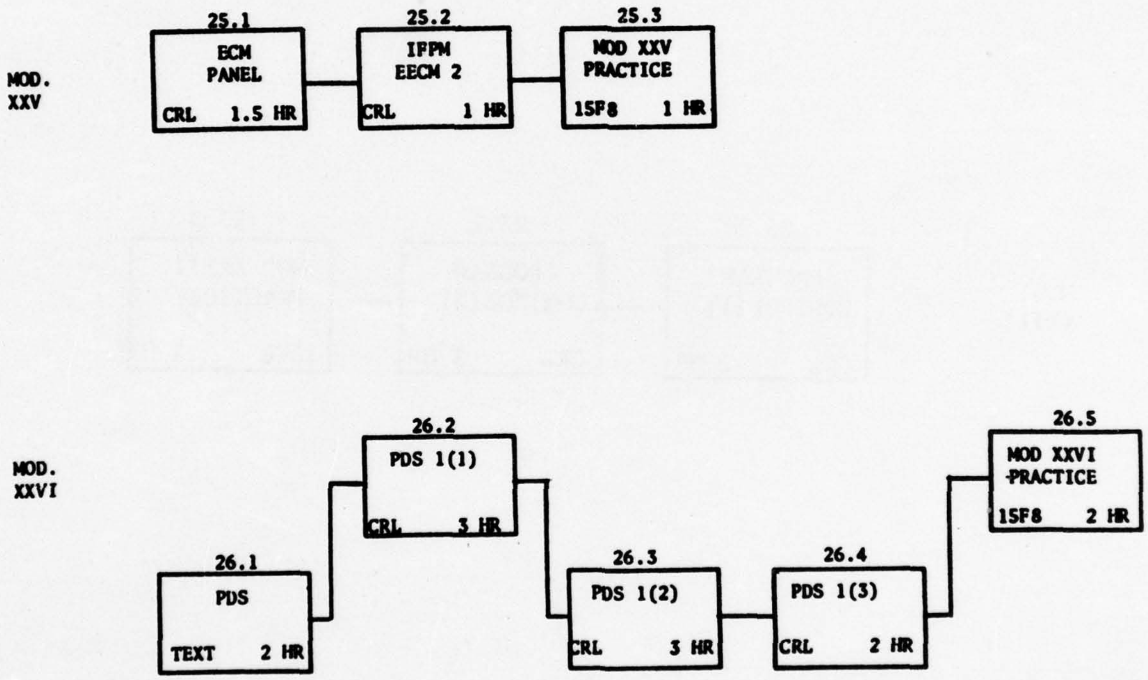
*Data Terminal Set (DTS)

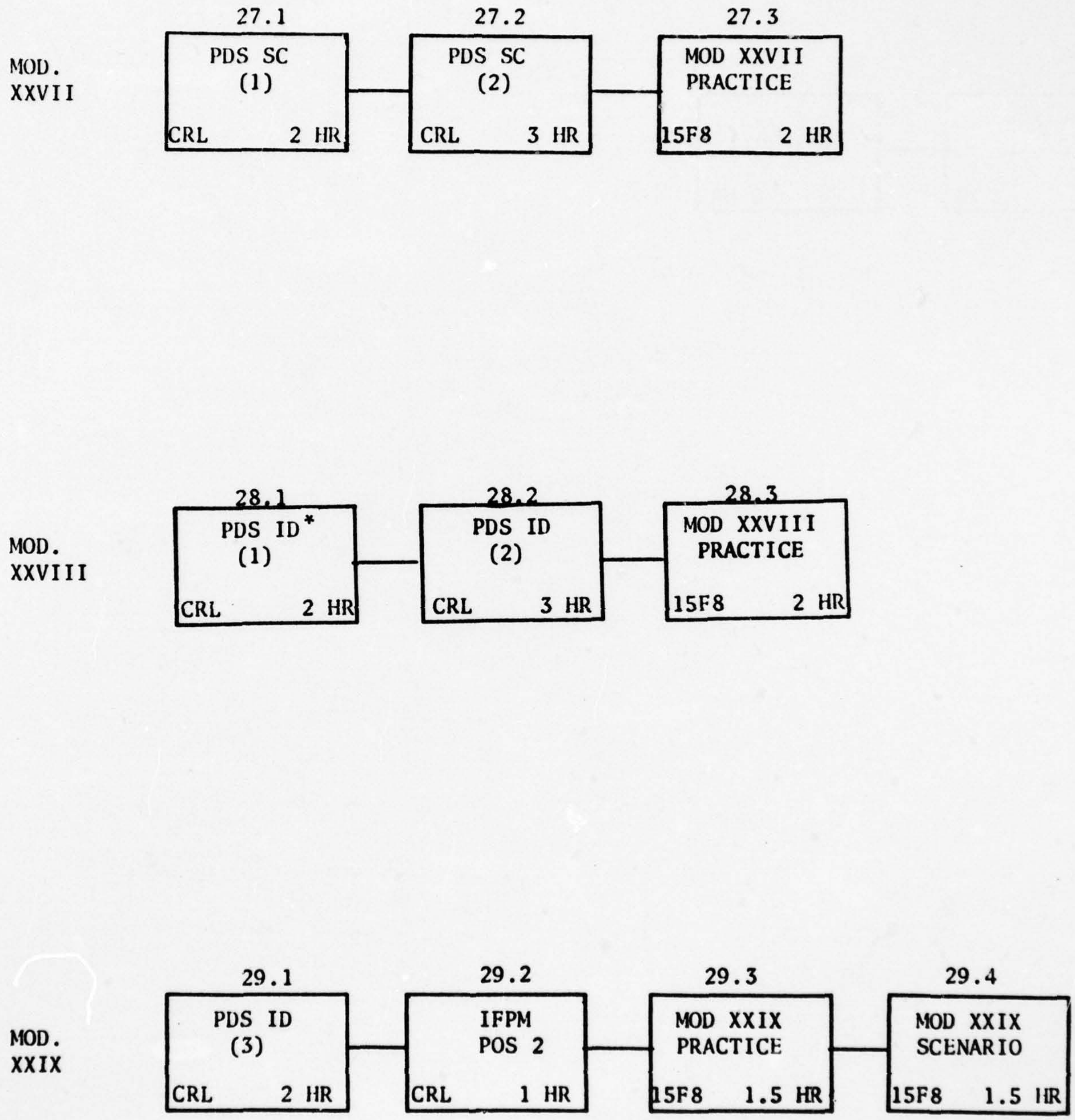

MOD.
XVI
16.1
LINK 11
1(1)
CRL 1 HR
16.2
LINK 11
1(2)
CRL 2 HR
16.3
MOD XVI
PRACTICE
15F8 2 HR
MOD.
XVII
17.1
LINK 11
2(1)
CRL 1 HR
17.2
LINK 11
2(2)
CRL 2 HR
17.3
LINK 11
2(3)
CRL 2 HR
17.4
MOD XVII
PRACTICE
15F8 1 HR
MOD.
XVIII
18.1
MOD XVIII
SCENARIO
15F8 4 HR


19.1
CP1
CRL 2 HR
19.2
CP
TEXT 2 HR
19.3
MOD XIX
PRACTICE
15F8 1 HR
MOD.
XIX
20.1
CP2
CRL 2 HR
20.2
MOD XX
PRACTICE
15F8 1 HR
MOD.
XX
21.1
CP3
CRL 2 HR
21.2
MOD XXI
PRACTICE
15F8 1 HR
MOD.
XXI



*Special (SPL), Test (TST)


MOD.
XXV
25.1
ECM
PANEL
CRL 1.5 HR
25.2
IFPM
EECM 2
CRL 1 HR
25.3
MOD XXV
PRACTICE
15F8 1 HR
MOD.
XXVI
26.1
PDS
TEXT 2 HR
26.2
PDS 1(1)
CRL 3 HR
26.3
PDS 1(2)
CRL 3 HR
26.4
PDS 1(3)
CRL 2 HR
26.5
MOD XXVI
PRACTICE
15F8 2 HR



*Identification

AD-A036 264 CALSPAN CORP BUFFALO N Y F/G 5/9

E-2 C SYSTEMS APPROACH TO TRAINING. PHASE I.(U)

DEC 76 R C SUGARMAN, S L JOHNSON N61339-75-C-0101

UNCLASSIFIED NAVTRAEQUIPC-75-C-0101-1 NL

2 OF 2

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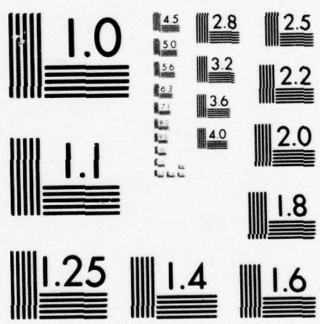
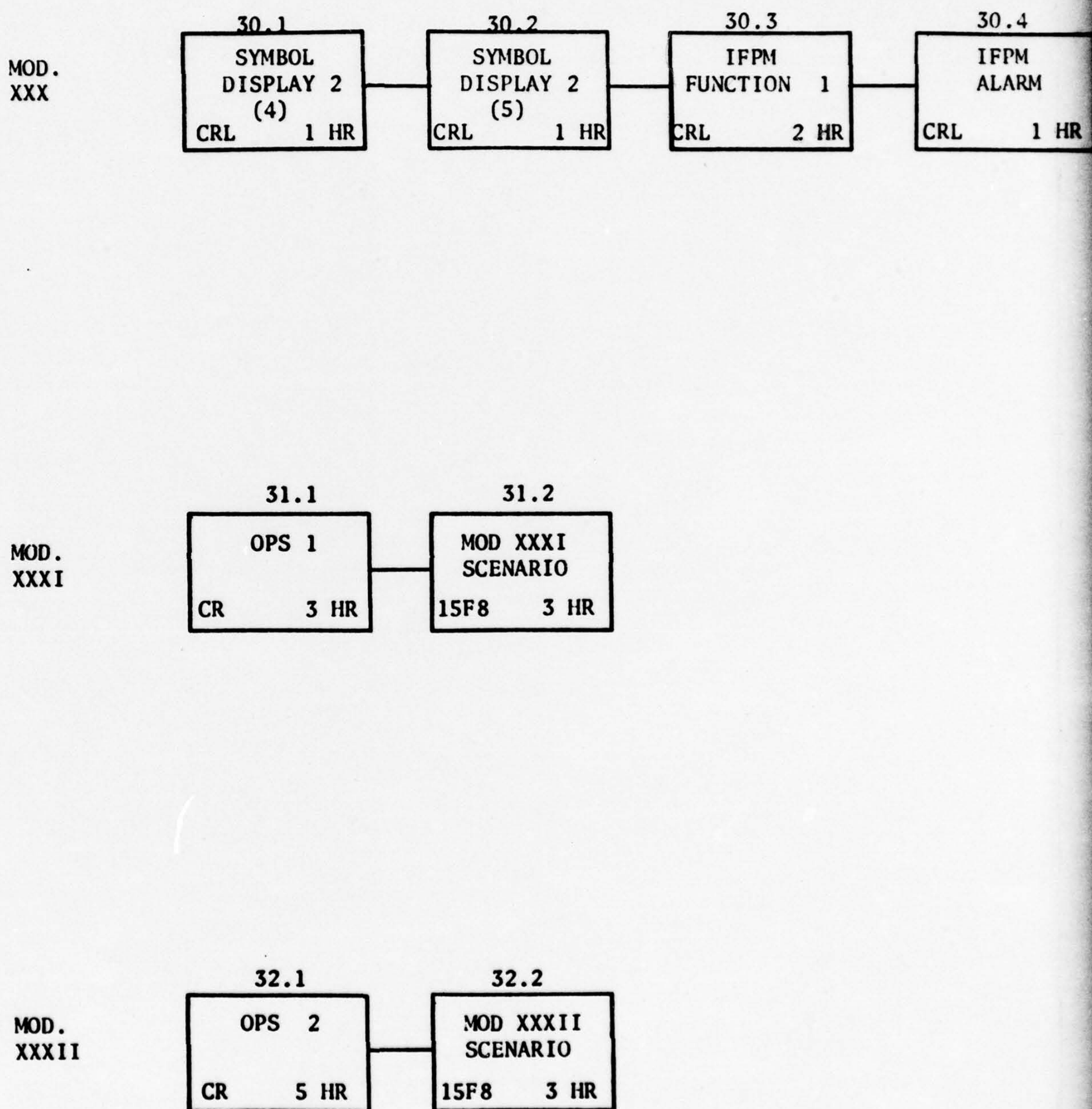
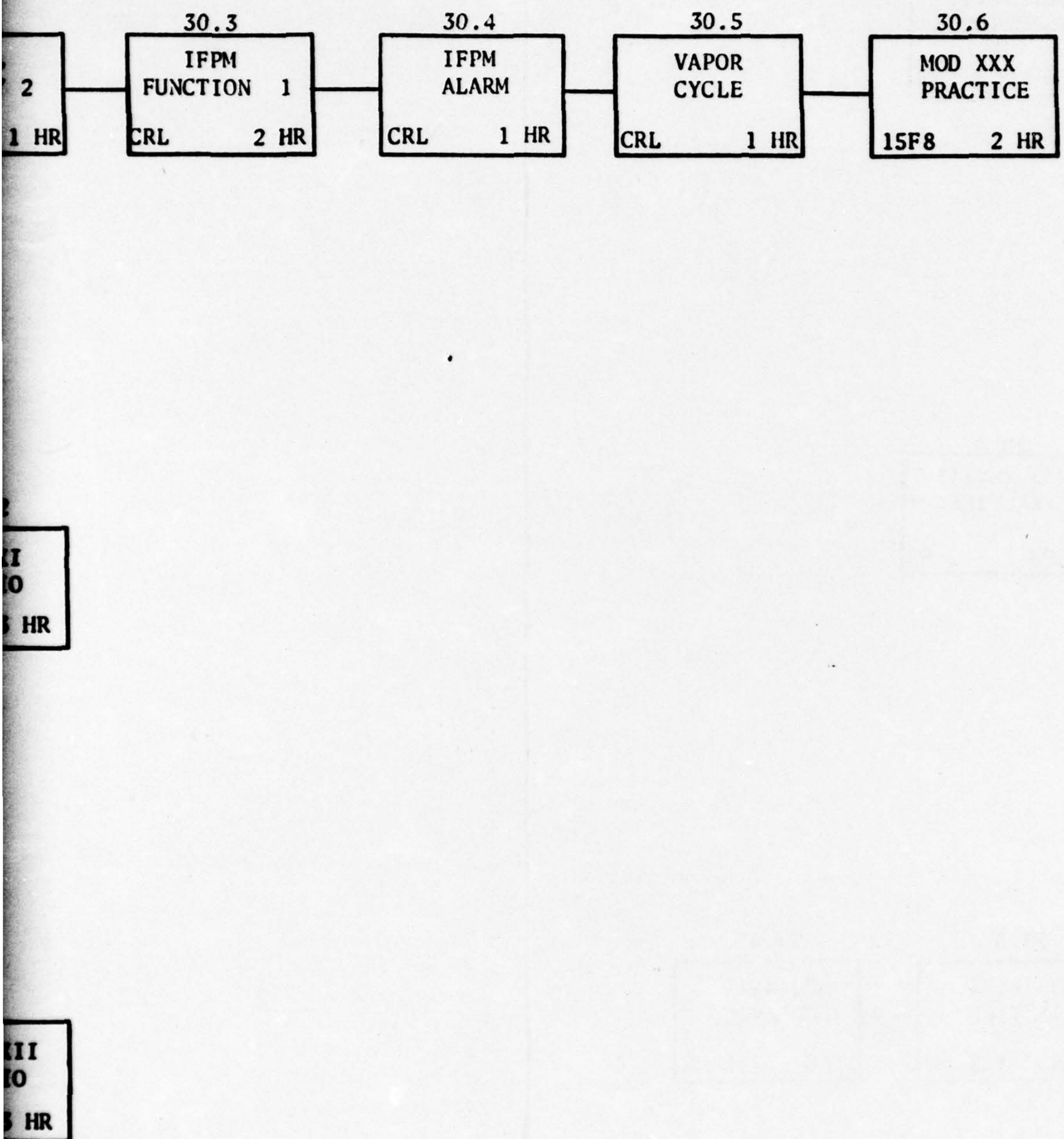
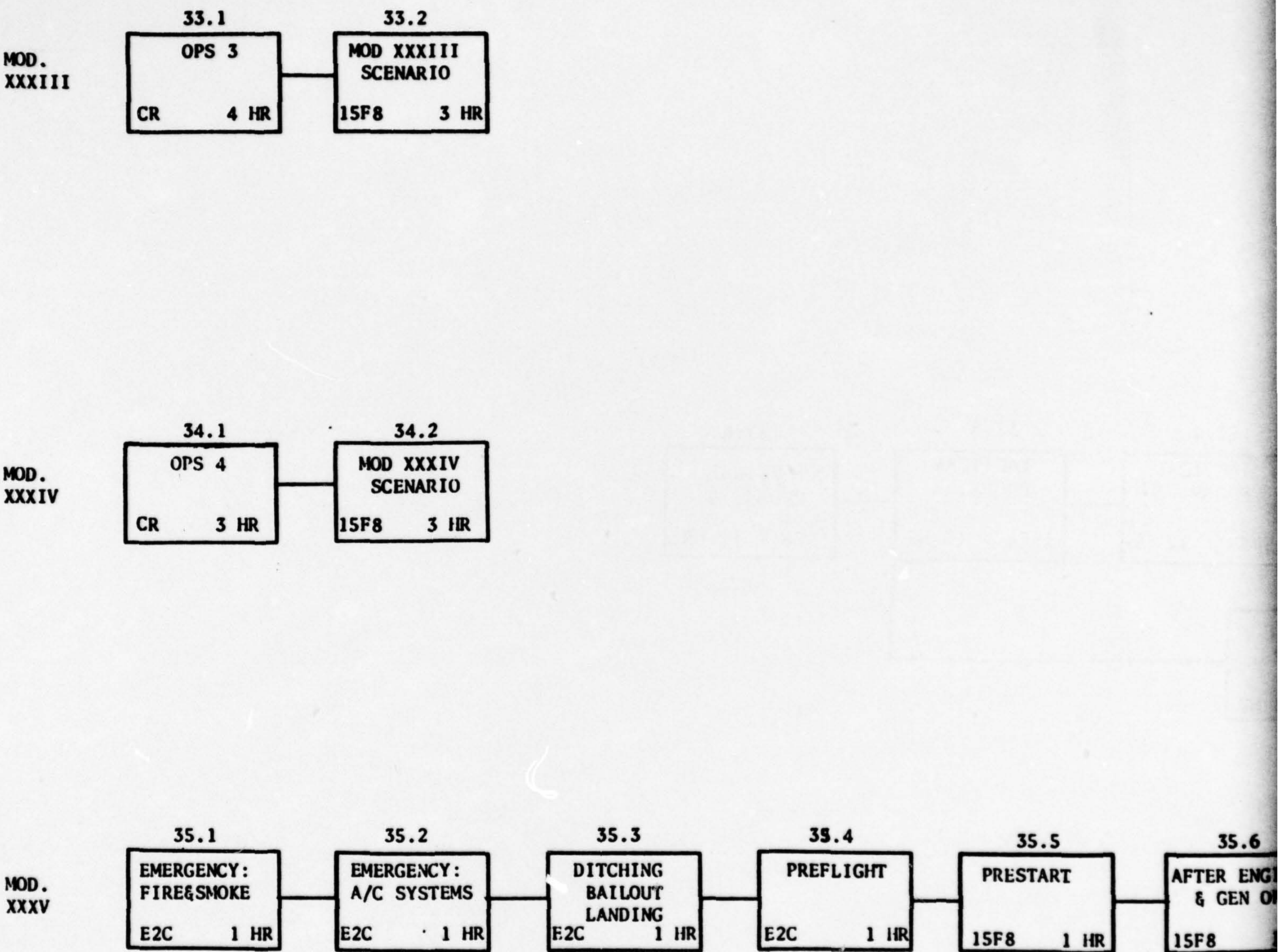


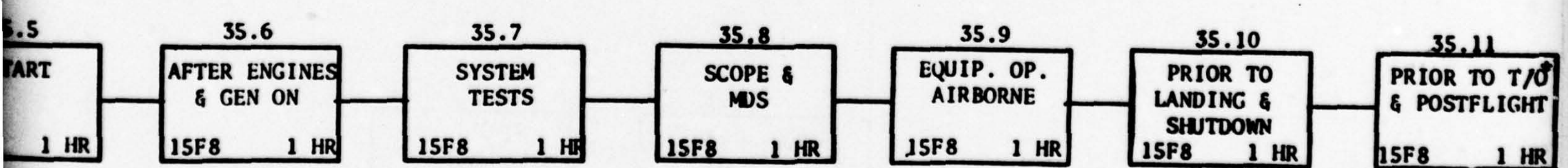
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A


MOD.
XXX
30.1
SYMBOL
DISPLAY 2
(4)
CRL 1 HR
30.2
SYMBOL
DISPLAY 2
(5)
CRL 1 HR
30.3
IFPM
FUNCTION 1
CRL 2 HR
30.4
IFPM
ALARM
CRL 1 HR
MOD.
XXXI
31.1
OPS 1
CR 3 HR
31.2
MOD XXXI
SCENARIO
15F8 3 HR
MOD.
XXXII
32.1
OPS 2
CR 5 HR
32.2
MOD XXXII
SCENARIO
15F8 3 HR

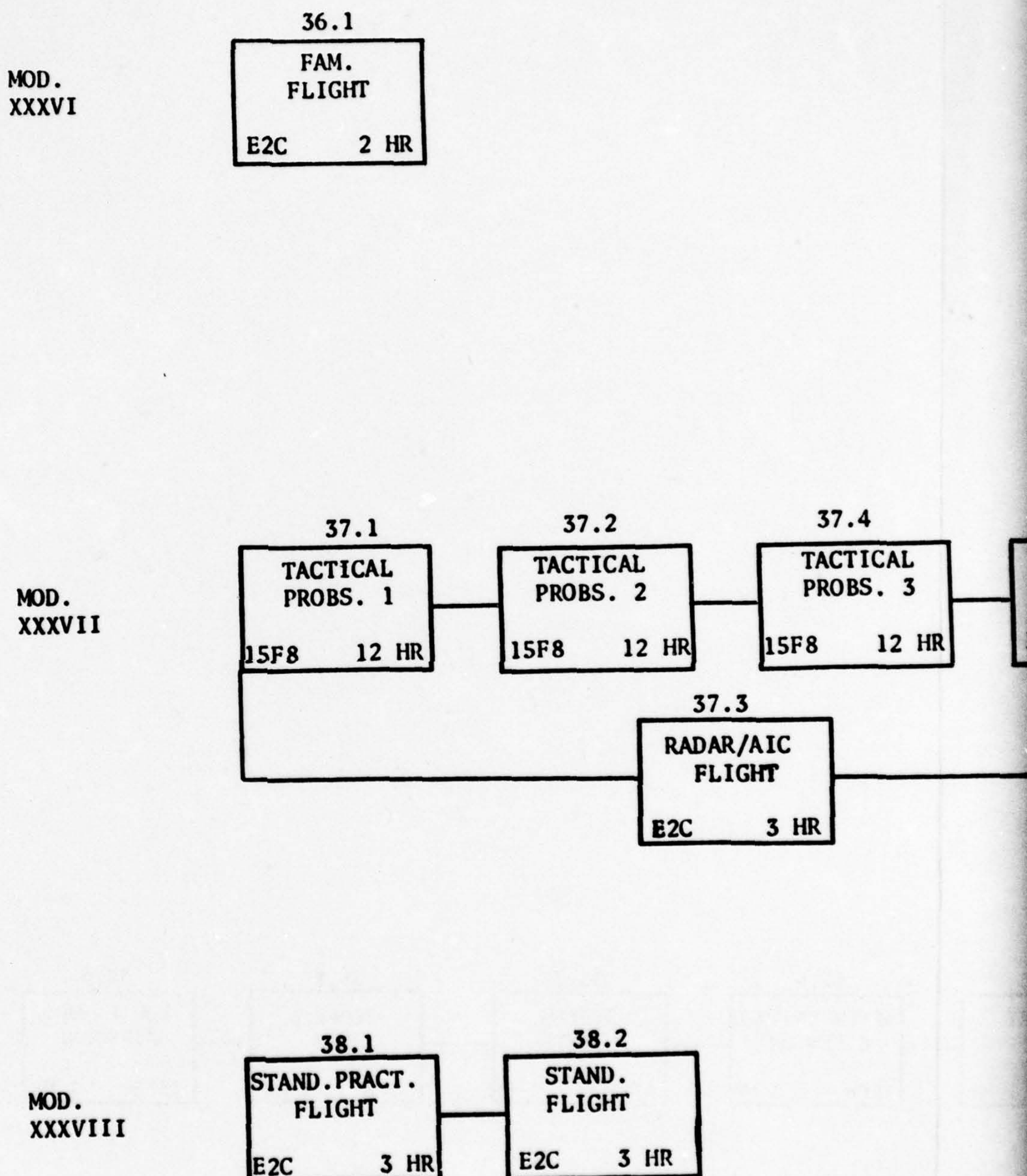


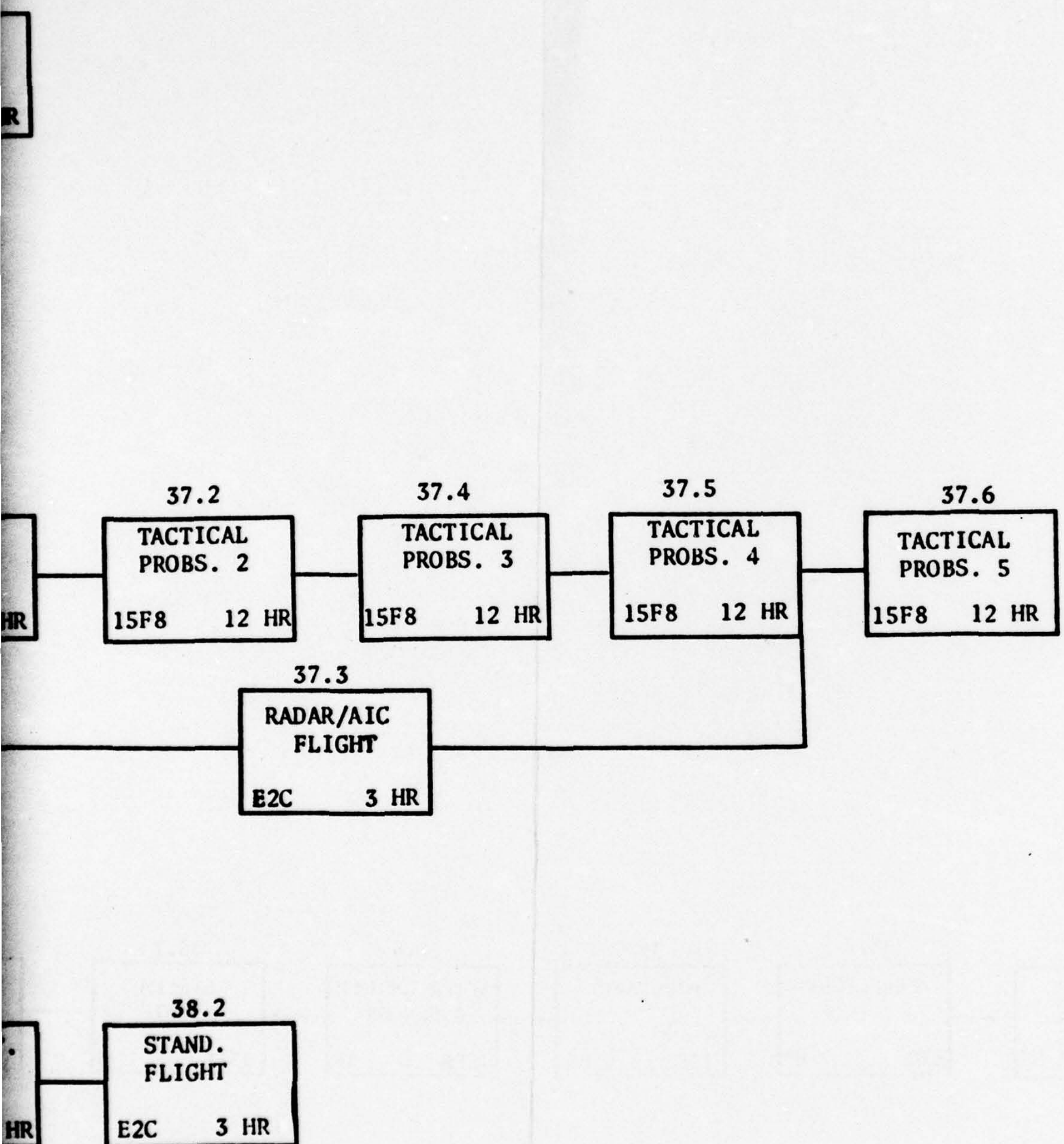
2
1 HR
30.3
IFPM
FUNCTION 1
CRL 2 HR
30.4
IFPM
ALARM
CRL 1 HR
30.5
VAPOR
CYCLE
CRL 1 HR
30.6
MOD XXX
PRACTICE
15F8 2 HR
HR
HR


MOD. XXXIII
33.1
OPS 3
CR 4 HR
33.2
MOD XXXIII SCENARIO
15F8 3 HR
MOD. XXXIV
34.1
OPS 4
CR 3 HR
34.2
MOD XXXIV SCENARIO
15F8 3 HR
MOD. XXXV
35.1
EMERGENCY: FIRE&SMOKE
E2C 1 HR
35.2
EMERGENCY: A/C SYSTEMS
E2C 1 HR
35.3
DITCHING BAILOUT LANDING
E2C 1 HR
35.4
PREFLIGHT
E2C 1 HR
35.5
PRESTART
15F8 1 HR
35.6
AFTER ENG
& GEN O
15F8


.5
TART
1 HR
35.6
AFTER ENGINES & GEN ON
15F8 1 HR
35.7
SYSTEM TESTS
15F8 1 HR
35.8
SCOPE & MDS
15F8 1 HR
35.9
EQUIP. OP. AIRBORNE
15F8 1 HR
35.10
PRIOR TO LANDING & SHUTDOWN
15F8 1 HR
35.11
PRIOR TO T/O* & POSTFLIGHT
15F8 1 HR

*Takeoff (T/O)


36.1
MOD.
XXXVI
FAM.
FLIGHT
E2C 2 HR
MOD.
XXXVII
37.1
TACTICAL
PROBS. 1
15F8 12 HR
37.2
TACTICAL
PROBS. 2
15F8 12 HR
37.4
TACTICAL
PROBS. 3
15F8 12 HR
37.3
RADAR/AIC
FLIGHT
E2C 3 HR
MOD.
XXXVIII
38.1
STAND.PRACT.
FLIGHT
E2C 3 HR
38.2
STAND.
FLIGHT
E2C 3 HR


37.2
TACTICAL PROBS. 2
15F8 12 HR
37.4
TACTICAL PROBS. 3
15F8 12 HR
37.5
TACTICAL PROBS. 4
15F8 12 HR
37.6
TACTICAL PROBS. 5
15F8 12 HR
37.3
RADAR/AIC FLIGHT
E2C 3 HR
38.2
STAND. FLIGHT
E2C 3 HR

2

APPENDIX D

ALLOCATION OF INSTRUCTIONAL BLOCKS TO NFO/FT BEHAVIORAL OBJECTIVES ACCORDING TO ASSESSMENT

This appendix provides a summary of the presentation and testing strategy employed in the NFO/FT training program, with its emphasis on behavioral objectives. Each of the behavioral objectives is keyed to the number of the lesson/block in which it is taught and subsequently assessed. This assessment is categorized by cognitive, practice, and scenario type lessons. "Initial" and "Final" columns in the latter two categories further trace the process from the assessment of a trainee's first experience in performing a behavioral objective to his final performance within a scenario. For example, Behavioral Objective 1.1, Operate the Indicator Power Switches on the UMD, is presented and assessed in Lesson 1.4. In this case, trainee performance of the behavioral objective is assessed only once in a practice lesson, Lesson 1.7. The first scenario assessment of this same objective takes place in Lesson 5.5, with the final scenario assessment occurring in Lesson 29.3.

In addition to identifying when trainee performance on each behavioral objective is assessed, the table provides a mapping of the behavioral objectives into the NFO/FT instructional block sequence (see Appendix C) and into the NFO/FT lesson specifications. That is, by referring to the instructional block sequence it can be determined when in the overall scheme of the NFO/FT course each behavioral objective is presented and performance is assessed. By referring to the lesson specifications it can be determined in what context the behavioral objective is presented and performance is assessed, i.e., what other behavioral objectives are presented and/or assessed in the same lesson.

TABLE D-1. ALLOCATION OF INSTRUCTIONAL BLOCKS TO BEHAVIORAL OBJECTIVES ACCORDING TO ASSESSMENT

Beh. Obj.	Title	Assessment				
		Cognitive	Practice		Scenario	
			Initial	Final	Initial	Final
	UPPER MAIN DISPLAY					
1.1	OPERATE THE INDICATOR POWER SWITCHES ON THE UMD	1.4	1.7	29.3	5.6	29.4
1.2	PERFORM DEFLECTION AMPLIFIER TEST	1.4	1.7	29.3	5.6	29.4
1.3	PERFORM MDU INPUT TEST	1.4	1.7	29.3	5.6	29.4
1.4	PERFORM LIGHTS TEST ON THE UMD	1.4	1.7	29.3	5.6	29.4
1.5	RESET UMD WRA FAULT	1.4	1.7	29.3	5.6	29.4
1.6	RESET MDU WRA FAULT	1.4	1.7	29.3	5.6	29.4
1.7	RESET ADU WRA FAULT	1.4	1.7	29.3	5.6	29.4
1.8	RESET MPS WRA FAULT	1.4	1.7	29.3	5.6	29.4
1.9	TURN CONSOLE ON FOLLOWING UMD OVERHEAT	1.4	1.7	29.3	5.6	29.4
1.10	TURN CONSOLE ON FOLLOWING MDU OVERHEAT	1.4	1.7	29.3	5.6	29.4
1.11	MONITOR ADU OVERHEAT LIGHT	1.4	1.7	29.3	5.6	29.4
1.12	TURN CONSOLE ON FOLLOWING MPS OVERHEAT	1.4	1.7	29.3	5.6	29.4
1.13	MONITOR RDP SATURATED LIGHT	1.4	1.7	29.3	5.6	29.4
1.14	OPERATE COMPUTER OPERATIONAL/FAILED SWITCHCAP	1.4	1.7	29.3	5.6	29.4
1.15	TURN LONG PULSE VIDEO INTENSITY CONTROL	1.4	1.7	29.3	5.6	29.4
1.16	TURN SHORT PULSE VIDEO INTENSITY CONTROL	1.4	1.7	29.3	5.6	29.4
1.17	TURN AMTI VIDEO INTENSITY CONTROL	1.4	1.7	29.3	5.6	29.4
1.18	TURN SYNTHETIC RADAR VIDEO INTENSITY CONTROL	1.4	1.7	29.3	5.6	29.4
1.19	TURN OWN HEADING & ACU GATES VIDEO INTENSITY CONTROL	1.4	1.7	29.3	5.6	29.4
1.20	TURN CODE IFF VIDEO INTENSITY CONTROL	1.4	1.7	29.3	5.6	29.4
1.21	TURN DECODE IFF VIDEO INTENSITY CONTROL	1.4	1.7	29.3	5.6	29.4
1.22	TURN SYNTHETIC IFF VIDEO INTENSITY CONTROL	1.4	1.7	29.3	5.6	29.4
1.23	TURN MODE IV VIDEO INTENSITY CONTROL	1.4	1.7	29.3	5.6	29.4

TABLE D-1. ALLOCATION OF INSTRUCTIONAL BLOCKS TO BEHAVIORAL OBJECTIVES ACCORDING TO ASSESSMENT (Cont.)

Beh. Obj.	Title	Assessment				
		Cognitive	Practice		Scenario	
			Initial	Final	Initial	Final
	MAIN DISPLAY UNIT					
2.1	ADJUST MDU DISPLAY CONTROLS	1.2	1.7	29.3	5.6	29.4
2.2	CLEAR OPERATOR ERROR	1.2	1.7	29.3	5.6	29.4
2.3	ESTABLISH NEW RANGE AND BEARING ORIGIN	1.2	1.7	29.3	5.6	29.4
2.4	ESTABLISH AN INTERCOM MARK	1.2	1.7	29.3	5.6	29.4
2.5	ESTABLISH AN OFFSET ON THE MDU	1.2	1.7	29.3	5.6	29.4
2.6	RETURN OFFSET DISPLAY TO NORMAL CENTERED DISPLAY	1.2	1.7	29.3	5.6	29.4
2.7	SELECT 500 NM DISPLAY RANGE	1.2	1.7	29.3	5.6	29.4
2.8	SELECT 250 NM DISPLAY RANGE	1.2	1.7	29.3	5.6	29.4
2.9	SELECT 150 NM DISPLAY RANGE	1.2	1.7	29.3	5.6	29.4
2.10	SELECT 100 NM DISPLAY RANGE	1.2	1.7	29.3	5.6	29.4
2.11	SELECT 50 NM DISPLAY RANGE	1.2	1.7	29.3	5.6	29.4
2.12	SELECT 25 NM DISPLAY RANGE	1.2	1.7	29.3	5.6	29.4
2.13	SELECT 10 NM DISPLAY RANGE	1.2	1.7	29.3	5.6	29.4
2.14	OPERATE DATA ENTRY KEYBOARD	1.2	1.7	29.3	5.6	29.4
2.15	OPERATE LIGHT PEN HOOKING MARKER	1.2	1.7	29.3	5.6	29.4
	AUXILIARY DISPLAY UNIT					
3.1	SELECT TURN PAGE IN VIDEO 1	4.2	4.7	29.3	5.6	29.4
3.2	SELECT AMTI/RAW VIDEO	1.5	1.7	29.3	5.6	29.4
3.3	SELECT LONG PULSE VIDEO	1.5	1.7	29.3	5.6	29.4
3.4	SELECT MODE IV CONFIRM	6.2	6.3	29.3	12.1	29.4
3.5	SELECT CODE IFF	6.1	6.3	29.3	12.1	29.4
3.6	SELECT DECODE IFF	6.1	6.3	29.3	12.1	29.4
3.7	SELECT SYNTHETIC IFF	6.1	6.3	29.3	12.1	29.4
3.8	SELECT SYNTHETIC RADAR	1.5	1.7	29.3	5.6	29.4
3.9	SELECT MODE I	6.2	6.3	29.3	12.1	29.4
3.10	SELECT MODE II	6.2	6.3	29.3	12.1	29.4
3.11	SELECT MODE III	6.2	6.3	29.3	12.1	29.4

TABLE D-1. ALLOCATION OF INSTRUCTIONAL BLOCKS TO BEHAVIORAL OBJECTIVES ACCORDING TO ASSESSMENT (Cont.)

Beh. Obj.	Title	Assessment				
		Cognitive	Practice		Scenario	
			Initial	Final	Initial	Final
3.12	SELECT MODE IV	6.2	6.3	29.3	12.1	29.4
3.13	SELECT MODE C	6.2	6.3	29.3	12.1	29.4
3.14	SELECT INTERROGATION	6.2	6.3	29.3	12.1	29.4
3.15	SELECT PASSIVE DECODE IN VIDEO 1	6.1	6.3	29.3	12.1	29.4
3.16	SELECT CLEAR PLOT	1.5	1.7	29.3	5.6	29.4
3.17	SELECT TURN PAGE IN NORMAL OPS 1	4.2	4.7	29.3	5.6	29.4
3.18	SELECT ACQUIRE TRACK IN NORMAL OPS 1	2.1	2.7	29.3	5.6	29.4
3.19	SELECT ASSIGN A/C IN NORMAL OPS 1	4.2	4.7	29.3	5.6	29.4
3.20	SELECT CANCEL TRACK IN NORMAL OPS 1	2.1	2.7	29.3	5.6	29.4
3.21	SELECT FRIEND IN NORMAL OPS 1	3.2	3.3	29.3	5.6	29.4
3.22	SELECT REPORT TRACK IN NORMAL OPS 1	2.1	2.7	29.3	5.6	29.4
3.23	SELECT CANCEL ASSIGN IN NORMAL OPS 1	4.2	4.7	29.3	5.6	29.4
3.24	SELECT EMERGENCY DOWNED AIRCRAFT IN NORMAL OPS 1	3.2	3.3	29.3	5.6	29.4
3.25	SELECT TRANSLATE IN NORMAL OPS 1	3.2	3.3	29.3	5.6	29.4
3.26	SELECT ASSOCIATE TRACKS IN NORMAL OPS 1	2.2	2.7	29.3	5.6	29.4
3.27	SELECT HOOK ADVANCE IN NORMAL OPS 1	4.2	4.7	29.3	5.6	29.4
3.28	SELECT FIXED MARK IN NORMAL OPS 1	3.2	3.3	29.3	5.6	29.4
3.29	SELECT TN ASSIGN IN NORMAL OPS 1	4.2	4.7	29.3	5.6	29.4
3.30	SELECT TN HOOK IN NORMAL OPS 1	4.2	4.7	29.3	5.6	29.4
3.31	SELECT PASSIVE DECODE IN NORMAL OPS 1	6.1	6.3	29.3	12.1	29.4
3.32	SELECT SURFACE IN NORMAL OPS 1	3.2	3.3	29.3	5.6	29.4
3.33	SELECT TURN PAGE IN TRKING 1	4.2	4.7	29.3	5.6	29.4
3.34	SELECT ACQUIRE TRACK IN TRKING 1	2.1	2.7	29.3	5.6	29.4
3.35	SELECT NO AUTO CANCEL IN TRKING 1			29.3		29.4
3.36	SELECT CANCEL TRACK IN TRKING 1	2.1	2.7	29.3	5.6	29.4
3.37	SELECT RATE AIDED	4.1	4.7	29.3	5.6	29.4
3.38	SELECT COURSE	4.1	4.7	29.3	5.6	29.4
3.39	SELECT SPEED	4.1	4.7	29.3	5.6	29.4
3.40	SELECT HEIGHT	4.1	4.7	29.3	5.6	29.4

TABLE D-1. ALLOCATION OF INSTRUCTIONAL BLOCKS TO BEHAVIORAL OBJECTIVES ACCORDING TO ASSESSMENT (Cont.)

Beh. Obj.	Title	Assessment				
		Cognitive	Practice		Scenario	
			Initial	Final	Initial	Final
3.41	SELECT TRANSLATE IN TRKING 1	3.2	3.3	29.3	5.6	29.4
3.42	SELECT SLAVE TRACK			29.3		29.4
3.43	SELECT HOOK ADVANCE IN TRKING 1	4.2	4.7	29.3	5.6	29.4
3.44	SELECT FIXED MARK IN TRKING 1	3.2	3.3	29.3	5.6	29.4
3.45	SELECT MANUAL REPORT	4.1	4.7	29.3	5.6	29.4
3.46	SELECT TN HOOK IN TRKING 1	4.2	4.7	29.3	5.6	29.4
3.47	SELECT IFF HOOK IN TRKING 1			29.3		29.4
3.48	SELECT TRKING 2	10.3	10.4	29.3	12.1	29.4
3.49	SELECT IAD ZONE	8.1	8.4	29.3	12.1	29.4
3.50	SELECT IAA ZONE	8.1	8.4	29.3	12.1	29.4
3.51	AMTI ZONE	8.1	8.4	29.3	12.1	29.4
3.52	SELECT DISPLAY ZONES			29.3		29.4
3.53	SELECT ENTER IFF			29.3		29.4
3.54	SELECT HI ALT TRKING	8.1	8.4	29.3	12.1	29.4
3.55	SELECT EECM ACT NAC	8.1	8.4	29.3	12.1	29.4
3.56	SELECT ENTER LINE IN TRKING 2	5.1	5.5	29.3	5.6	29.4
3.57	SELECT REPORT HEIGHT			29.3		29.4
3.58	SELECT PROV TRACKS			29.3		29.4
3.59	SELECT DISPLAY FMZ	8.1	8.4	29.3	12.1	29.4
3.60	SELECT FMZ IN TRACKING 2	8.1	8.4	29.3	12.1	29.4
3.61	SELECT RETURN 1 IN TRKING 2	17.2	17.4	29.3	18.1	29.4
3.62	SELECT TURN PAGE IN A/C CONTROL 1	4.2	4.7	29.3	5.6	29.4
3.63	SELECT TRAIL ASSIGN IN A/C CONTROL 1			29.3		29.4
3.64	SELECT ASSIGN A/C IN A/C CONTROL 1	4.2	4.7	29.3	5.6	29.4
3.65	SELECT F-14 CNTRL 2	10.3	10.4	29.3	12.1	29.4
3.66	SELECT TURN PAGE IN F-14 CNTRL 2	4.2	4.7	29.3	5.6	29.4
3.67	SELECT CANCEL REPORT	14.2	14.3	29.3	18.1	29.4
3.68	SELECT TWO-WAY LINK	14.1	14.3	29.3	18.1	29.4
3.69	SELECT DISPLAY RPTS FR	14.2	14.3	29.3	18.1	29.4
3.70	SELECT SEND CHAL	14.1	14.3	29.3	18.1	29.4

TABLE D-1. ALLOCATION OF INSTRUCTIONAL BLOCKS TO BEHAVIORAL OBJECTIVES ACCORDING TO ASSESSMENT (Cont.)

Beh. Obj.	Title	Assessment				
		Cognitive	Practice		Scenario	
			Initial	Final	Initial	Final
3.71	SELECT SEND DISENGAGE	14.1	14.3	29.3	18.1	29.4
3.72	SELECT NO REPLY	14.2	14.3	29.3	18.1	29.4
3.73	SELECT DISPLAY RPTS TO	14.2	14.3	29.3	18.1	29.4
3.74	SELECT SEND DESTROY	14.1	14.3	29.3	18.1	29.4
3.75	SELECT ASSOCIATE TRACKS IN F-14 CNTRL 2	2.2	2.7	29.3	5.6	29.4
3.76	SELECT LINK 4 POINTER	14.1	14.3	29.3	18.1	29.4
3.77	SELECT MULTIPLE TARGET SEQUENCE IN F-14 CNTRL 2	14.2	14.3	29.3	18.1	29.4
3.78	SEND PR KILL	14.1	14.3	29.3	18.1	29.4
3.79	SELECT SEND REPORT	14.1	14.3	29.3	18.1	29.4
3.80	SELECT L4 AUTO ASSOC	14.2	14.3	29.3	18.1	29.4
3.81	SELECT RETURN 1 IN F-14 CNTRL 2	17.2	17.4	29.3	18.1	29.4
3.82	SELECT DESTROY IN A/C CONTROL 1			29.3		29.4
3.83	SELECT STRIKE POINT IN A/C CONTROL 1	5.1	5.5	29.3	5.6	29.4
3.84	SELECT CANCEL ASSIGN IN A/C CONTROL 1	4.2	4.7	29.3	5.6	29.4
3.85	SELECT MISSION 2	10.3	10.4	29.3	12.1	29.4
3.86	SELECT REVERT TO VOICE	11.3	11.5	29.3	12.1	29.4
3.87	SELECT TRIAL ASSIGN IN A/C MISSION 2			29.3		29.4
3.88	SELECT ASSIGN A/C IN A/C MISSION 2	4.2	4.7	29.3	5.6	29.4
3.89	SELECT ASSIGN SPEED	11.1	11.5	29.3	12.1	29.4
3.90	SELECT DESTROY IN A/C MISSION 2	11.3	11.5	29.3	12.1	29.4
3.91	SELECT REAR ATTACK GEOMETRY	11.2	11.5	29.3	12.1	29.4
3.92	SELECT CANCEL ASSIGN IN A/C MISSION 2	4.2	4.7	29.3	5.6	29.4
3.93	SELECT ASSIGN ALTITUDE	11.1	11.5	29.3	12.1	29.4
3.94	SELECT DISENGAGE	11.3	11.5	29.3	12.1	29.4
3.95	SELECT PURSUIT ATTACK GEOMETRY	11.2	11.5	29.3	12.1	29.4
3.96	SELECT COLLISION ATTACK GEOMETRY	11.2	11.5	29.3	12.1	29.4
3.97	SELECT ASSIGN HEADING	11.1	11.5	29.3	12.1	29.4
3.98	SELECT RETURN TO BASE	11.3	11.5	29.3	12.1	29.4
3.99	SELECT COMMAND TRKING	11.3	11.5	29.3	12.1	29.4

TABLE D-1. ALLOCATION OF INSTRUCTIONAL BLOCKS TO BEHAVIORAL OBJECTIVES ACCORDING TO ASSESSMENT (Cont.)

Beh. Obj.	Title	Assessment				
		Cognitive	Practice		Scenario	
			Initial	Final	Initial	Final
3.100	SELECT LEAD COLLISION ATTACK GEOMETRY	11.2	11.5	29.3	12.1	29.4
3.101	SELECT RETURN 1 IN A/C MISSION 2	17.2	17.4	29.3	18.1	29.4
3.102	SELECT WAYPOINT	3.1	3.3	29.3	5.6	29.4
3.103	SELECT DATUM	3.1	3.3	29.3	5.6	29.4
3.104	SELECT HOOK ADVANCE IN A/C CONTROL 1	4.2	4.7	29.3	5.6	29.4
3.105	SELECT MULTIPLE TARGET SEQUENCE IN A/C CONTROL 1	14.2	14.3	29.3	18.1	29.4
3.106	SELECT CAP STATION IN A/C CONTROL 1			29.3		29.4
3.107	SELECT TN HOOK IN A/C CONTROL 1	4.2	4.7	29.3	5.6	29.4
3.108	SELECT IFF HOOK IN A/C CONTROL 1			29.3		29.4
3.109	SELECT A/C DATA 2	10.3	10.4	29.3	12.1	29.4
3.110	SELECT ENTER EXPECTED PI	13.3	13.4	29.3	18.1	29.4
3.111	SELECT DATA LINK ADDRESS/VOICE	13.3	13.4	29.3	18.1	29.4
3.112	SELECT F-4	13.1	13.4	29.3	18.1	29.4
3.113	SELECT F-14	13.1	13.4	29.3	18.1	29.4
3.114	SELECT CLEAN CONFIGURATION	13.1	13.4	29.3	18.1	29.4
3.115	SELECT CENTER TANK CONFIGURATION	13.1	13.4	29.3	18.1	29.4
3.116	SELECT WING TANKS CONFIGURATION	13.1	13.4	29.3	18.1	29.4
3.117	SELECT ALL TANKS CONFIGURATION	13.1	13.4	29.3	18.1	29.4
3.118	SELECT ENTER FUEL	13.1	13.4	29.3	18.1	29.4
3.119	SELECT PHOENIX CONFIGURATION	13.2	13.4	29.3	18.1	29.4
3.120	SELECT SPARROW CONFIGURATION	13.2	13.4	29.3	18.1	29.4
3.121	SELECT SIDEWINDER CONFIGURATION	13.2	13.4	29.3	18.1	29.4
3.122	SELECT READ EXPECTED PI	13.3	13.4	29.3	18.1	29.4
3.123	SELECT CONTROL A/C	13.3	13.4	29.3	18.1	29.4
3.124	SELECT RETURN 1 IN A/C DATA 2	17.2	17.4	29.3	18.1	29.4
3.125	SELECT TURN PAGE IN LINK-11 1	4.2	4.7	29.3	5.6	29.4
3.126	SELECT HANDOVER	16.2	16.3	29.3	18.1	29.4
3.127	SELECT PRIOR REPORT	16.1	16.3	29.3	18.1	29.4
3.128	SELECT CANCEL TRACK IN LINK 11 1	2.1	2.7	29.3	5.6	29.4

TABLE D-1. ALLOCATION OF INSTRUCTIONAL BLOCKS TO BEHAVIORAL OBJECTIVES ACCORDING TO ASSESSMENT (Cont.)

Beh. Obj.	Title	Assessment				
		Cognitive	Practice		Scenario	
			Initial	Final	Initial	Final
3.129	SELECT DISPLAY PU REPORTS	16.1	16.3	29.3	18.1	29.4
3.130	SELECT REPORT TRACK	2.1	2.7	29.3	5.6	29.4
3.131	SELECT NOT REPORT TRACK	16.1	16.3	29.3	18.1	29.4
3.132	SELECT WILCO	16.1	16.3	29.3	18.1	29.4
3.133	SELECT LINK 11 POINTER	16.2	16.3	29.3	18.1	29.4
3.134	SELECT ASSOCIATE TRACKS IN LINK 11 1	2.2	2.7	29.3	5.6	29.4
3.135	SELECT HOOK ADVANCE IN LINK 11 1	4.2	4.7	29.3	5.6	29.4
3.136	SELECT CANTCO	16.1	16.3	29.3	18.1	29.4
3.137	SELECT TN ASSIGN IN LINK 11 1	4.2	4.7	29.3	5.6	29.4
3.138	SELECT TN HOOK IN LINK 11 1	4.2	4.7	29.3	5.6	29.4
3.139	SELECT CONFIRM ID	16.2	16.3	29.3	18.1	29.4
3.140	SELECT LINK 11 2	10.3	10.4	29.3	12.1	29.4
3.141	SELECT TURN PAGE IN LINK 11 2	4.2	4.7	29.3	5.6	29.4
3.142	SELECT NON TDS	17.2	17.4	29.3	18.1	29.4
3.143	SELECT DLRP IN LINK 11 2	17.3	17.4	29.3	18.1	29.4
3.144	SELECT SINGLE/SMALL	17.1	17.4	29.3	18.1	29.4
3.145	SELECT DISPLAY REMOTE ENGAGEMENTS	17.2	17.4	29.3	18.1	29.4
3.146	SELECT GRIDLOCK	17.3	17.4	29.3	18.1	29.4
3.147	SELECT INCOMING SECTOR	17.3	17.4	29.3	18.1	29.4
3.148	SELECT FEW/MEDIUM	17.1	17.4	29.3	18.1	29.4
3.149	SELECT REMOTE ENGAGEMENTS SEQUENCE	17.2	17.4	29.3	18.1	29.4
3.150	SELECT SECTOR CENTER	17.3	17.4	29.3	18.1	29.4
3.151	SELECT OUTGOING SECTOR	17.3	17.4	29.3	18.1	29.4
3.152	SELECT MANY/LARGE	17.1	17.4	29.3	18.1	29.4
3.153	SELECT AUTOMATIC DISASSOCIATION	17.2	17.4	29.3	18.1	29.4
3.154	SELECT TN LIMITS	17.2	17.4	29.3	18.1	29.4
3.155	SELECT RETURN 1 IN LINK 11 2	17.2	17.4	29.3	18.1	29.4
3.156	SELECT TURN PAGE IN PDS 1	26.2	26.5	29.3	29.4	29.4
3.157	SELECT DATA SEQUENCE IN PDS 1	26.2	26.5	29.3	29.4	29.4
3.158	SELECT NO AUTO CANCEL IN PDS 1			29.3		29.4

TABLE D-1. ALLOCATION OF INSTRUCTIONAL BLOCKS TO BEHAVIORAL OBJECTIVES ACCORDING TO ASSESSMENT (Cont.)

Beh. Obj.	Title	Assessment				
		Cognitive	Practice		Scenario	
			Initial	Final	Initial	Final
3.159	SELECT ACTIVE/PASSIVE ASSOCIATION	26.3	26.5	29.3	29.4	29.4
3.160	SELECT PASSIVE/PASSIVE ASSOCIATION	26.3	26.5	29.3	29.4	29.4
3.161	SELECT ASSOCIATE TRACKS IN PDS 1	2.2	2.7	29.3	5.6	29.4
3.162	SELECT HOOK ADVANCE IN PDS 1	4.2	4.7	29.3	5.6	29.4
3.163	SELECT PDS ID 2	28.1	28.3	29.3	29.4	29.4
3.164	SELECT TURN PAGE IN PDS ID 2	4.2	4.7	29.3	5.6	29.4
3.165	SELECT DATA SEQUENCE IN PDS ID 2	26.2	26.5	29.3	29.4	29.4
3.166	SELECT CANCEL PLATFORM ID	28.2	28.3	29.3	29.4	29.4
3.167	SELECT CANCEL EMITTER ID	28.1	28.3	29.3	29.4	29.4
3.168	SELECT EMITTER SEQUENCE	28.1	28.3	29.3	29.4	29.4
3.169	SELECT DISPLAY NO I-FILE ID	28.1	28.3	29.3	29.4	29.4
3.170	SELECT CONFIRM PLATFORM ID	28.2	28.3	29.3	29.4	29.4
3.171	SELECT CONFIRM EMITTER ID	28.1	28.3	29.3	29.4	29.4
3.172	SELECT PLATFORM SEQUENCE	28.2	28.3	29.3	29.4	29.4
3.173	SELECT ENTER SPECIAL BAND	29.1	29.3	29.3	29.4	29.4
3.174	SELECT HOOK ADVANCE IN PDS ID 2	4.2	4.7	29.3	5.6	29.4
3.175	SELECT PLATFORM ASSOCIATION	28.2	28.3	29.3	29.4	29.4
3.176	SELECT SPECIAL BAND FREQUENCY	29.1	29.3	29.3	29.4	29.4
3.177	SELECT SPECIAL BAND PRF	29.1	29.3	29.3	29.4	29.4
3.178	SELECT SPECIAL BAND PULSE WIDTH	29.1	29.3	29.3	29.4	29.4
3.179	SELECT RETURN 1 IN PDS ID 2	17.2	17.4	29.3	18.1	29.4
3.180	SELECT ECM FIX	26.4	26.5	29.3	29.4	29.4
3.181	SELECT PDS LOAD	26.2	26.5	29.3	29.4	29.4
3.182	SELECT SCAN RATE	26.2	26.5	29.3	29.4	29.4
3.183	SELECT SYSTEM CONTROL 2	28.1	28.3	29.3	29.4	29.4
3.184	SELECT READ PRIORITY BAND	27.1	27.3	29.3	29.4	29.4
3.185	SELECT FREQUENCY	27.2	27.3	29.3	29.4	29.4
3.186	SELECT PRIORITY BAND RECYCLE TIME	27.2	27.3	29.3	29.4	29.4
3.187	SELECT READ NON-PRIORITY BAND	27.1	27.3	29.3	29.4	29.4
3.188	SELECT DWELL TIME	27.2	27.3	29.3	29.4	29.4

TABLE D-1. ALLOCATION OF INSTRUCTIONAL BLOCKS TO BEHAVIORAL OBJECTIVES ACCORDING TO ASSESSMENT (Cont.)

Beh. Obj.	Title	Assessment				
		Cognitive	Practice		Scenario	
			Initial	Final	Initial	Final
3.189	SELECT ATTENUATION	27.2	27.3	29.3	29.4	29.4
3.190	SELECT ENTER BAND	27.1	27.3	29.3	29.4	29.4
3.191	SELECT PRF	27.2	27.3	29.3	29.4	29.4
3.192	SELECT PREDICTED GATE WIDTH	27.2	27.3	29.3	29.4	29.4
3.193	SELECT SEND DATA	27.1	27.3	29.3	29.4	29.4
3.194	SELECT AZIMUTH	27.2	27.3	29.3	29.4	29.4
3.195	SELECT ENABLE LOW CONFIDENCE	27.1	27.3	29.3	29.4	29.4
3.196	SELECT RETURN 1 IN PDS SYS CNTRL 2	17.2	17.4	29.3	18.1	29.4
3.197	SELECT IFF UNKNOWN	5.2	5.5	29.3	5.6	29.4
3.198	SELECT NEUTRAL	5.2	5.5	29.3	5.6	29.4
3.199	SELECT INTERCEPTOR	5.4	5.5	29.3	5.6	29.4
3.200	SELECT AIR	5.3	5.5	29.3	5.6	29.4
3.201	SELECT FRIEND IN TRACK CLASS 1	5.2	5.5	29.3	5.6	29.4
3.202	SELECT CONFIRM	5.2	5.5	29.3	5.6	29.4
3.203	SELECT STRIKE	5.4	5.5	29.3	5.6	29.4
3.204	SELECT EMERGENCY DOWNED AIRCRAFT IN TRACK CLASS 1	3.2	3.3	29.3	5.6	29.4
3.205	SELECT UNKNOWN	5.2	5.5	29.3	5.6	29.4
3.206	SELECT TANKER PROBE	5.4	5.5	29.3	5.6	29.4
3.207	SELECT MISSILE UNIT	5.4	5.5	29.3	5.6	29.4
3.208	SELECT SUBSURFACE	5.3	5.5	29.3	5.6	29.4
3.209	SELECT HOSTILE	5.2	5.5	29.3	5.6	29.4
3.210	SELECT TANKER DROGUE	5.4	5.5	29.3	5.6	29.4
3.211	SELECT PATROL	5.4	5.5	29.3	5.6	29.4
3.212	SELECT SURFACE IN TRACK CLASS 1	5.3	5.5	29.3	5.6	29.4
3.213	SELECT TAC STATION	5.1	5.5	29.3	5.6	29.4
3.214	SELECT NAV FIX	3.1	3.3	29.3	5.6	29.4
3.215	SELECT DLRP IN POINT CLASS 1	17.3	17.4	29.3	18.1	29.4
3.216	SELECT SYSTEM REFERENCE POINT	3.1	3.3	29.3	5.6	29.4
3.217	SELECT HOME PLATE	5.1	5.5	29.3	5.6	29.4

TABLE D-1. ALLOCATION OF INSTRUCTIONAL BLOCKS TO BEHAVIORAL OBJECTIVES ACCORDING TO ASSESSMENT (Cont.)

Beh. Obj.	Title	Assessment				
		Cognitive	Practice		Scenario	
			Initial	Final	Initial	Final
3.218	SELECT STRIKE POINT IN POINT CLASS 1	5.1	5.5	29.3	5.6	29.4
3.219	SELECT BARRIER REFERENCE POINT	3.1	3.3	29.3	5.6	29.4
3.220	SELECT EMERGENCY DOWNED AIRCRAFT IN POINT CLASS 1	3.2	3.3	29.3	5.6	29.4
3.221	SELECT WAYPOINT IN POINT CLASS 1	3.1	3.3	29.3	5.6	29.4
3.222	SELECT DATUM IN POINT CLASS 1	3.1	3.3	29.3	5.6	29.4
3.223	SELECT ENTER LINE IN POINT CLASS 1	5.1	5.5	29.3	5.6	29.4
3.224	SELECT FIXED MARK IN POINT CLASS 1	3.2	3.3	29.3	5.6	29.4
3.225	SELECT CAP STATION IN POINT CLASS 1			29.3		29.4
3.226	SELECT FLIGHT PATH	5.1	5.5	29.3	5.6	29.4
3.227	SELECT FMZ IN POINT CLASS 1	8.1	8.4	29.3	12.1	29.4
3.228	SELECT CONSOLE REFERENCE POINT	3.1	3.3	29.3	5.6	29.4
3.229	SELECT ENABLE DATA EXTRACTION	24.1	24.3	29.3	29.4	29.4
3.230	SELECT READ EXTRACTION POINTS	24.2	24.3	29.3	29.4	29.4
3.231	SELECT EXTRACTION OF SELECT TRACK	24.2	24.3	29.3	29.4	29.4
3.232	SELECT SELECT TRACK	24.2	24.3	29.3	29.4	29.4
3.233	SELECT READ TAPE LENGTH	24.2	24.3	29.3	29.4	29.4
3.234	SELECT TIME	23.2	23.3	29.3	29.4	29.4
3.235	SELECT SYSTEM RESET	23.1	23.3	29.3	29.4	29.4
3.236	SELECT SYSTEM RESET	23.1	23.3	29.3	29.4	29.4
3.237	SELECT READ POINTS	23.2	23.3	29.3	29.4	29.4
3.238	SELECT MAXIMUM LIVE TRACKS	23.1	23.3	29.3	29.4	29.4
3.239	SELECT TRACK FILE CLEAR	23.1	23.3	29.3	29.4	29.4
3.240	SELECT WRITE POINTS	23.2	23.3	29.3	29.4	29.4
3.241	SELECT READ TRUE HEADING/BEARING	23.2	23.3	29.3	29.4	29.4
3.242	SELECT COMMAND SPEED IN KNOTS	23.2	23.3	29.3	29.4	29.4
3.243	SELECT AIR FRIEND	1.6	1.7	29.3	5.6	29.4
3.244	SELECT SURFACE/SUBSURFACE FRIEND	1.6	1.7	29.3	5.6	29.4
3.245	SELECT CONTROL A/C	4.3	4.7	29.3	5.6	29.4
3.246	SELECT PATHS	4.4	4.7	29.3	5.6	29.4

TABLE D-1. ALLOCATION OF INSTRUCTIONAL BLOCKS TO BEHAVIORAL OBJECTIVES ACCORDING TO ASSESSMENT (Cont.)

Beh. Obj.	Title	Assessment				
		Cognitive	Practice		Scenario	
			Initial	Final	Initial	Final
3.247	SELECT AIR UNKNOWN	1.6	1.7	29.3	5.6	29.4
3.248	SELECT SURFACE/SUBSURFACE UNKNOWN	1.6	1.7	29.3	5.6	29.4
3.249	SELECT TACTICAL POINTS	4.3	4.7	29.3	5.6	29.4
3.250	SELECT VELOCITY VECTORS	4.4	4.7	29.3	5.6	29.4
3.251	SELECT AIR HOSTILE	1.6	1.7	29.3	5.6	29.4
3.252	SELECT SURFACE/SUBSURFACE HOSTILE	1.6	1.7	29.3	5.6	29.4
3.253	SELECT REFERENCE POINTS	4.3	4.7	29.3	5.6	29.4
3.254	SELECT LINES	4.4	4.7	29.3	5.6	29.4
3.255	SELECT ALL SYMBOLS OFF	4.4	4.7	29.3	5.6	29.4
3.256	SELECT HEIGHT STRATA	4.4	4.7	29.3	5.6	29.4
3.257	SELECT FIXED MARK	4.3	4.7	29.3	5.6	29.4
3.258	SELECT SYMBOL DISP 2	10.3	10.4	29.3	12.1	29.4
3.259	SELECT PDS SECTOR	30.2	30.6	30.6	31.2	31.2
3.260	SELECT PRIORITY BAND	30.1	30.6	30.6	31.2	31.2
3.261	SELECT LINK 11 FRIEND					
3.262	SELECT ALPHANUMERICS SELECT	4.5	4.7	29.3	5.6	29.4
3.263	SELECT PDS FRIEND	30.2	30.6	30.6	31.2	31.2
3.264	SELECT NON-PRIORITY BAND	30.1	30.6	30.6	31.2	31.2
3.265	SELECT LINK 11 HOSTILE/UNKNOWN					
3.266	SELECT DOT	4.5	4.7	29.3	5.6	29.4
3.267	SELECT PDS HOSTILE/UNKNOWN	30.2	30.6	30.6	31.2	31.2
3.268	SELECT EECM	30.1	30.6	30.6	31.2	31.2
3.269	SELECT LINK 11 ECM					
3.270	SELECT CANCEL SYMBOL	4.5	4.7	29.3	5.6	29.4
3.271	SELECT MAJOR BANDS	30.1	30.6	30.6	31.2	31.2
3.272	SELECT PDS PLATFORM	30.2	30.6	30.6	31.2	31.2
3.273	SELECT ALL LINK 4 TRACKS					
3.274	SELECT RETURN 1 IN SYMBOL DISP 2	4.5	4.7	29.3	5.6	29.4
3.275	SELECT IFPM MESSAGE	10.3	10.4	29.3	12.1	29.4
3.276	SELECT RDR XMTR 2	10.3	10.4	29.3	12.1	29.4
3.277	SELECT CLEAR SCRAM IN RDR XMTR 2	10.3	10.4	29.3	12.1	29.4

TABLE D-1. ALLOCATION OF INSTRUCTIONAL BLOCKS TO BEHAVIORAL OBJECTIVES ACCORDING TO ASSESSMENT (Cont.)

Beh. Obj.	Title	Assessment				
		Cognitive	Practice		Scenario	
			Initial	Final	Initial	Final
3.278	SELECT RADAR TRANSMITTER RESET	10.3	10.4	29.3	12.1	29.4
3.279	SELECT POWER METER	10.3	10.4	29.3	12.1	29.4
3.280	SELECT IFPM MESSAGE IN RDR XMTR 2	10.3	10.4	29.3	12.1	29.4
3.281	SELECT RETURN 1 IN RDR XMTR 2	10.3	10.4	29.3	12.1	29.4
3.282	SELECT RDR SIG PROC 2	10.3	10.4	29.3	12.1	29.4
3.283	SELECT RDP TEST TARGET	10.3	10.4	29.3	12.1	29.4
3.284	SELECT RADAR TEST TARGET	10.3	10.4	29.3	12.1	29.4
3.285	SELECT FAR RDR RNG	10.3	10.4	29.3	12.1	29.4
3.286	SELECT RDP REPORT TAG	10.3	10.4	29.3	12.1	29.4
3.287	SELECT AEDF OVERRIDE	10.3	10.4	29.3	12.1	29.4
3.288	SELECT NEAR RADAR RING	10.3	10.4	29.3	12.1	29.4
3.289	SELECT CLEAR SCRAM IN RDR SIG PROC 2	10.3	10.4	29.3	12.1	29.4
3.290	SELECT RADAR SIGNAL PROCESSOR RESET	10.3	10.4	29.3	12.1	29.4
3.291	SELECT RDP RESET	10.3	10.4	29.3	12.1	29.4
3.292	SELECT IFPM MESSAGE IN RDR SIG PROC 2	10.3	10.4	29.3	12.1	29.4
3.293	SELECT RETURN 1 IN RDR SIG PROC 2	10.3	10.4	29.3	12.1	29.4
3.294	SELECT IFF EECM 2	10.3	10.4	29.3	12.1	29.4
3.295	SELECT IDP TEST TARGET	25.2	25.3	29.3	29.4	29.4
3.296	SELECT IFF TEST TARGET	25.2	25.3	29.3	29.4	29.4
3.297	SELECT IFF RING TEST TARGET	25.2	25.3	29.3	29.4	29.4
3.298	SELECT ALIGN SET-UP	25.2	25.3	29.3	29.4	29.4
3.299	SELECT TRANSPONDER TEST	25.2	25.3	29.3	29.4	29.4
3.300	SELECT EECM TEST	25.2	25.3	29.3	29.4	29.4
3.301	SELECT CLEAR SCRAM IN IFF EECM 2	25.2	25.3	29.3	29.4	29.4
3.302	SELECT IDP RESET	25.2	25.3	29.3	29.4	29.4
3.303	SELECT TRANSPONDER RESET	25.2	25.3	29.3	29.4	29.4
3.304	SELECT EECM RESET	25.2	25.3	29.3	29.4	29.4
3.305	SELECT IFPM MESSAGE IN IFF EECM 2	25.2	25.3	29.3	29.4	29.4
3.306	SELECT RETURN 1 IN IFF EECM 2	25.2	25.3	29.3	29.4	29.4
3.307	SELECT COMM2	2.6	2.7	29.3	29.4	29.4
3.308	SELECT DATA TERMINAL SET TEST	2.6	2.7	29.3	29.4	29.4

TABLE D-1. ALLOCATION OF INSTRUCTIONAL BLOCKS TO BEHAVIORAL OBJECTIVES ACCORDING TO ASSESSMENT (Cont.)

Beh. Obj.	Title	Assessment				
		Cognitive	Practice		Scenario	
			Initial	Final	Initial	Final
3.309	SELECT HF-1 TEST	2.6	2.7	29.3	5.6	29.4
3.310	SELECT HF-2 TEST	2.6	2.7	29.3	5.6	29.4
3.311	SELECT UHF-3 TEST	2.6	2.7	29.3	5.6	29.4
3.312	SELECT UHF-4 TEST	2.6	2.7	29.3	5.6	29.4
3.313	SELECT UHF-5 TEST	2.6	2.7	29.3	5.6	29.4
3.314	SELECT CLEAR SCRAM IN COMM 2	2.6	2.7	29.3	5.6	29.4
3.315	SELECT UHF 1-2 RESET	2.6	2.7	29.3	5.6	29.4
3.316	SELECT UHF 3-5 RESET	2.6	2.7	29.3	5.6	29.4
3.317	SELECT HF 1-2 RESET	2.6	2.7	29.3	5.6	29.4
3.318	SELECT KG-23 RESET	2.6	2.7	29.3	5.6	29.4
3.319	SELECT IFPM MESSAGE IN COMM 2	2.6	2.7	29.3	5.6	29.4
3.320	SELECT RETURN 1 IN COMM 2	2.6	2.7	29.3	5.6	29.4
3.321	SELECT NAV 2	11.4	11.5	29.3	12.1	29.4
3.322	SELECT DOPPLER TEST	11.4	11.5	29.3	12.1	29.4
3.323	SELECT HAR/SDC TEST	11.4	11.5	29.3	12.1	29.4
3.324	SELECT CLEAR SCRAM IN NAV 2	11.4	11.5	29.3	12.1	29.4
3.325	SELECT NAV POWER SUPPLY RESET	11.4	11.5	29.3	12.1	29.4
3.326	SELECT HAR/SDC RESET	11.4	11.5	29.3	12.1	29.4
3.327	SELECT ADC RESET	11.4	11.5	29.3	12.1	29.4
3.328	SELECT CAINS RESET	11.4	11.5	29.3	12.1	29.4
3.329	SELECT IFPM MESSAGE IN NAV 2	11.4	11.5	29.3	12.1	29.4
3.330	SELECT RETURN 1 IN NAV 2	11.4	11.5	29.3	12.1	29.4
3.331	SELECT PDS 2	10.3	10.4	29.3	12.1	29.4
3.332	SELECT PDS TEST TARGET	29.2	29.3	92.3	29.4	29.4
3.333	SELECT CLEAR SCRAM IN PDS 2	29.2	29.3	29.3	29.4	29.4
3.334	SELECT PDS RESET	29.2	29.3	29.3	29.4	29.4
3.335	SELECT IFPM MESSAGE IN PDS 2	29.2	29.3	29.3	29.4	29.4
3.336	SELECT RETURN 1 IN PDS 2	29.2	29.3	29.3	29.4	29.4
3.337	SELECT SPL TST 2	22.1	22.2	29.3	29.4	29.4
3.338	SELECT ALERT LIGHT TEST	22.1	22.2	29.3	29.4	29.4
3.339	SELECT NIXIE SEQUENCE TEST	22.1	22.2	29.3	29.4	29.4

TABLE D-1. ALLOCATION OF INSTRUCTIONAL BLOCKS TO BEHAVIORAL OBJECTIVES ACCORDING TO ASSESSMENT (Cont.)

Beh. Obj.	Title	Assessment				
		Cognitive	Practice		Scenario	
			Initial	Final	Initial	Final
3.340	SELECT BDHI TEST	22.1	22.2	29.3	29.4	29.4
3.341	SELECT TEST POINT SELECT	22.1	22.2	29.3	29.4	29.4
3.342	SELECT MULTIPLEXER TEST	22.1	22.2	29.3	29.4	29.4
3.343	SELECT IFPM MESSAGE IN SPL TST 2	22.1	22.2	29.3	29.4	29.4
3.344	SELECT RETURN 1 IN SPL TST 2	22.1	22.2	29.3	29.4	29.4
3.345	SELECT CLEAR ALL SCRAMS	30.3	30.6	30.6	31.2	31.2
3.346	SELECT CP TEST RESET	30.3	30.6	30.6	31.2	31.2
3.347	SELECT I/O STATUS	30.3	30.6	30.6	31.2	31.2
3.348	SELECT INTERMITTENCY COUNTERS RESET	30.3	30.6	30.6	31.2	31.2
3.349	SELECT IFPM CLEAR	30.3	30.6	30.6	31.2	31.2
3.350	SELECT IFPM HISTORY	30.3	30.6	30.6	31.2	31.2
3.351	SELECT IFPM MESSAGE IN IFPM FCTN 1	30.3	30.6	30.6	31.2	31.2
3.352	SELECT FAULT STATUS	30.3	30.6	30.6	31.2	31.2
3.353	ADJUST ADU INTENSITY CONTROLS					
3.354	RESET IFF EMERG ALERT					
3.355	RESET RADAR JAM ALERT					
3.356	RESET IFPM ALERT					
	AUXILIARY CONTROL UNIT					
4.1	ESTABLISH AMTI SECTOR WITH SECTOR GATE #1 CONTROLS	7.1	7.2	29.3	12.1	29.4
4.2	ESTABLISH AMTI SECTOR WITH SECTOR GATE #3 CONTROLS	7.1	7.2	29.3	12.1	29.4
4.3	ESTABLISH RDP IAD SECTOR WITH SECTOR GATE #1 CONTROLS	7.1	7.2	29.3	12.1	29.4
4.4	ESTABLISH RDP IAD SECTOR WITH SECTOR GATE #3 CONTROLS	7.1	7.2	29.3	12.1	29.4
4.5	ESTABLISH NO IFF SECTOR WITH SECTOR GATE #1 CONTROLS	7.1	7.2	29.3	12.1	29.4
4.6	ESTABLISH NO IFF SECTOR WITH SECTOR GATE #3 CONTROLS	7.1	7.2	29.3	12.1	29.4

TABLE D-1. ALLOCATION OF INSTRUCTIONAL BLOCKS TO BEHAVIORAL OBJECTIVES ACCORDING TO ASSESSMENT (Cont.)

Beh. Obj.	Title	Assessment				
		Cognitive	Practice		Scenario	
			Initial	Final	Initial	Final
4.7	ESTABLISH AMTI SECTOR WITH VIDEO AMTI/RAW RDP TRANSFER RANGE CONTROL	7.1	7.2	29.3	12.1	29.4
4.8	ESTABLISH RDP IAD SECTOR WITH NO/AUTO DETECTION RDP TRANSFER RANGE CONTROL	7.1	7.2	29.3	12.1	29.4
4.9	SELECT SIF MODES OF INTERROGATION	7.1	7.2	29.3	12.1	29.4
4.10	SELECT OUTGOING AIR TARGET REPORTS	7.1	7.2	29.3	12.1	29.4
4.11	SELECT OUTGOING SURFACE TARGET REPORTS	7.1	7.2	29.3	12.1	29.4
4.12	SELECT INCOMING SURFACE TARGET REPORTS	7.1	7.2	29.3	12.1	29.4
4.13	OPERATE NORM/BYPASS SWITCH	7.1	7.2	29.3	12.1	29.4
4.14	OPERATE THE A/B/ZERO CODE SWITCH	7.1	7.2	29.3	12.1	29.4
4.15	OPERATE ANTENNA AZIMUTH SOURCE SWITCH	7.1	7.2	29.3	12.1	29.4
4.16	RESFT ACU FAULT CIRCUITRY	7.1	7.2	29.3	12.1	29.4
	RADAR SET CONTROL					
5.1	OPERATE RSC POWER CONTROL SWITCHES	8.2	8.4	29.3	12.1	29.4
5.2	OPERATE CHANNEL SWITCH	8.2	8.4	29.3	12.1	29.4
5.3	SELECT RSC OPERATING MODE	8.2	8.4	29.3	12.1	29.4
5.4	OPERATE HV RAISE/LOWER SWITCH	10.1	10.4	29.3	12.1	29.4
5.5	OPERATE ANTENNA	10.1	10.4	29.3	12.1	29.4
5.6	OPERATE BATTLE SHORT SWITCH	10.1	10.4	29.3	12.1	29.4
5.7	ESTABLISH MDS AND SET UP THE RSC TO DETECT JAMMING	10.1	10.4	29.3	12.1	29.4
5.8	SELECT RSC RADAR MODE OPTION	9.1	9.2	29.3	12.1	29.4
5.9	PERFORM TACCAR TEST LOOP LOCK	9.1	9.2	29.3	12.1	29.4
5.10	OPERATE RADAR IN DUMMY LOAD OR ANTENNA	10.1	10.4	29.3	12.1	29.4
5.11	OPERATE AMTI STC LEVEL CONTROL	10.1	10.4	29.3	12.1	29.4
5.12	OPERATE LONG PULSE GAIN AND STC LEVEL CONTROLS	10.1	10.4	29.3	12.1	29.4

TABLE D-1. ALLOCATION OF INSTRUCTIONAL BLOCKS TO BEHAVIORAL OBJECTIVES ACCORDING TO ASSESSMENT (Cont.)

Beh. Obj.	Title	Assessment				
		Cognitive	Practice		Scenario	
			Initial	Final	Initial	Final
	COMPUTER PROGRAMMER					
6.1	ENTER DIAGNOSTIC ROUTINE IN THE CP	19.1	19.3	29.3	29.4	29.4
6.2	OPERATE CP SYSTEM CONTROL SWITCHES AND INDICATORS	19.1	19.3	29.3	29.4	29.4
6.3	OPERATE ERROR RESET ON THE CCP	19.1	19.3	29.3	29.4	29.4
6.4	ADVANCE AND REWIND DDRR TAPE IN MANUAL MODE	19.1	19.3	29.3	29.4	29.4
6.5	OPERATE WRITE ENABLE SWITCHCAP	19.1	19.3	29.3	29.4	29.4
6.6	LOAD DUAL PROCESSOR TACTICAL PROGRAM	20.1	20.2	29.3	29.4	29.4
6.7	LOAD SINGLE PROCESSOR TACTICAL PROGRAM					
6.8	OPERATE PROCESSOR MANUALLY	20.1 & 21.1	20.2	29.3	29.4	29.4
	COMMUNICATIONS					
7.1	ARC-158 UHF SINGLE CHANNEL-PLAIN VOICE OPERATION	1.3 & 15.1	1.7	29.3	5.6	29.4
7.2	ARC-158 UHF SINGLE CHANNEL-SECURE VOICE OPERATIONS	1.3 & 15.1	1.7	29.3	5.6	29.4
7.3	ARC-158 LINK 4 OPERATION	1.3	1.7	29.3	5.6	29.4
7.4	ARC-158 LINK 11 RELAY OPERATION	1.3 & 15.1	1.7	29.3	5.6	29.4
7.5	ARC-158 SINGLE CHANNEL-LINK 11 OPERATION	1.3	1.7	29.3	5.6	29.4
7.6	ARC-158 UHF PLAIN VOICE RELAY OPERATION	1.3	1.7	29.3	5.6	29.4
7.7	ARC-158 SECURE VOICE RELAY OPERATION	1.3	1.7	29.3	5.6	29.4
7.8	ARC-51A UHF SINGLE CHANNEL-PLAIN AND SECURE VOICE OPERATION	2.3	2.7	29.3	5.6	29.4
7.9	HF RADIO SET-UP---ON CARRIER	2.3	2.7	29.3	5.6	29.4
7.10	HF RADIO SET-UP--AIRBORNE	2.3	2.7	29.3	5.6	29.4
7.11	HF TRANSMITTER CONTROL	2.3	2.7	29.3	5.6	29.4
7.12	DATA TERMINAL SET OPERATION	15.2	15.3	29.3	18.1	29.4
7.13	DATA TERMINAL SET/INTERNAL TIME BASE OPERATION	15.2	15.3	29.3	18.1	29.4

TABLE D-1. ALLOCATION OF INSTRUCTIONAL BLOCKS TO BEHAVIORAL OBJECTIVES ACCORDING TO ASSESSMENT (Cont.)

Beh. Obj.	Title	Assessment				
		Cognitive	Practice		Scenario	
			Initial	Final	Initial	Final
7.14	ICS SET-UP	1.3	1.7	29.3	5.6	29.4
7.15	RADIO SELECTION	1.3	1.7	29.3	5.6	29.4
	SIGNAL DATA CONVERTER					
8.1	PERFORM DOPPLER SIGNAL DATA CONVERTER TEST	2.4	2.7	29.3	5.6	29.4
	ELECTRONIC COUNTERMEASURES					
9.1	OPERATE ECM CONTROLS TO MONITOR TYPES 2 & 9 DISPLAYS	25.1	25.3	29.3	29.4	29.4
9.2	OPERATE ECM PRF SELECT	25.1	25.3	29.3	29.4	29.4
9.3	OPERATE ECM TYPE 9 DECODE	25.1	25.3	29.3	29.4	29.4
9.4	OPERATE ECM SELF TEST	25.1	25.3	29.3	29.4	29.4
9.5	OPERATE ECM TRANSMITTER	25.1	25.3	29.3	29.4	29.4
	PROCESSOR POWER CONTROL					
10.1	OPERATE ON/OFF CONTROLS ON PROCESSOR POWER CONTROL PANEL	4.6	4.7	29.3	5.6	29.4
10.2	OPERATE CIG SYSTEM TRIGGER SWITCH ON PROCESSOR POWER CONTROL PANEL	4.6	4.7	29.3	5.6	29.4
	IN-FLIGHT PERFORMANCE MONITOR					
11.2	OPERATE SELF TEST ON IFPM ALARM PANEL	30.4	30.6	30.6	31.2	31.2
11.3	OPERATE DIMMER CONTROL ON IFPM ALARM PANEL	30.4	30.6	30.6	31.2	31.2
	ANTENNA SIMULATOR					
12.1	OPERATE CONTROLS ON ANTENNA SIMULATOR PANEL	10.2	10.4	29.3	12.1	29.4

TABLE D-1. ALLOCATION OF INSTRUCTIONAL BLOCKS TO BEHAVIORAL OBJECTIVES ACCORDING TO ASSESSMENT (Cont.)

Beh. Obj.	Title	Assessment				
		Cognitive	Practice		Scenario	
			Initial	Final	Initial	Final
	VAPOR CYCLE					
13.1	OPERATE VC MODE SELECT IN AUTO PREHEAT/ COOL	30.5	30.6	30.6	31.2	31.2
13.2	OPERATE VC MODE SELECT IN DIRECT COOL	30.5	30.6	30.6	31.2	31.2
13.3	OPERATE VC MODE SELECT IN DIRECT HEAT	30.5	30.6	30.6	31.2	31.2
13.4	OPERATE VC MODE SELECT IN COCKPIT CONTROL	30.5	30.6	30.6	31.2	31.2
13.5	OPERATE VC MODE SELECT IN GROUND COOL/ FLIGHT OVERRIDE	30.5	30.6	30.6	31.2	31.2
13.6	OPERATE VC TEMPERATURE CONTROL SWITCHES	30.5	30.6	30.6	31.2	31.2
13.7	OPERATE VC LAMP TEST	30.5	30.6	30.6	31.2	31.2
13.8	OPERATE VC OVERLOAD RESET SWITCH	30.5	30.6	30.6	31.2	31.2
13.9	MONITOR VC PRESSURE GAGE	30.5	30.6	30.6	31.2	31.2

APPENDIX E

SAMPLE OF PRELIMINARY DATA BANK FOR TEST ITEM DEVELOPMENT

This appendix presents a representative sample consisting of three sections of the Preliminary Data Bank for Test Item Development. These three sections provide supporting data for Lesson 1.3, ICS and 158, which cover (1) the Intercommunications Set (AIC-14A), (2) the UHF Subsystem ARC-158 (single) channel), and (3) the ARC-158 (relay). Each item represents a unit of information corresponding to a teaching point and is appropriate for development into a multiple-choice test item. The items have not yet been constructed in the multiple-choice format, however, as that effort will require a test development process involving initial inputs from RVAW-120 instructor personnel and formative responses from a sample of RVAW-120 trainees. Accordingly, appropriate test item "stems," correct answers, and "distractors" can be formulated with a high degree of content validity. This process will be applied to all the preliminary test items in constructing the complete data bank which will support all learning objectives in the E-2C training course at the teaching point level. Both adaptive (short form) and diagnostic (long form) lesson tests will then be composed from these items after further data collection and statistical analysis establishing predictive validity.

Intercommunications Set (AIC-14A)

1. The Intercommunications Set (ICS) AIC-14A provides voice communications between the five crewmembers of the aircraft and interfaces with the radio systems.

2. At each operating station, control panel switches permit the operator to select the desired operating mode. Each operator may listen to the output of any or all radio receivers. Each operator may also make voice transmissions over the UHF-1, UHF-2, UHF-3, UHF-4, UHF-5, HF-1 or HF-2.

3. Operators may select the following: TACAN receiver audio output for TACAN station code identification, IFF emergency alert tone indication for identification of friendly aircraft in an emergency condition, aural indication for IFF Mode IV E-2C interrogations and replies.

4. The ICS crew station layout provides each crewmember with the following ICS panels: Amplifier Selector C-2645D; Interphone Selector C-4951, and Radio Selector C-4952A. In addition, each crewmember is provided with external keying switches, headset, and microphone.

5. There are two auxiliary ICS stations; one auxiliary station is in the forward equipment compartment and the other is on the nose-wheel door fairing.

6. A CX-4623 cordset is above the main electronic junction box circuit breaker panel for use at either of the auxiliary ICS stations. FT and auxiliary ICS stations operate using the control panel settings at the FT position.

7. When an ICS footswitch or an I pushbutton is operated by a crewmember, the amplified audio output from his microphone is connected to the headset of another crewmember at a selected C-4951 interphone station and to his own headset by an ICS sidetone. When a RADIO footswitch or an M pushbutton is operated by a crewmember, the audio output from his microphone is connected to a selected C-4952 transmitter, for transmission. A transmitter sidetone will also be received.

8. Should the ICS fail, either at one station or throughout the aircraft, interphone communication may be maintained by placing AMP SELECT to EMERG and selecting transmitter (UHF-1 UHF-2, or UHF-3) on the radio selection box. The microphone is switched to transmit over a corresponding radio transmitter. Interphone facilities are inoperative; however, the sidetones of the transmitter selected can be used to communicate between crew ICS stations.

9. All crewmembers must be on same XMIT/RCV selector for successful ICS communications. Emergency ICS transmissions should be held to a minimum.

10. The amplifier selector panel is the master ICS control unit for each station. It provides controls to select the mode of operation of the ICS, control the microphone circuits, and vary the audio level in a crew headset.

11. The interphone volume (INTPH VOL) control adjusts the audio level of the intercommunications signal heard in the headsets. The sidetone audio level may also be adjusted using this control. When the amplifier selector switch is in the NORM position, the signal received from the radio receivers will not be affected by the operation of this control.

12. The amplifier selector (AMP SEL) switch is a four-position rotary switch in the center panel. During normal ICS operation, this switch is set to the normal (NORM) position. If there is difficulty in hearing any of the signals in this position, the switch is set to either the ALT 1 or ALT 2 (alternate channel) position. The EMERG position may be used when loss of power to the ICS occurs at a particular crew station or when both channels (amplifier) fail.

13. In the ALT 1 position, the interphone amplifier is disconnected and the isolation amplifier amplifies microphone audio output signals and sidetone as well as interphone and radio receiver input signals. In ALT 2 position, the isolation amplifier is disconnected and the interphone amplifier amplifies microphone audio output signals and sidetone as well as interphone and radio receiver signals.

14. In ALT 1 and ALT 2 modes of the AMPL SEL switch only COLD microphone operation is available.

15. The microphone selector (MIC SEL) switch is a three-position toggle switch with positions marked COLD, HOT, and CALL. With the switch in the COLD position, interphone communications can be accomplished only if the ICS switch is depressed. When in the HOT position, interphone communications may be accomplished by speaking into the microphone without depressing the ICS switch. The CALL position is spring-loaded out of CALL, and acts as an override, allowing the operator's interphone signal to be heard at all ICS stations, regardless of the position of the stations's C-4952A ICS ON/OFF switch.

16. Voice-operated keying is in operation if hot mike is selected. The C-2645D VOX sensitivity control is adjusted just above the ambient noise level so that this level does not key the ICS.

17. Each crew station has two external keying switches. The keying switches for the ACO, CICO, and FT stations are momentary contact foot-switches, labeled ICS and RADIO.

18. The ICS selector panel directs outgoing interphone signals to other ICS stations. On the panel are six selector switches that connect an individual ICS station to one or more of the other four ICS stations.

19. The mode selector switch is a three-position toggle switch labeled ALL-MIXED-SEL'D (Selected). With the mode selector switch in the SEL'D position, the station operator can receive only those incoming interphone audio signals from selected remote stations.

20. With the mode selector switch in the MIXED position, the station can receive interphone input signals from any remote station which has selected that particular station. Signal monitor procedures are the same as in the select mode.

21. With the mode selector switch in the ALL position, that station's output interphone signals are connected to all ICS remote stations simultaneously. This function is similar to the CALL function of the Amplifier Selector Panel C-2645D, except that the ALL function will not override a disconnected interphone condition at another crew station (provided by ICS OFF switch on C-4952A), or during radio transmission by that station. COLD MIKE operation is used for the ICS selector panel ALL position.

22. The five C-4951 three-position toggle switches are labeled PLT, CPLT, CICO, ACO, and RO. Holding the ICS switch in the momentary down position enables the user to monitor interphone input and output signals present at another station. This provides an indication that the other station operator is in voice correspondence.

23. The function of the center position of the C-4951 three position toggle switches is dependent on the switch position of the interphone mode selector switch (ALL-MIXED-SEL'D). In the MIXED or ALL position, the center position allows reception of input signals from all remote stations which have that particular station selected. In the SEL'D position, reception of all input signals is inhibited, except those originating from a remote station which has selected the ALL position.

24. An indicating lamp next to each ICS station selector switch indicates an attempt of indicated station to communicate or indicates that the station is in use. The indicator lamps do not illuminate if the transmitting station has selected the ALL position. The audio signals on the station interphone input line cause the lamp brightness to fluctuate; this enables the station operator to determine which station is calling (interphone operation) in the event that more than one station has selected his station.

25. The modified CX-4623/AR cordset connects either auxiliary station to a headset. This cordset includes an in-line switch assembly that contains a pre-amplifier, matching transformer, and a microphone keying switch. The use of inline amplifiers with the auxiliary ICS stations will be dictated by squadron aircraft configuration.

26. The radio selector panel permits selection of one or a combination of radio receivers and selection of any one radio transmitter at a time. This selection capability is implemented with three-position (RT-OFF-R) toggle switches in the top and bottom row of radio switches. Each toggle switch has an associated indicator lamp.

27. A receiver is selected by setting the appropriate toggle switch to the down or up position. Setting the switch to the down position selects only a receiver but setting the switch to the up position selects a receiver and its transmitter.

28. Transmitter selection is accomplished by setting the toggle switch to the up position. This connects the microphone audio circuit and the external radio key switch to a selected transmitter. Transmitter switches are interconnected so as to provide transmitter selection precedence, the right-hand switch having priority.

29. Lamp indicators indicate radio receiver or radio transmit operation. Radio lamp indicators designate a keyed tranmitter at all stations, regardless of keying origin.

30. The TACAN, Mode 4 and IFF/ALR toggle switches are mechanically locked to operate in the receive (down) position only; the switches cannot be placed into the up position.

31. The KY1 switch is associated with UHF-3 and UHF-4 secure voice operation. For secure voice single-channel operation on either UHF-3 or UHF-4, and for UHF-3/UHF-4 secure voice relay, the KY1 switch is used in place of the UHF-3 and UHF-4 switches.

32. A radio indicator lamp at each crew selector switch position lights with a steady intensity during voice radio transmission regardless of the station transmit keying origin. The radio indicator lamp will modulate at each station when that radio is receiving an incoming voice signal. The radio indicator lamps operate independently of the radio selector switch position;

33. During UHF-3/UHF-4 plain voice relay, the radio pair lamps modulate while a signal is being relayed (lamps will be out during time when no signal is being relayed).

34. During UHF-3/UHF-4 secure voice relay, the C-4952A UHF-3/UHF-4 lamps are not on but the KY-1 switch lamp blinks, and is used to monitor the UHF-3/UHF-4 relay operation.

35. An interphone disconnect feature is provided by the C-4952A ICS OFF switch, permitting the incoming interphone signal to be manually disabled. The interphone input is automatically disabled whenever the user operates the external radio keying circuits, thus preventing interphone interference during radio transmission periods.

36. The ICS OFF condition (due to manual or automatic operation) at another station may be bypassed by setting the microphone selector switch to the CALL position. The ICS OFF condition is implemented by setting the toggle switch to the down position, and is indicated by the blue indicator light going on.

37. The RAD VOL knob adjusts the audio level of selected radio receiver signals simultaneously (master volume control); a volume control is provided for each radio set.

38. The pilot's and co-pilot's interphone disconnect feature has been modified to prevent complete isolation from the aft crew stations. When either pilot or co-pilot selects the ICS OFF, his interphone signals are automatically routed to the other's ICS station. When both pilot and co-pilot have selected ICS OFF, interphone signals are directed to the co-pilot's station only, regardless of the caller's selection on his ICS panel.

UHF Subsystem ARC-158

1. The UHF Subsystem ARC-158 provides two-way communications for various data and voice operational modes. It includes three radio transceivers in the mode combinations of AM VOICE (plain), AM SECURE VOICE, LINK 11 and LINK 4, with a relay capability in one of the following modes selected; plain, secure voice, or LINK 11.

2. The ARC-158 subsystem consists of three ARC-156 radio sets and associated controls with radio designations as follows: UHF-3, UHF-4 and UHF-5.

3. The ARC-158 subsystem contains the following items:
   - RT-1017 Receiver Transmitter - 3 each
   - F-1357 Filter/Converter - 3 each
   - C-9197 Radio Control Unit - 3 each
   - C-9196 Mode Selector Control - 1

4. The three radio controls and mode selector for the ARC-158 are on the console panel between the ACO and CICO stations.

5. The ARC-158 RT-1017 is a multi-mode transceiver that is solid-state and electronically tuned. At present, the aircraft uses only the following RT-1017 operational modes: plain or secure voice (AM), LINK 4 (FSK), LINK 11 (FM).

6. The antenna filter/converter provides the additional selectivity required to meet the EMI conditions and requirements of E-2C system operation. Electromechanical frequency tuning is synchronous with the radio control frequency setting. The filter prevents receiver and transmitter interaction through antenna coupling between any two of the three RT-1017 radios. The converter portion converts the serial data from the control unit to parallel data logic for the RT-1017 transceiver.

7. The logic circuitry within the ARC-158 subsystem mode selector is such that upon selection of UHF-3 and/or UHF-4 secure voice, the KY-28 No. 1 unit is automatically placed in line through the KY-28 transfer relay for receive/transmit audio signals. When UHF-3 and UHF-4 are not in secure voice operation, thr KY-28 No. 1 remains in line with the ARC-51A subsystem and ARC-158 UHF-3/UHF-4 Receive/Transmit audio signals are routed within the mode selector, radio control and ICS (AIC-14A). Consequently the ARC-158 C-9197 volume control for UHF-3 and UHF-4 is operational only during plain voice operation (two single channels or relay).

8. When ARC-158 secure voice operation is selected with KY-28 No. 1, it is noted that transmit and receive functions are indicated by means of the radio control panel KY-1 switch. For UHF-3/UHF-4 secure voice operation (single channel or relay) only the KY-1 switch is to be used for the transmit/receive function.

9. The operational mode selector switch on the ARC-158 radio control unit is bypassed by the mode selector control selection. The operational mode selector switch is used to turn the radio on only with the switch discrete positions being ineffective as to radio mode of operation.

10. The C-9197 radio control panel is the interface between the operator and the transceiver. Alternately, the control unit can be used with the subsystem mode selector to provide a total subsystem interface.

11. The frequency setting control provides complete frequency control of the transceiver in 25 kHz increments from 225 MHz to 399.975 MHz by three distinct methods.
    - Manual frequency selection is provided by utilizing the four frequency selection knobs (inner) when the functional mode selector is in the MAN position.
    - The control provides memory storage for 20 preset frequency channels. Pre-programmed frequency selection is provided by 20 channels of stored frequency information. Distinct channels are selected by manual rotation of the channel select knob when the functional mode selector is in the PRST position.
    - Guard (emergency channel) frequency selection is provided when the functional mode selector is in the GD position. This emergency frequency is changeable by switching internal to the control unit.

12. The CHAN SET button permits the operator to program the frequency, which is present on the lighted display when the functional mode switch is in the MAN position, into the channel present on the lighted display when the functional mode switch is in the PRST position.

13. If the functional mode selector is in the guard position, the frequency offset feature is disabled regardless of the position of the operational mode selector. When interfacing with the mode selector, the operational mode selector on the control unit no longer determines whether the transceiver receives and transmits AM or FM signals; this is controlled by the mode selector.

14. The SQ DIS switch is a three-position toggle switch which allows the operator to:
    - Enable the main squelch circuits (OFF position).
    - Disable the main receiver squelch (MAIN position).
    - GD position not functional in E-2C.

15. The BIT TEST pushbutton switch allows the operator to initiate self-test of the control, filter/converter, transceiver, and guard receiver.

Depressing this button causes:

- The frequency LED's to display 243,000.
- Three momentary tones which can be heard by selecting the appropriate radio.
- Illumination of the radio indicator lamp for the radio under test.
- Return of the LED's to the selected channel or frequency.

16. The mode selector panel is referred to as the ARC-158 subsystem operational mode selector. It controls the operational mode combinations of the three RT-1017 transceivers.

17. Single Radio Channel-Plain Voice Operation for UHF-3, UHF-4, and UHF-5 consists of the following procedures:

- Place radio to an ON position.
- Set desired radio control unit frequency mode selector for manual or preset operation, and set the assigned operating frequency accordingly.
- Set SQ DISABLE switch to the OFF position.
- Place UHF-3, -4, or -5 switches to the T/R (up) position.
- Use XMIT Key (RADIO footswitch or yoke button) for transmission.

18. Single Radio Channel-Secure Voice Operation for UHF-3, UHF-4, and UHF-5 consists of the following procedures:

- Repeat steps 1, 2 and 3 for plain voice single radio channel except that only UHF No. 3 or UHF No. 4 radio may be selected for secure voice single-channel operation.
- Depress MODE SELECTOR UHF-3 or UHF-4 SECURE VOICE button (it becomes brightly illuminated).
- Place KY1 switch to R/T (up) position; UHF-3 or UHF-4 T/R switches have no effect.
- Place the KY-28 No. 1 P-C switch to the C position, and the control switch to the ON position.
- Use XMIT Key (RADIO footswitch or yoke button) for transmission.

19. Single Radio Channel--Link 11 Operation for UHF-3 or UHF-4 consists of the following procedures:

- Repeat above steps 1, 2 and 3 for plain voice single radio channel.
- Check that the MODE SELECTOR UHF-3 and UHF-4 LINK 11 buttons are dim to assure availability of DTS to ARC-158 subsystem; if buttons are dim, depress UHF-4 or UHF-4 LINK 11 button.
- Place the KY1 switch to the R/T (up) position; UHF-3 and UHF-4 switches have no effect.
- With either radio in the R/T position, transmit over both radios at their set frequencies. Use the appropriate XMT key switch.

20. LINK 4 operation for UHF-5 consists of the following procedures:
    - Repeat above steps 1, and 2 (plain voice single radio channel for radio UHF No. 5.
    - Depress the MODE SELECTOR UHF-5 LINK 4 button.

21. The built-in-test (BIT) and the in-flight performance monitoring (IFPM) control circuitry in the filter converter performs the following functions for the complete subsystem:
    - Receives and stores all fault signals from the WRA fault lines. Fault indications are retained until a fault reset signal is received from the SCRAM.
    - Prepares a fault summary for the SCRAM by comparing and combining fault signals from various fault lines and determining which WRA is responsible for the failure mode.
    - Sends signals to the fault indicators on the filter front panel for fault isolation to either the filter or antenna.
    - Generates and controls the BIT sequence.

22. The built-in-test (BIT) function provides fault isolation beyond the capabilities of the IFPM system. In addition to all continuous IFPM sensors and fault lines, the BIT system uses fault sensors that are enabled only during a specific phase of the test sequence. This allows a more detailed fault analysis.

23. A BIT sequence can be initiated from either the SCRAM or the control box. As with the IFPM system, any fault indication derived during a test remains until reset by the SCRAM.

ARC-158 (relay)

1. A frequency separation of at least 6% is required between channels during plain or secure relay.

2. Plain Voice Relay Operation consists of the following procedures:
   - Repeat steps 1, 2 and 3 above (plain voice single radio channel) for radios UHF No. 3 and UHF No. 4.
   - Depress the MODE SELECTOR UHF-3 and UHF-4 NORMAL VOICE buttons, and the NORMAL VOICE RELAY button.
   - Place UHF-3 and UHF-4 switches to the T/R (up) position.
   - During monitoring, adjust the two C-9197 radio volume controls and, if necessary, the C-4952A radio volume control to achieve an acceptable audio level.
   - Use the XMT key switch (RADIO footswitch or yoke button) for transmission over both radios at their set frequencies with either radio in the R/T position.

3. Secure Voice Relay Operation consists of the following procedures:
   - Repeat steps 1, 2 and 3 above, (plain voice single radio channel) for radios UHF No. 3 and UHF No. 4 (radio operating frequencies must differ).
   - Depress the MODE SELECTOR UHF-3 and UHF-4 SECURE VOICE buttons; check that the RELAY indicator between these buttons is on.
   - Place KY-28 No. 1 P-C switch in the C position (if it is desired to monitor the relay) and turn the KY-28 ON.
   - Have remote units make functional check of relay.

4. Link 11 Relay Operation consists of the following procedures:
   - Repeat steps 1 and 2, above, (plain voice single radio channel) for radios UHF No. 3 and UHF No. 4.
   - Repeat above step 2 (for single radio channel-Link 11) except depress both UHF-3 and UHF-4 LINK 11 buttons and check that relay indicator between buttons goes on.
   - When Link 11 relay operation is activated, data tones may be monitored by selecting UHF-3 and UHF-4 switches to the receive position.

5. LINK 11 ARC-158 VOICE/DATA Select operation is available only when the HF communications system ARQ-34 is not using the DTS. This occurs when the switch on the HF Control Panel (C-9077AR) is in the VOICE - 1/2 position. This condition is realized on the mode selector when the UHF-3 and UHF-4 LINK 11 buttons have dim lighting. If the lighting on these buttons is not dim, then the DTS is not available to the ARC-158 subsystem for LINK 11 operation.

6. The HF communication system has priority over the ARC-158 (that is, aircraft wiring) for DTS LINK 11 operation.

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