CONTRACT TRAINING SYSTEMS
A TURNKEY, GROUND-UP APPROACH TO MILITARY AIRCREW READINESS

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ABSTRACT

Contract Training Systems, once the "leading edge" innovation of the '80s, are now routinely meeting the training needs of a variety of commercial and government customers. Rising costs of and increased confidence in contractors' abilities created an opportunity for training companies to provide services that were formerly in the customer's domain.

Aircrew training was previously accomplished through the piecemeal purchase and integration of training aids, training devices, and traditional classroom lecture and orientation. Contractors provided initial training to military and civil service personnel who then became the instructional staff. This approach generally resulted in the following: Initial knowledge was frequently lost early in the program because of government personnel turnover; under-utilization of training resources such as simulators became commonplace; maintaining currency of the course syllabi with the aircraft was difficult; a "Training System" sense was never developed.

This paper discusses "ground-up" training system development and the special problems presented in creating a contract training system while aircraft design and operational employment issues are evolving. The U.S. Navy's E-6A (TACAMO) Contract Flight Crew Training System (CFCTS) will be used as the discussion model.

INTRODUCTION

The successful design and development of a contract training system from the ground-up requires close coordination and the combined efforts of a wide range of training disciplines. The following paragraphs outline the Navy's E-6A program requirements, the ground-up contract training system concept, the E-6A CFCTS program elements, Navy and Contractor approaches, and significant measures taken to satisfy the Navy training requirement.

This is a snapshot of a maturing program, therefore, a lot of questions remain unanswered. For example, is the approach cost effective? Is training effectiveness increased with this approach? Does the two-year validation period meet the requirement? These questions and others can best be answered after the E-6A CFCTS implementation. The answers to these questions are candidates for future papers of this nature.

PROGRAM REQUIREMENTS

RFT Concurrent with End Item Delivery

Achieving a Ready For Training (RFT) posture in time to support the Initial Operational Capability (IOC) of the weapon system is a continual goal of the training community. Frequently, we begin program development, determined to design, develop, and field our training system by IOC, only to fall victim to budget cuts, developmental problems, and higher priorities.

When the contract for the E-6A CFCTS, the Navy's first total training system, was awarded in September, 1986, concurrency was the primary goal. In fact, this was the most important requirement of the program. This vital strategic mission required an uninterrupted transition from the current mission aircraft, the EC-130, to its replacement, the Boeing E-6A. The transition had to occur with minimum impact on crew operational readiness. For this reason it was essential that training system preparations keep pace with, or proceed ahead of, aircraft development.

The Navy took several steps to achieve concurrency. First, they isolated training system development in a separate contract, ensuring high contractor priority. Secondly, Navy managers limited contract specifications to allow the contractor flexibility in approaching the problem by allowing design and development of the training system elements to best commercial practice, a key element in meeting the schedule requirements. These

were innovative steps taken to ensure that the TACAMO mission was uninterrupted in spite of the introduction of an entirely new airframe.

Ground-Up Training System Development Concept

Ground-up Training System development is defined as beginning the CFCTS with nothing and developing the capability to train students at the same time, (or earlier than), the aircraft IOC. There are no existing training materials, little or no data, no training devices, no facilities, no analysis results, and no personnel experienced with the new aircraft.

In the case of the E-6A CFCTS, the Navy recognized prior to RFP that no existing training resources could be made available. E-6A aircraft could not be dedicated to training because of cost. Furthermore, manpower constraints precluded an organic training approach. On the plus side was the fact that the E-6A was a derivative of the commercial Boeing 707-320 which had been successfully used in the commercial world for a number of years. These considerations led the Navy to structure a program which relied on a contractor to develop and operate the system in a manner similar to many commercial training programs. To provide maximum flexibility to the contractor, the Navy specified minimum self involvement and oversight during the development and operational phases. To work around the problem of the developing weapon system, to reduce time lags, and to avoid placing the Navy in the role of middleman, the contractor was tasked with achieving an intimate working relationship with the prime weapon system manufacturer in order that a rapid flow of data, design information, and operating characteristics was achieved. Likewise, the contractor was tasked to develop all training tools, devices and systems to be used in the training program. The only government furnished equipment defined for the entire CFCTS was the E-6A Flight Management System for use in the simulators.

Although the contract training system was not a new concept, the ground-up approach was novel. It was the only reasonable solution to meeting the Navy's RFT requirements for this emerging weapon system.

E-6A Program Description

During the initial phase of the E-6A fleet introduction, the primary focus of the CFCTS training will be on initial qualification of Aircrew Members; Pilots, Flight Engineers, and Naval Flight Officers (Navigators). While the entry level of these crew members is based upon first tour experience level, the initial training classes will handle a mixture of entry levels. Students will also come from the following sources:

Cross training from the existing EC-130 TACAMO mission aircraft

The Air Force Pilot Exchange Program (PEP)

Naval Air Training pipelines.

After the weapon system has been introduced in the fleet, additional courses will be brought fully on line; to upgrade third pilot qualified crew members to second pilot status, and to upgrade all categories of crew members to instructor status. Also, as the E-6A crews operate in the fleet they will return to the CFCTS as formed crews for refresher training. In addition, the CFCTS will conduct engine run training for selected E-6A aircraft maintenance personnel.

The contractor for the CFCTS will also provide initial and recurring training for the on-site Navy evaluator cadre. One category of training which specifically will not be addressed in the CFCTS is upgrading of second pilots to Aircraft Commander. This upgrade will be based on performance in the operational mission and will be the local commander's prerogative and decision.

All tasks required to fly and operate the E-6A in a safe and efficient manner have been analyzed and training objectives established. All tasks identified are to be trained to proficiency levels established for each type and category of student. This proficiency will be evaluated by the on-site Navy evaluation group. The criteria for acceptance is based on Navy defined performance standards. Students who fail to meet the standards will be retrained at the contractor's expense until they succeed or are determined, jointly with the Navy, to be untrainable for the tasks at hand.

The attainment of the learning objectives is supported by an Academic Training System (ATS), a Cockpit Procedures Trainer (CPT), an Operational Flight Trainer (OFT), and surrogate In-Flight Trainer (IFT) aircraft. The ATS consists of self paced Computer Based Training (CBT) methodology with an interactive capability. This allows procedural tasks to be trained prior to CPT, OFT, and IFT exercises. The ATS is augmented and supported by more traditional classroom methods such as mission briefings, lecture, audio-visual presentations, and self paced workbook problem solving exercises.

Throughout the academics phase, performance exercises will be conducted in the CPT to enhance the academic experience. These performance exercises are conducted at the individual lesson level. As a group of lessons have been mastered, training shifts to the OFT where performance skills are refined using various

mission scenarios. At the end of each major area of instruction, a unit criterion evaluation is conducted to assess overall performance against the learning objectives defined for that particular unit. Students may not advance in the course until they have demonstrated satisfactory performance in each unit.

For the student pilot, in-flight training concludes the syllabus. The primary purpose of the in-flight training is to teach the aerial refueling task set. As a side benefit the student pilots will gain the confidence and experience in handling a large aircraft of this type in activities such as takeoffs, landings, and approaches.

The CFCTS Ready for Training (RFT) date is established so that initial training of the crews can commence in sufficient time for the crews to receive training and return to their squadrons 75 days prior to the commencement of operational flights. Since the fleet squadrons will have no dedicated training resources, refresher training will be provided quarterly at the CFCTS.

All training, (including initial, upgrade, and refresher), will take place at the contractor built and maintained training facility. This allows the concentration of all instructional resources as well as logistics support, aircraft operations, and student and training system administration at one central location.

NAVY ACQUISITION STRATEGY

Contract Training

Contract Training Systems are not a new concept. In contract training the contractor is assigned the responsibility for elements of the training system. This can include courseware development, simulator manufacture, facilities design, logistics support, delivery of the ground instruction, and conduct of the in-flight training. In the E-6A CFCTS, the contractor has the responsibility for all these elements, a level not required previously in ground-up training system development.

The past ten years have seen a shift, in both military and civil sectors, toward contract training. The Navy's E-6A TACAMO program, however, differs from others because it is being built by the contractor from the ground up. There were no existing trainers, courseware, or front-end analysis results to draw upon. The acquisition strategy required a contractor, in twenty-six months, to design, develop, and field a total training system while the aircraft was under development.

Recognizing the difficulty facing the contractor, the Navy took several actions to facilitate program success. First, not only was the E-6A the Navy's first total training system, it is one of the industry's most extensive. The contractor was made responsible for virtually every aspect of the training program. Given an input population that varies from "nuggets" fresh from the Naval Air Training Command to experienced EC-130 TACAMO crews, the contractor provides all training necessary for students to pass a certification check for the appropriate crew position.

The Request for Proposal (RFP) and Statement of Work (SOW) were designed to provide the contractor with the flexibility to meet the E-6A's training needs within the short development time available. Specifications were general and as flexible as possible. The OFT specification for example, was contained on a single page. This strategy of maximum contractor flexibility with minimum government oversight posed a large risk for Navy officials.

Without detailed specifications or frequent and thorough Navy reviews and controls, a significant amount of faith in the contractor was necessary. By developing a sound management plan that included sufficient government opportunity to monitor progress, the Navy gave the contractor the freedom to pursue the most efficient training solution. This contract relies on the contractor's ability to deliver using best commercial practice, resulting in a considerable savings in time and effort. The original E-6A CFCTS program schedule is shown in Figure 1.

RFP/Contract Content

The RFP for the E-6A CFCTS was unique in many respects. One of the primary elements of the RFP was that Navy involvement in program oversight and management was significantly reduced. The provisions of the RFP allowed maximum flexibility for the contractor to meet the training requirements. Best commercial practices were specified, relaxing some of the stringent MIL SPEC requirements for training materials and devices. Specific language and clauses were included to accelerate and simplify the effecting of minor changes to the system as the aircraft matured. The Contract Data Requirements List (CDRL) was simplified and the Navy required no approval on data items. Additionally, the contractor was made responsible for all of the data acquisition. The final provision of the RFP was that for the student to graduate from the training system, tests and check rides based on the Navy standards must be completed successfully. The contractor had to guarantee student performance. The RFP for this ground-up CFCTS was well structured to provide an effective means of meeting the training requirement in the time specified.

E-6A CFCTS
PROGRAM SCHEDULE

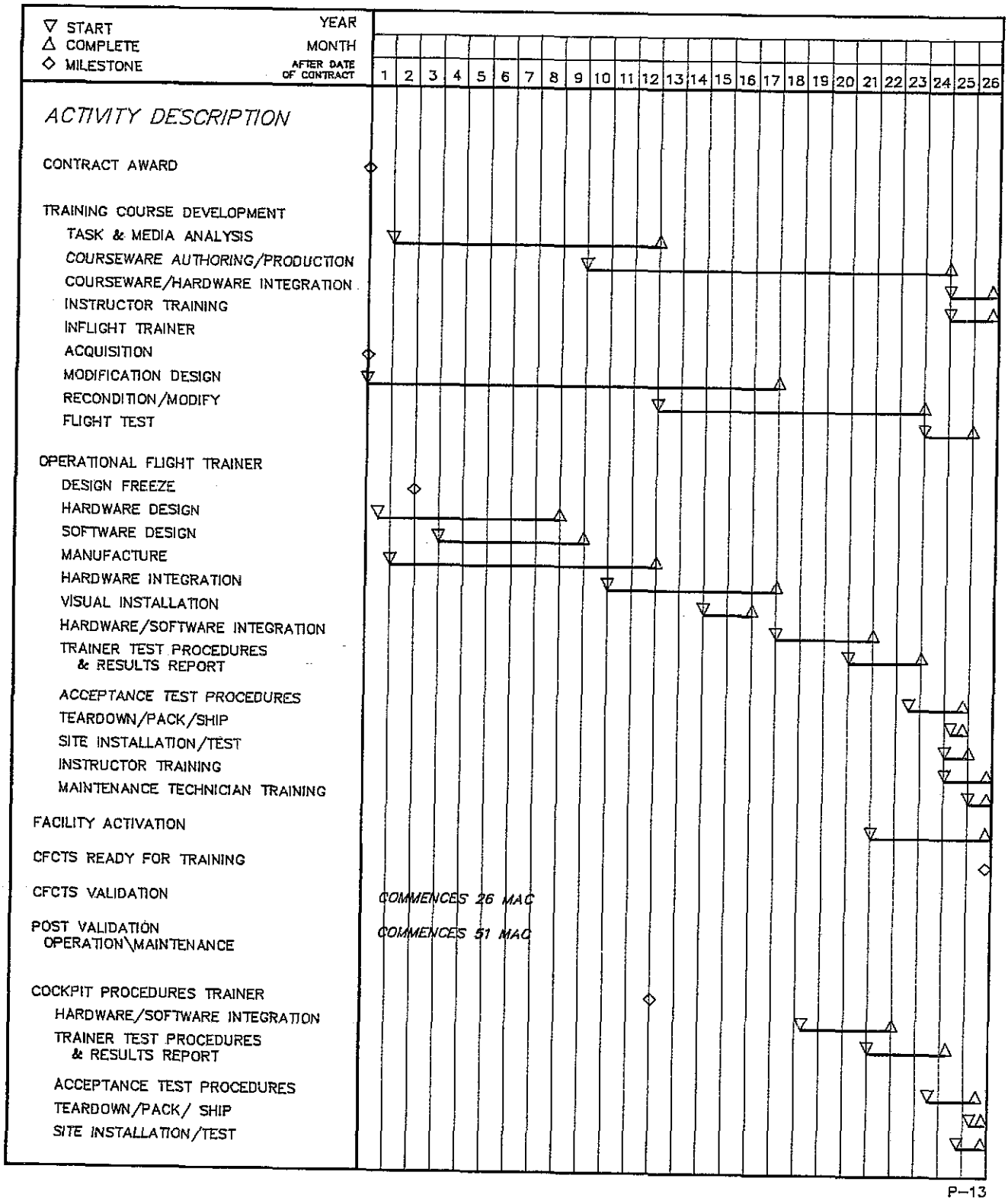

FIGURE 1

Two-Year Validation Period

Recognizing the accelerated pace at which the E-6A training system was developed, the Navy provided a unique contractual feature. In this contract, the Navy does not take delivery of the hardware, courseware, or other elements that make up the training system at RFT. Instead, the contractor retains custody during the two-year validation period.

Even given the best possible performance by the contractor, the very nature of the concurrent training system development will result in the need for training modifications to achieve all objectives. The process of concurrent development necessitates the use of assumptions and surrogate/forecast data.

Until the aircraft approaches IOC, some of the specific information on which the training system is based is either unknown, under development, or subject to change. The initial courseware, and hardware/software for the simulators, is based on the best available data, realizing that minor changes to the instructional system will be necessary as the aircraft is fielded.

Using the two year contractual validation period incorporated in the E-6A contract, these necessary adjustments are planned, funded, and specified. Block updates are planned for the simulators to upgrade the "surrogate" aero data. Actual E-6A flight test information will be used, when available, to increase device fidelity. Currently, the device is designed to perform like the surrogate aircraft and the E-6A. As NATOPs procedures are stabilized, and aircraft equipment modifications completed, training system courseware and hardware configurations will be adjusted. These changes are simplified by special provisions included in the contract.

It is clear that achieving concurrency requires some "best guessing". A contractual validation period, such as that provided in the E-6A contract, and special change order provisions can greatly expedite the process of making the minor changes that were necessary as the weapon system was fielded.

CONTRACTOR'S APPROACH

Assumptions Made

In order to produce the elements of the training system, various assumptions were necessary. The first assumption made was that insufficient data would be available on the E-6A and substitute data would be required. Additionally, the data would be changing throughout the program. It was assumed that the data existed in similar aircraft, and could serve as the basis for the initial design.

Another assumption was that many basic operating procedures, such as air refueling, could be derived from Air Force procedures for similar aircraft.

It was believed that commercial B-707 simulator cockpit shells would be available for re-manufacture into the E-6A CPT/OFT to reduce the schedule.

Instructors/SMEs could be drawn from resources familiar with the operation of B-707 aircraft, aircraft systems, and procedures. They could also be intimately involved with the front-end analysis and courseware development evolutions, expediting the schedule toward RFT.

The contractor also assumed that a strong management team had to be put in place in a common location immediately to ensure the cohesive development of all elements of the training system by RFT.

Based on these assumptions, the contractor began the construction of the E-6A CFCTS. The following paragraphs outline the events and their results, based on the assumptions.

SIGNIFICANT EVENTS

Overall System Design

When the overall design of the E-6A CFCTS began, it became apparent that to design the system in the shortest period of time and be on target, a maximum of experience had to be brought to bear on the effort. The approach taken was to co-locate the various design teams in the initial development phases of the program. Simulation Engineers, Instructional Designers, Logisticians, Facilities Engineers, and Management personnel converged in one location to structure the CFCTS overall design and carry out the initial phases of the program. Benefits expected, and to a large extent achieved, included immediate dissemination of data and concurrent growth of knowledge within the various teams of professionals. Additionally, this provided a common understanding of the requirements of each element of the training system, and provided a mutually defined and well understood concept for further, more detailed development. The resultant efficiencies allowed the contractor to proceed on a "fast track" development approach to achieve the early RFT.

One of the first problems the team began to solve was the lack of data on the aircraft. When the program began there was only basic aircraft design data available. There was no NATOPs manual, no physical model, and generally a paucity of data. As the data became available it was integrated into all facets of the system; courseware, simulators, logistics, facility, etc. The training system and the aircraft were being developed separately and because of that fact, data sharing

from the aircraft manufacturer required a considerable effort. The aircraft prime contractor was extremely busy building the aircraft, and had no contractual obligation to supply the data. The Navy assisted the training system contractor in coordinating the data collection efforts. The contractor's data collection plan closely tracked the progress of the data items for the aircraft. Data was acquired as soon as it was available. An effective data collection mechanism and effort ensured acquisition of required data.

Courseware Development

Another significant event occurring during the evolution of the E-6A CFCTS was the accurate definition and production of the courseware to support the CFCTS. It was extremely difficult, but not impossible, to conduct the analysis portion of the ISD process. At this point in time, the NATOPS manuals did not exist. As NATOPs evolved through its various stages of completion, it was integrated before design freeze was reached. Additionally, data that was available from similar aircraft was used to extrapolate what was required during the analysis phase of the ISD process. Since the E-6A is a derivative aircraft within the B-707 family, it was possible and expedient to do this. For example, during task analysis and lesson specification preparation, a representative fuel system from a similar aircraft, the KE-3, was used as a model for delineating the tasks. Some of the tasks on any flight crew training system are rather generic and were utilized as the framework for the E-6A task set model. Also, the basic procedures for takeoffs and landings are similar for various types of aircraft within the B-707 family. Using a basic set of tasks as the starting point, the rest of the courseware design documents were produced. As data became available, the task listing and lesson specifications were updated to reflect the new E-6A data prior to design freeze (September, 1987). This process proved to be reasonable in that only fine tuning of analysis and design data was required. This does not mean that all of the data is totally accurate, but reasonable models have been built which support the development of instruction. The two-year validation period will ensure that the most accurate data will be integrated as it becomes available.

Because of the ground-up approach to training system development, new technology had to be employed in the production of training media. The latest Computer Based Training methodology, utilizing Interactive Video Disc technology, was employed. Direct Read After Write (DRAW) technology was used to allow the direct transporting of video images to the video disc rather than relying on the technology which required "pressing" a master disk. The disk pressing approach would have required a remake of the disk (at a cost of $2500 or more) to add corrected or new images which were inevitable in this evolutionary, ground-up approach. The normal video disc process could not meet the needs of a dynamic data situation inherent in the E-6A CFCTS. With the DRAW technology implemented with the CBT system, corrections are made to the disc in concordance with a corresponding change to the authored lesson to identify the new image disc location. Use of this and other related technology allows the successful design and development of courseware concurrent with the airframe development in this ground-up system.

Instructors/SMEs

Because of the ground-up nature of the E-6A CFCTS, acquiring qualified instructors and subject matter experts was a challenge. Where do the qualified E-6A crew members come from, (since there is no operational aircraft at this time), to support courseware development as Subject Matter Experts (SMEs) and ultimately serve as the instructors? The basic answer is that the contractor has to develop his own. The crews that are being used in the E-6A CFCTS come from a military 707 background and are In Flight Refueling (IFR) receiver qualified. These requirements were formulated by the contractor during the recruiting phase of this program. It was necessary to find experienced personnel who had flown an aircraft similar to the E-6A design. During the courseware design phase of the program, these personnel became part of the instructional development team for several reasons. The contractor's instructor crews required an intimate knowledge of the syllabus to become effective and efficient in their role. As data became available before the hardware and courseware design freeze, it had to be integrated into the CFCTS products. This process allows the contractor, in a ground-up CFCTS, to produce the only qualified instructor crews for the training system.

CPT/OFT Development

The design and development of the CPT and OFT required data in the same manner as the courseware. Available data was changing daily. A design freeze was effected nine months after contract award that allowed the design and specification of the two simulators by the contractor. The contractor wrote and provided the specifications to the internal division responsible for the CPT/OFT production. The government, through the RFP, provided a skeletal specification from which the contractor prepared the detailed specifications for the devices. This shortened the learning curve for the contractor, and provided a set of training devices in less time than might normally be expected in a

program of this magnitude. The contractor's expertise in designing and developing training devices of this nature provided for the design and specification of these devices.

The government gave the contractor relief from full MIL SPEC CDRLs, program reviews, and detailed monitoring. This allowed production of best commercial practice training devices that meet FAA Phase II requirements.

The contractor implemented micro detailed planning, scheduling, and status reporting. This kept attention to the project details in many cases to a daily status report level. This level of attention provided the management necessary to produce the CPT and OFT in time to meet the RFT requirements.

There will be some differences between the simulators and the E-6A aircraft after RFT and IOC. The contract recognizes this and provisions have been made by the contractor to perform the block updates required during the two-year validation period.

The above paragraphs outline how a ground-up training system deals with the evolving aircraft data in the development of the training devices.

Facility Development

Facility design requirements were defined during the proposal stage of the E-6A CFCTS program by the contractor's training specialists. These specialists drew upon knowledge and experience gained from operations at large military and private sector flight crew training academies.

Factors taken into consideration included functional requirements of the physical layout to facilitate student flow and academic success with a minimum of travel and disruption during the training day. Additionally, the facility had to be designed to support the CPT and the OFT. These factors also included the proper utilization of space and economy of operation.

The basic requirements were transmitted to the contractor's facilities subcontractor for architectural and engineering design. Because the training system had to be RFT within a two year period, only construction firms with proven track records were invited to bid on the facility construction. The firm selected had demonstrated success in similar construction projects, including training facilities. From architectural design to ground breaking to beneficial occupancy date, only twelve months time elapsed. This is an example of how the contractor used his experience and best commercial practices to meet the required RFT date.

Surrogate Aircraft

The Navy has had little experience in boom-receptacle aerial refueling of a heavy-jet, swept wing, receiver aircraft. To enhance safety in this mission critical area to the maximum extent possible, the requirement for a surrogate in-flight trainer was identified to ensure full proficiency in this task set. The process of identifying, procuring, and modifying the surrogate trainer aircraft began prior to contract award. However, the aircraft that had been identified as candidates during the proposal phase were no longer available by the time the contract was awarded. The B-707 market had changed significantly since the proposal was prepared. The contractor ultimately utilized the services of an aircraft broker and embarked upon a world-wide search for quality aircraft. The basic B-707 airframe, of which the E-6A is a derivative, is in excess of twenty years old. During the aircraft selection process, the best available match of remaining useful life of airframe and engines was sought. Eventually, one-owner aircraft were found which met the requirements, but they were of foreign registry. This presented additional problems in importation and FAA re-registry as public use aircraft.

The public use category of the aircraft posed the additional problem of assuring the U.S. Navy of the air worthy condition of the aircraft. The services of the FAA were enlisted to review the modifications, inspect the design data and analyses, and the aircraft themselves, with the objective of receiving FAA certificates of an equivalent level of safety, as well as supplemental certificates for the various modifications required.

To perform the aircraft modifications required to more closely approximate the E-6A, an experienced aircraft modification firm was engaged as a subcontractor and teaming partner. This firm also had available operating rights at a suitable airport, and a maintenance capability. By providing the daily maintenance and inspections required, this subcontractor will continue to be fully involved in the conduct of the training using the surrogate in-flight trainer aircraft .

CONCLUSION

The Navy's E-6A CFCTS is one of the first to be structured using the ground-up approach. This system will be RFT before the aircraft is operational in the fleet, an accomplishment long desired by the

aircrew training community. Because this paper is a snapshot of the program as it currently exists, there are numerous areas of interest to explore in the future. Discussions of the two-year validation concept, cost comparisons between this and other methods, and the overall training effectiveness of the system are topics for future papers in this forum.

ABOUT THE AUTHORS

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Mr. Kriebel has been involved with major training systems, devices, and courseware development efforts for over 25 years. A great deal of that time was spent in various training billets while serving in the U.S. Navy for over 22 years. He has over 7 years of experience in industry designing and developing major training efforts for a variety of DOD and commercial customers.

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