CHARLESTON TACTICAL AIRCREW COMBAT TRAINING SYSTEM OFFSHORE

by Thomas J. O'Boyle and Terri M. Regin

Ocean Engineering and Construction Project Office
Chesapeake Division, Naval Facilities Engineering Command

ABSTRACT

This paper presents an overview of the Ocean Engineering and Construction Project Office (FPO-1) of the Chesapeake Division, Naval Facilities Engineering Command design and construction of eight ocean towers. These towers are for the Charleston Tactical Aircrew Combat Training System (CTACTS). The offshore portion of the CTACTS provides the necessary facilities to accurately monitor and control the training of Navy, Marine Corps, and Air Force pilots, during aerial warfare training exercises. These offshore facilities are located 30 to 72 nautical miles east of northern Georgia in water depths ranging from 81 to 143 feet. In June, 1984, FPO-1 awarded the ocean tower design contract to Brown & Root Development, Inc. The final design was completed in August, 1985 and in January, 1986, FPO-1 awarded a contract to McDermott Marine Construction to fabricate and install the platforms. The installation is scheduled to be completed by mid-September, 1986.

1. INTRODUCTION

Extensive Air Combat Maneuvering (ACM) training is conducted on sea ranges and airspace warning areas W-133/W-134 and W-157A/W-158C using training missiles and guns against drones and towed targets. Targets do not simulate true air combat conditions, as confirmed in Southeast Asia operation, whereby target takes all evasive action capable of high performance aircraft. These are uninstrumented air spaces and therefore training is limited since no scoring or post mission reconstruction is possible.

The CTACTS will encompass a volume of airspace from sea level to 60,000 feet and four major subsystems as shown in Figure 1 and described below.

Aircraft Instrumentation Subsystem (AIS). The AIS is self-contained. It monitors aircraft performance and weapon bus switchology and transmits this information to the tracking instrumentation subsystem via a low power radio link.

Tracking Instrumentation Subsystem (TIS). The CTACTS offshore TIS is comprised of two master-remote stations, one relay-remote station and five remote stations. The marine structures provide support towers and utilities for the TIS. The function of the TIS is to provide for the relay of digital data messages between the Aircraft Instrumentation Subsystem (AIS) and the Computation and Control Subsystem (CCS) and provide ranging data to the CCS to enable the CCS to calculate aircraft positions.

Control and Computation Subsystem (CCS). The CCS processes the aircraft performance range data relayed by microwave from the TIS master subsystem for real-time display. The CCS will be colocated with the DDS and AIS Pod Shop at MCAS Beaufort, SC.
Display and Debriefing Subsystem (DDS). The DDS contains display consoles that provide real-time three-dimensional views of air combat operations. Recording and playback features permit complete post-mission analysis and aircrew debriefing. The DDS is contained in a separate room in the same building as the CCS and AIS Pod Shop at MCAS Beaufort, SC. An additional DDS is located at NAS Cecil Field, FL.

The installation of the TACTS range east of northern Georgia, will provide a highly effective and safe training system that would enable Navy, Marine Corps, and Air Force pilots to improve their ability to recognize missile firing envelopes, thereby increasing the readiness of our military pilots. The offshore location of this TACTS range is beyond the 30 nautical mile sonic boom limit required by the Navy and therefore permits the pilots to conduct supersonic ACM training that would otherwise be unavailable.

Both the Navy and the Air Force have existing over water ranges in various parts of the world. Figure 2 illustrates the location of the ranges off the east coast of the United States. The ocean part of the Navy's Oceana TACTS range installed in the middle 1970's has four, three legged template pile structures. These structures were designed and constructed by FPO-1. The Air Force ACM (Air Combat Maneuvering Instrumentation is the Air Force description for TACTS) located off of Tyndall Air Force Base, FL, also installed in the middle 1970's, has five gravity mat founded ocean structures. The Air Force also has other ranges overseas that use floating structures. These floating structures are either 10 meter discus buoys or three legged semisubmersibles.

These existing U.S. Government owned ocean structures formed the concept data base used by the Navy to develop the facility study necessary to initiate this military construction project.

2. PROJECT DESIGN ORGANIZATION

The Charleston TACTS is made up of all the subsystems discussed previously. However, FPO-1 was only responsible for the ocean facilities project. This required the preparation of final plans and specifications and the supporting cost estimates and calculations, ready for bidding for the construction and installation of the eight offshore facilities. This follows the contracting policy that prior to issuing an Invitation For Bid (IFB), a 100 percent complete set of plans and specifications for that project must be completed.

The organization set-up to accomplish the design is shown in Figure 3. This organization was both an efficient and effective means of maintaining control of the project while conducting a high level technical review of the Architect-Engineer (A-E) contractor's submittals. The facility requirements coming from Commander Naval Air Systems Command (COMNAVAIRSYSCOM) went directly to the Engineer In Charge/Project Manager at FPO-1. The prime design A-E contractor for FPO-1 was Brown & Root Development Inc., who used Oceanweather Inc. for meteorological and oceanographic work and McClelland Engineers, Inc. for geophysical and geotechnical work. Also under contract to FPO-1 was Earl and Wright Consulting Engineers, who provided the Design Quality Assurance (DQA) for this project. Earl and Wright used Evans-Hamilton, Inc. for meteorological and oceanographic review and Dames & Moore for geophysical and geotechnical review. The Government used the DQA contractor as a technical reviewer/adviser on all submittals from the design A-E contractor. The DQA contractor's job was not to tell the Government if the design could be done a different way, but to assure that the design A-E contractor's work was technically correct. All submittals were sent by the A-E contractor simultaneously to FPO-1 and the DQA contractor for review. After the DQA contractor and FPO-1 completed their independent review of the submittal, they would meet and discuss their comments. The Government considered all the DQA comments and presented all review comments to the A-E contractor.
3. PROJECT LOCATION & REQUIREMENTS

The offshore site illustrated in Figure 4 is approximately 80 miles south of Charleston, South Carolina, and about 60 miles east of northern Georgia.

All the facilities are permanent and unmanned, and designed for a useful service life of 20 years. The ocean facilities are designed to enable the Charleston TACTS to remain operational while experiencing the following environmental conditions, including possible combinations thereof:

Wind: Up to 50 MPH from any direction with buffeting (peak) winds up to 75 MPH.

Rain: Up to four inches per hour with driving winds as stated above.

Humidity: 2 to 100 percent for extended periods of time including condensation due to temperature changes.

Temperature: +10°F to +110°F.

Waves and Tides: Wave height (crest to trough) up to fifteen (15) feet superimposed on a storm tide.

The stability of the ocean towers is adequate to enable orientation of the parabolic antennas used for data transmission. The beam width of each parabolic antenna is approximately plus or minus three degrees. Therefore, the bending or torsional movement of all towers is constrained by design to enable all antennas to maintain their orientation within the specified plus or minus three degrees from nominal steady-state conditions while experiencing the range of operational conditions.

The A-E contractor was required to conduct a study to determine the wind, wave and current design criteria to be used for survival conditions. The A-E contractor also included the consideration of seismic activity in the design criteria.

As described earlier, Commander Naval Air Systems Command provided all the facility requirements. These requirements are presented below for the three different types of offshore towers.

The Master Structures support:

(a) two parabolic antennas, ten foot diameter with weather covers, oriented toward each remote, with an additional set for the microwave relay, (approximate total weight is 5500 pounds);

(b) a water/weather tight enclosed area for the TACTS TIS's considerable electronics, power control and conditioning equipment and access space, work areas, and maintenance/ spares storage space (approximately 500 square feet);

(c) approximately 24,000 pounds of batteries and associated equipment that require approximately 150 square feet of floor space in a separate area;
(d) a stand-alone hybrid solar and wind power system consisting of an estimated 600 square feet of photovoltaic panels (approximately 7000 pounds) and two wind generators mounted to allow the 13-foot radius blades to rotate freely (approximate weight of each wind machine and support tower is 3000 pounds).

(e) a stand-by diesel generator set that has a minimum power output of 17.3 KW and 1200 gallons of fuel storage.

(f) a heliport with a 43 feet by 43 feet landing surface designed for an 11,200 pound maximum gross weight helicopter.

The Relay/Remote structure supports:

(a) two parabolic antennas, ten foot diameter with weather covers, oriented toward the each master, an additional set oriented toward the each master for the microwave relay and a fifth set oriented toward shore;

(b) the same battery requirements and stand-alone hybrid solar and wind power system as the Master.

(c) the same stand-by diesel generator set as on the Master towers.

(d) the same heliport as on the Master towers.

The Remotes support:

(a) two parabolic antennas, ten foot diameter with weather covers oriented toward the master;

(b) approximately 250 square feet of photovoltaic panels at 60 degrees from the horizontal;

(c) approximately 1700 pounds of batteries and associated equipment.

(d) a heliport designed for a 5500 pound maximum gross weight helicopter.

4. DESIGN PHASES

The design work was done in several phases as follows.

Phase A included: (a) obtaining all environmental, bathymetric and geologic/geotechnical data needed for foundation analysis; (b) defining the design criteria for fatigue, loads and deflections due to the predicted wave spectrum for the 50-year maximum storm and seismic conditions at the sites and; (c) conducting structure and foundation trade studies to support the selection of the best concept to meet functional and cost criteria for a 20-year life.

Phase B included: (a) obtaining any additional bathymetric and geologic/geotechnical data needed for design; (b) the preparation of preliminary plans and specifications based on the data produced by Phase A and the selected concept.

Phase C was for the preparation of the final plans and specifications.

Phase D is for follow-on engineering services during construction.

The final design was completed in August, 1985. Figures 5 illustrates the final configuration of the Masters M1R1 & M2R6 and Relay/Remote R2. Figure 6 illustrates the final configuration of the Remotes R3, R4, R5, R7 & R8.
Each of the eight ocean structures consists of a tubular steel space frame template, a superstructure, and piling. The aggregate length of the piling exceeds 6,000 feet. The total steel tonnage for all eight platforms is approximately 7,000 tons.

5. CONSTRUCTION

The project schedule requires all eight ocean structures be installed in the summer months of 1986. To accomplish this schedule, FPO-1 pre-qualified the potential construction contractors to ensure each bidder had adequate resources to complete the project. First a questionnaire was sent to all requestors which provided FPO-1 the necessary information to evaluate each contractor. After the pre-qualification board members reviewed all responses, the decision was made regarding each firm's capability of completing the job in the required time frame. The IFB was issued to the pre-qualified contractors in September 1985. In January, 1986 FPO-1 awarded a contract to McDermott Marine Construction to fabricate and install the platforms.

The construction contract is administered by FPO-1 through a Resident Officer In Charge of Construction (ROICC) in the fabrication yard. The ROICC is assisted by FPO-1 engineers and contracted engineering services. To acquire this needed contractor support, Phase D of the design contract was exercised. This provided Post Construction Award Services (PCAS) and Title II inspection services to the ROICC.

The PCAS requires the design A-E firm to (a) review submittals required by the specification, (b) provide consultation services to the Government and (c) prepare the project as-built drawings.

The Title II inspection services requires the design A-E firm to provide construction and installation surveillance services of all work done in connection with the CTACTS offshore structures. The A-E surveillance personnel are knowledgeable in welding, fabrication, and offshore construction practices.

6. CONCLUSION

The successful completion of the CTACTS design, ahead of schedule and within budget, proves the effectiveness of FPO-1's design organization. FPO-1's expertise in ocean engineering and the use of a DQA contractor were essential elements that contributed to the professional quality of the design and resulted in a product familiar to the offshore industry bidders.

The ROICC organization and the pre-qualification of the bidders ensures a successful completion of the construction phase of this project on schedule. The installation is scheduled to be completed by mid-September, 1986.