PIERSIDE COMBAT SYSTEMS TRAINING WITH THE 20B4

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ABSTRACT

Pierside combat systems training is a way to supplement the shore based training facilities and the at-sea exercises which are so necessary to keep a combat team at a high level of proficiency. This paper presents how pierside training is being accomplished with the use of the Device 20B4, Mobile Combat Systems Trainer. The 20B4 provides the capability for conducting individual operator and team training on the crew's ownship through stimulation of the installed operational equipment. The user can develop, modify, expand, and replay training exercises quickly through a combination of real-time and off-line software routines. The system presents a total electronic warfare environment to a wide range of sensors with a cost effective adaptability to the sensors and threats. The mobility of the 20B4 enables the system to be moved wherever the ships are located to achieve improved fleet readiness through realistic training and checkout.

INTRODUCTION

The classic problem in warfare is to ensure that the Military personnel and equipment are organized, trained, and ready to handle a wide variety of combat situations. This is particularly true for naval ships where complex team operations, actions, interactions, and decisions are required. The precision and speed involved in threat detection, identification, engagement, and weapons deployment are critical to the survival of combat ships. The coordination of these activities in a battle environment is complicated and crew proficiency is difficult and expensive to maintain during peacetime. To achieve a high level of proficiency, without being in battle, is the goal of all training activities.

Until recently, coordinated combat systems team training was provided to varying degrees at land-based training facilities, and through at-sea exercises which involved the use of operational aircraft and ships. As with any training situation, there were limitations to what could be accomplished under these conditions. The problem was to fill the gaps, bring training to the fleet, and accent the coordination of the combat systems team. Among alternatives considered to supplement the shore based facilities and at-sea exercises, was that of a pierside combat systems trainer. This device would create a realistic threat environment, directly stimulate shipboard sensors, and interact with the operation of these sensors.

The result would be a training system that permitted on-ship training of combat systems teams using their shipboard equipment and training scenario coordination provided by knowledgeable Fleet training personnel. The Device 20B4 Mobile Combat Systems Trainer (MCST) is one such device.

DESCRIPTION OF THE 20B4

Functional Description

The 20B4 MCST is a completely mobile unit, with all equipment contained in an air-conditioned semitrailer which has an air-cushioned suspension system. (See Figure 1, Picture of 20B4 Van.)

The software programs and peripheral devices compute all target and vehicle dynamics for any training exercise. Three-dimensional landmass and weather formations are stored on easily accessed magnetic tape and disc cartridges. Among the other software programs are those for data entry, radar parameter tables, Electronic Warfare emitter tables, and hardware diagnostics for ease of maintenance. (See Figure 2, the 20B4 MCST block diagram.)

Data from the computer is passed to high speed electronic modules designed specifically for the 20B4. Each module performs a designated task, such as target attenuation. This modularization permits easy fault isolation, and correction by module replacement. The combination of many elements of target characteristics data is generated in the proper format for application to various types of radar systems (such as pulse Continuous Wave, pulsed doppler, chirped pulse, coded pulse groups, Frequency Modulation, Continuous Wave, or others). This signal is provided to the appropriate radar channel from the 20B4 van. Fire control radar types may be of the conical scan, Conical Scan Receive Only scan, simultaneous monopulse using 1, 2, or 3 channel receiver systems, with or without sidelobe cancellation features.

The signals are transmitted to the ship through 1-inch diameter cables (normally, one

per sensor), which terminate in sensor interface units. The attache-case sized interface units further condition and distribute the signals through a harness which is configured to permit quick, temporary connection to the sensor. (See Figure 3, Interface Kit). Stimulation of the radars is done at the Intermediate Frequency of the radar to use as much of the radar system as reasonable, and to achieve realistic interface for effective Electronic Counter Measures interactions. A side benefit of this approach is that it serves as a systems level device to generally assess the operability of the radar. EW equipment interface is provided at the RF level for the same reasons.

In its present configuration, the 20B4 simultaneously stimulates up to seven radar sensors and various Electronic Warfare equipments. The radars typically include a short range surface search, a long range air search, a three-dimensional air search, and four missile or gun fire control radars. These radars are selected from the list of 23 different radars currently interfaced by the 20B4. The Electronic Warfare equipment stimulated include countermeasures sets, deception repeaters, Direction Finder Sets, countermeasures receivers, and threat identifiers. The 20B4 also stimulates Identification Friend or Foe (IFF) and ownship motion equipment.

The threat environment of the 20B4 presents up to 32 independent targets simultaneously, such as ships, aircraft decoys, and missiles. In any given scenario, hundreds of targets can be presented over time. These are accompanied by appropriate signatures, landmass, weather, sea state, Electronic Counter Measures and chaff. Each threat or environment parameter output results in presenting the shipboard equipment with the static or dynamic features which would be associated with real conditions. Three-dimensional landmasses from around the world are available, and aircraft features include size, aspect, turn rate, speed, and acceleration, among others. Missiles employed in the training scenarios feature appropriate elements such as Electronic Warfare emissions, range, altitude, and velocity characteristics. Jamming conditions can be automated or activated by operators during exercises. Targets that fly behind the landmass mountains are masked as in real life, and targets which are successfully engaged are removed from the displays when they are destroyed.

The Electronic Warfare Simulator (EWS) of the 20B4 will present up to 32 simultaneous threats in the upper bands (A through J). Again, in any scenario, hundreds of Electronic Warfare targets can be presented over time. Each Electronic Warfare threat may be assigned a unique pulse repetition interval and pulse code, and there are no restrictions placed on the number of threats in any particular band. Each emitter may have any of 10 basic scan patterns (circular, spiral, raster, palmer, etc.) generated from one of 16 hardware stored antenna patterns. Disc storage provides for 250 emitter signatures for scenario preparation and implementation.

Sixteen independent, programmable jammers are available for simultaneous use. Hundreds of these may be employed during the course of any given scenario. They provide selectable features such as carrier and amplitude modulation, range or angle gate steal, blink and angle deception. Chaff drops are also programmable and up to 16 simultaneous drops may be made at any time.

The 20B4 stimulates the AIMS MK X or MK XII IFF systems at the radio frequency level. All modes are stimulated, although mode 4 is simulated to avoid exercising crypto-secure circuits.

Ownship motion is provided for any one of the 10 classes of ships currently in the 20B4 library. The overall gaming area is 1,024 by 1,024 nautical miles which permits a great deal of flexibility in scenario preparation.

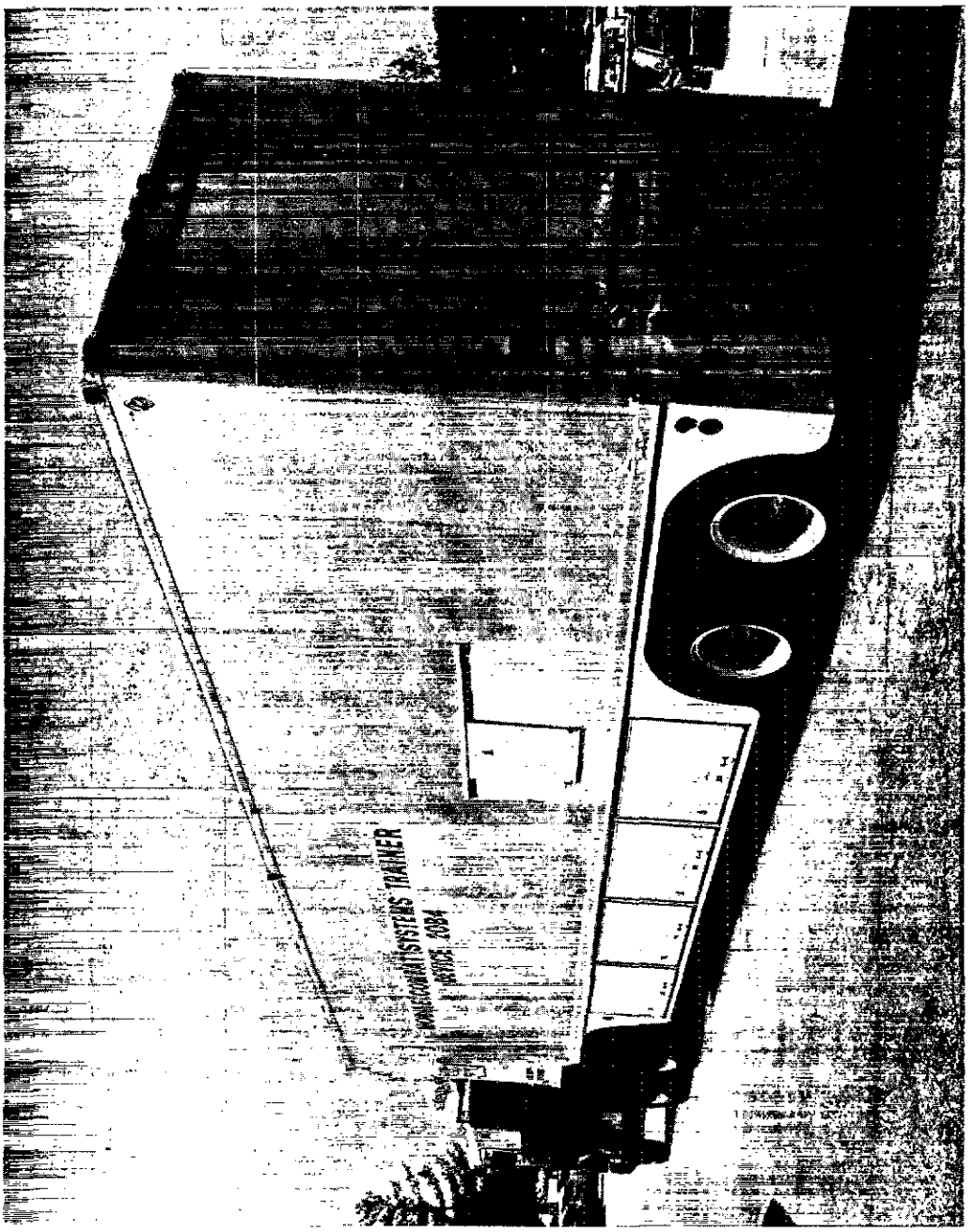
Pre-operating Features

All information used to prepare an exercise is entered via the Operator Console of Device 20B4. (See Figure 4, Operator Control Console.) Two cathode ray tube displays with keyboards allow the instructor to create targets, activate jammers, start and stop scenarios, change weather conditions, or alter any other factors that would affect the ship's sensors. A Plan Position Indicator is provided to show the actual display being presented to the ship's radars. Also, an A-scope and patch panel including an intermediate frequency amplifier-detector allow the instructor to monitor pertinent signals such as radar sync, ranging, video, and error signals.

The importance of realistic training scenarios cannot be overstressed, and the 20B4 permits scenario preparation by the user, based on his training objectives. These can be prepared off-line through use of the scenario compiler, and instructions are entered in time, target or object, function, and value format. The resultant data is stored on magnetic tape (or cards) and a hard copy output may be obtained from a line printer installed in the van. Scenarios may also be generated on-line through Instructor Manual (Keyboard) operations and automatically recorded. Scenarios may be created for simple or complex missions, to emphasize some specific training goal or for a variety of other uses.

Interface with the ship is through the Interface Kits previously mentioned. These are electronically keyed and automatically alert the 20B4 Instructor if the cable interconnections are incorrect.

After the interface is completed and verified, the 20B4 and ship sensors must be correlated through alignment. This is done in


WEAPON SYSTEMS TRAINER
MODEL 1084

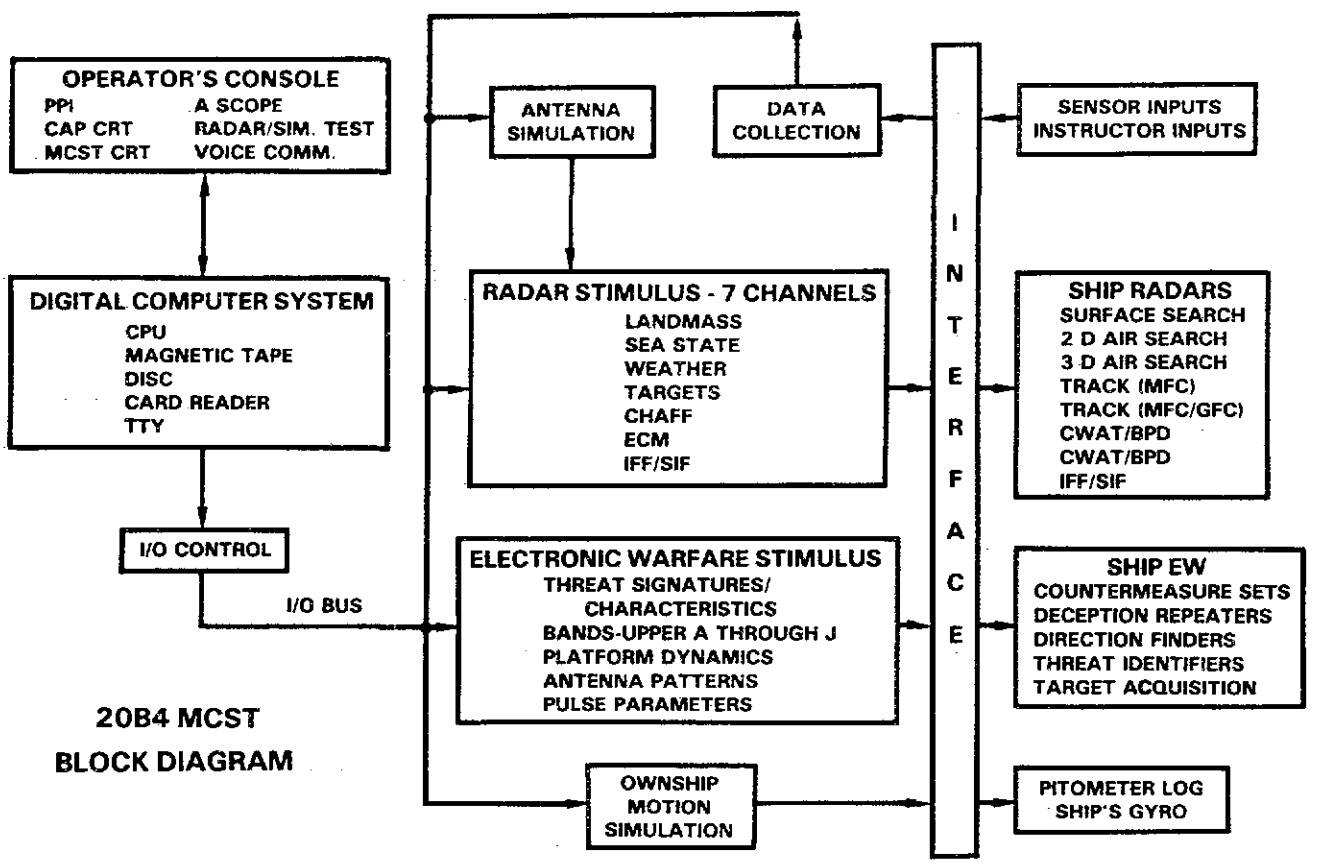

OPERATOR'S CONSOLE
PPI
A SCOPE
CAP CRT
RADAR/SIM. TEST
MCST CRT
VOICE COMM.
DIGITAL COMPUTER SYSTEM
CPU
MAGNETIC TAPE
DISC
CARD READER
TTY
I/O CONTROL
I/O BUS
20B4 MCST
BLOCK DIAGRAM
ANTENNA SIMULATION
DATA COLLECTION
SENSOR INPUTS
INSTRUCTOR INPUTS
RADAR STIMULUS - 7 CHANNELS
LANDMASS
SEA STATE
WEATHER
TARGETS
CHAFF
ECM
IFF/SIF
ELECTRONIC WARFARE STIMULUS
THREAT SIGNATURES/
CHARACTERISTICS
BANDS-UPPER A THROUGH J
PLATFORM DYNAMICS
ANTENNA PATTERNS
PULSE PARAMETERS
OWNSHIP
MOTION
SIMULATION
INTERFACE
SHIP RADARS
SURFACE SEARCH
2 D AIR SEARCH
3 D AIR SEARCH
TRACK (MFC)
TRACK (MFC/GFC)
CWAT/BPD
CWAT/BPD
IFF/SIF
SHIP EW
COUNTERMEASURE SETS
DECEPTION REPEATERS
DIRECTION FINDERS
THREAT IDENTIFIERS
TARGET ACQUISITION
PITOMETER LOG
SHIP'S GYRO

Figure 2.

a step-by-step procedure from the 20B4 Instructor position and includes such elements as azimuth and elevation angle offsets. Depending on the type of ship and number of sensors to interface, this overall interface task can be done in as little as 1 or 2 days. All data for a given ship is recorded on disc, so that it is readily recalled for that ship when training is conducted at a later time.

The final step is to initialize the training program. This is done by selecting the scenario, landmass map, weather map, and weather height. This may be done from the Operator's position. The Operator then selects the appropriate mode of operation, NORMAL or RECORD. The RECORD mode is used to generate a scenario on-line.

Operation

Following interface and alignment, the 20B4 may be used to run as many scenarios as training time permits.

Operation in the NORMAL mode consists of starting a prerecorded scenario and monitoring the sensor operator action and responses. For greater realism, there is a second Operator position from which the Combat Air Patrol (CAP) simulated aircraft is controlled. Due to the dynamics of the CAP interactions with the ships' Air Intercept Control personnel, both target control and communications are handled by this Operator. Both positions for the 20B4 and CAP instructors are identical, and each has access to all displays as well as the capability to manually intervene to modify the scenario, if desired. The use of the prepared scenarios thus minimizes the operating functions to be performed, but the system offers the potential to modify the scenario during training as desired. Further, the use of standardized, repeatable scenarios can provide relative personnel training assessments or evaluation of combat systems capabilities of various classes of ships.

Data Collection and Evaluation

During the training exercises (and keyed to the specific scenario), there are a number of important events that are recorded. These are automatically obtained from flagged scenario data, sensing points in the interface or from inputs derived from hand-held keysets controlled by Instructor/Observers positioned at critical locations aboard ships. The data recorded includes administrative information such as the date, ship, time, as well as other inputs. Electronic Warfare data which can be recorded includes emitters presented, identified correctly, engaged correctly and the time to detect high priority threats. Radar target data which can be recorded includes targets presented, engaged, and killed by threat class, average detection time, average target assignment time, as well as Search and Track radar summary information. This data may be used to identify specific problem areas, debrief ships crews and officers, or assess overall effectiveness for readiness evaluation. Due to the complexities of evaluation, the data collection use is strictly up to the user.

20B4 MCST Expandability

Although the 20B4 currently supports a defined set of sensors, additional units can be stimulated with very little modification. The 20B4 provides stimulation for many types of radar, as well as Electronic Warfare signatures within the radio frequency spectrum from 0.2 to 18 GHz. To stimulate a new sensor, the general technique is to develop a new interface or modify an existing one.

The capability to provide anti-submarine warfare training has been taken into account in the basic 20B4 design. Should there be a requirement for this training mission to be assigned to the 20B4, there is enough physical space and system computing time to accommodate it.

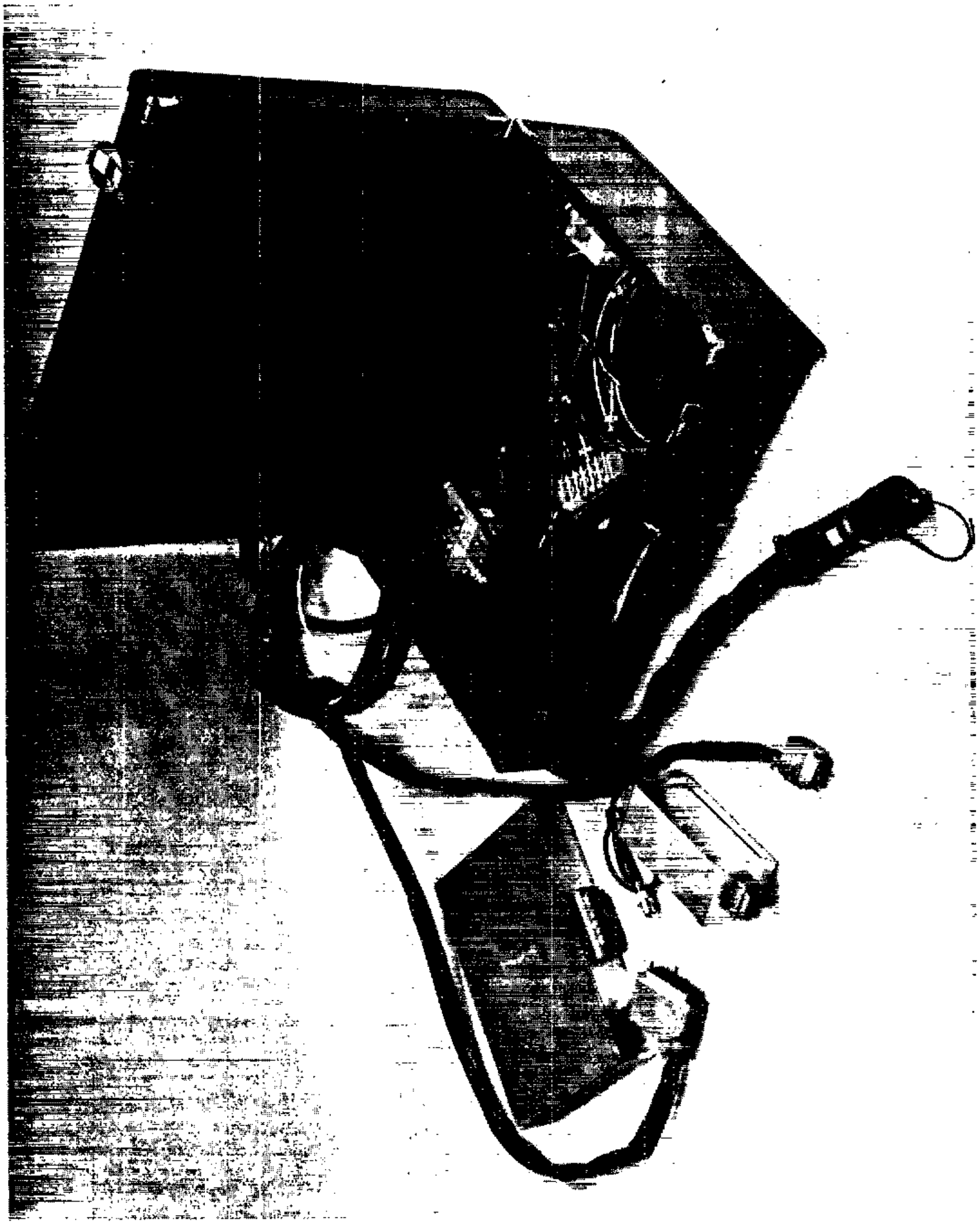
Conclusion:

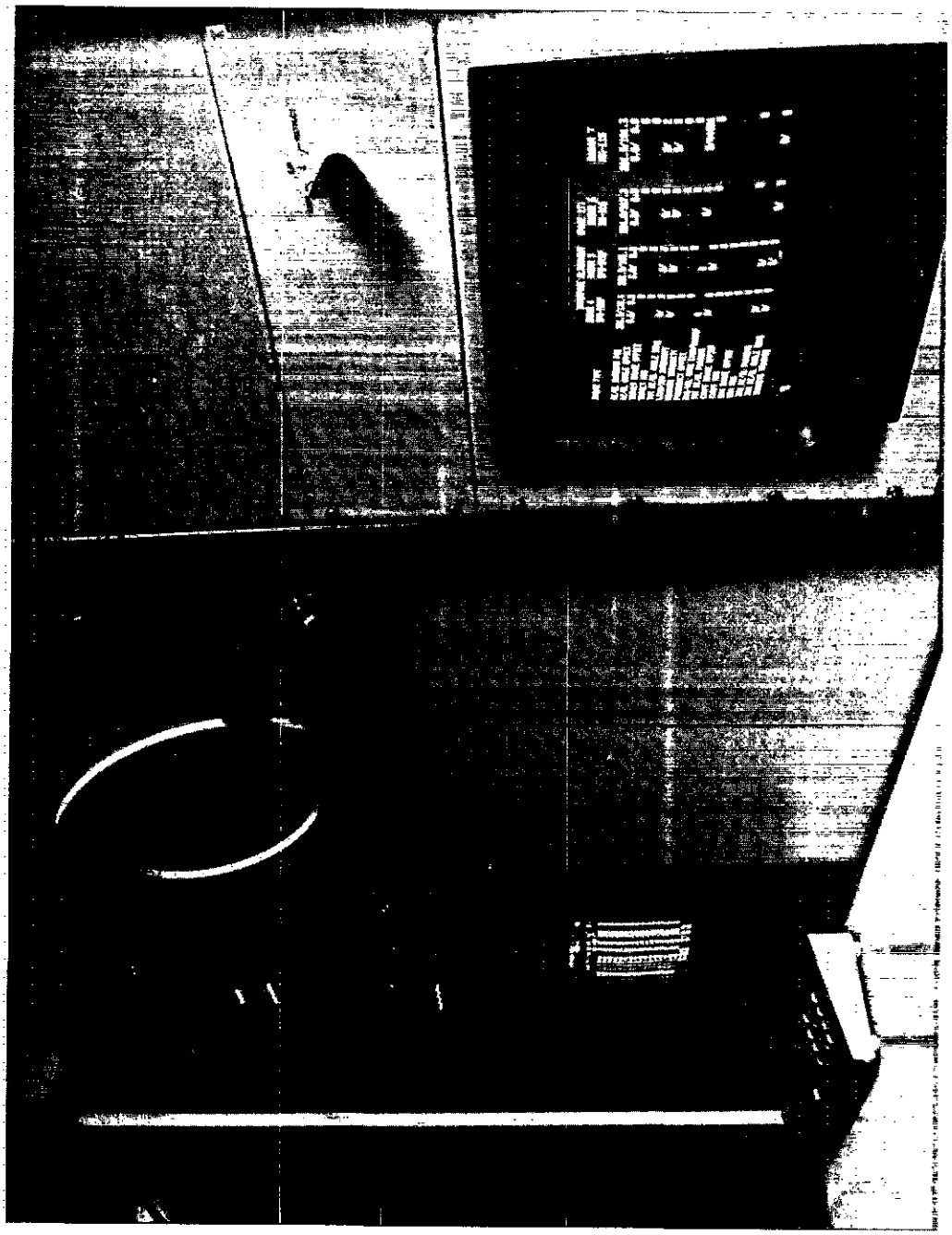
Pierside combat systems training is an important element in the present training concept for Navy shipboard personnel. The strong point of pierside training is that it brings the environmental control of the classroom to the actual shipboard equipment and combat teams. The 20B4 has been used successfully as a cost effective means of maintaining combat crew proficiency for a number of ship types including aircraft carriers, cruisers,destroyers, and frigates during the past two years at a number of east coast Naval bases.

Experience to date indicates that ship's crews welcome the training experience because they are integrated as combat crews into composite training exercises in which these crews are given an opportunity to interrelate and cooperate under psuedo-combat conditions to successfully complete a training mission.

Additional 20B4 MCST units are currently being fabricated and deployed at selected locations throughout the world for more widespread economical proficiency training.

The Device 20B4 is not limited to pierside combat systems training. It is a general purpose radar and EW stimulator/ trainer and is a natural extension of the AN/MPQ-T1 Nike Hercules Radar Simulator previously designed by AAI. (The AN/MPQ-T1 trainer is a trailer mounted system which can be readily moved from missile site to missile site to provide training to the weapon system operators.) With the addition of new interface kits, the Device 20B4 could provide individual or team training to almost any radar or Electronic Warfare systems. This could include air, land, or sea based electronic sensing platforms.





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