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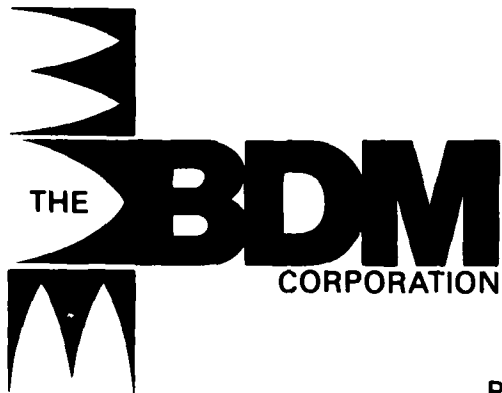
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EXECUTIVE SUMMARY  
OF  
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THE NATIONAL TRAINING CENTER  
PLANNING SUPPORT

Submitted to: The TRADOC Systems Manager for NTC, U.S. Army Training and Doctrine Command, Fort Monroe, Virginia.

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OVERVIEW

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## Overview

### NTC PLANNING SUPPORT - TASK SUMMARY

This Executive Summary Report presents the results of selected tasks of the Phase I Planning Support.

The tasks performed are shown in Figure 1. This summary presents the results of Subtasks 1.2, 1.3, and 1.4 of Task 1.

Task 2 was performed for and reported to the Defense Advanced Research Projects Agency (DARPA). Subtasks 1.2, 1.3, and 1.4 were performed for the NTC TSM.

TASK SUMMARY

TASK 1 - PHASE I PLANNING SUPPORT

- SUBTASK 1.1 DEVELOP TRAINING AND TRAINING DEVELOPMENTS CONCEPTS - PERFORMED AND REPORTED TO CATRADA
- SUBTASK 1.2 PROVIDE SYSTEMS INTEGRATION SUPPORT
- SUBTASK 1.3 DEVELOP A MANAGEMENT CONCEPT
- SUBTASK 1.4 INVESTIGATION OF PHASE I OPPORTUNITIES TO BE DERIVED FROM NTC IA TEST

TASK 2 - PHASE II PLANNING SUPPORT - PERFORMED AND REPORTED TO DARPA

- SUBTASK 2.1 REFINE SYSTEM ARCHITECTURE
- SUBTASK 2.2 DEVELOP BROCHURE FOR INDUSTRY SYMPOSIUM
- SUBTASK 2.3 PROVIDE FOLLOW-UP TECHNICAL ASSESSMENT

Figure 1. Summary of NTC Planning Support Tasks

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SYSTEMS INTEGRATION SUPPORT

- NTC Phase I Development Options - Summary
- Principal NTC System Components
- Design and Systems Integration for Phase I
- Representative NTC Phase I Configuration
- Command Post Exercises/Notional Battalions
- Training Analysis and Feedback Requirements
- Field Data Collection - Electronic Clipboard
- Field Data Collection - Manual Data Forms

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## Systems Integration Support

### NTC PHASE I DEVELOPMENT OPTIONS - SUMMARY

For NTC Phase I integration planning purposes, four representative development approaches were considered.

NTC Phase I will be developed under contract with industry. To provide a basis for assessing alternative approaches, four representative development approaches for NTC Phase I have been published. Details of these were provided in earlier reports submitted to TRADOC.

Option A, Limited Phase I - This plan limits the number of RMS-instrumented players to 120 in Phase I. The PLAFIRE concept would be introduced in the fourth quarter of FY 82, three to four years earlier than currently planned.

This plan avoids heavy reliance on RMS instrumentation and minimizes the development effort for Phase I. This is accomplished by using CDEC's TASVAL software, which can support 120 players, directly on NTC computers. Development effort and schedule risk are avoided by not attempting to upgrade the RMS system to 450 players. An alternative to the CDEC TASVAL software is the OSD DDT&E SEL-86 software.

Option B, Full Phase I Instrumentation - This plan provides for fielding 450 RMS-instrumented players in Phase I, followed by early introduction of PLAFIRE in fourth quarter FY 82.

Option C, Full Phase I Instrumentation, PLAFIRE Delayed - This plan provides the same option as B but delays PLAFIRE.

Options A, B and C all require major investments in A-Stations for RMS coverage. Options B and C require 330 more B-Units than does Option A, not counting additional spares. This increase in B-Units would cost on the order of eight million dollars. Further, both Option B and C involve substantially more development effort than Option A. Further, according to CDEC engineering estimates, 55 A-Stations are needed for minimum coverage of the 10KM by 10KM playing area. For Fort Irwin, approximately 50KM by 50KM, this would require upwards of 275 A-Stations at a cost of over \$20 million, exclusive of B-Units.

Option D, PLAFIRE - This plan provides for elimination of Phase I, shifting the IOC to fourth quarter of FY 82 and immediate development of PLAFIRE.

In this approach, TRADOC does not invest resources in the development and implementation of two operational systems for two separate phases. All resources are concentrated on the modern PLAFIRE instrumentation.

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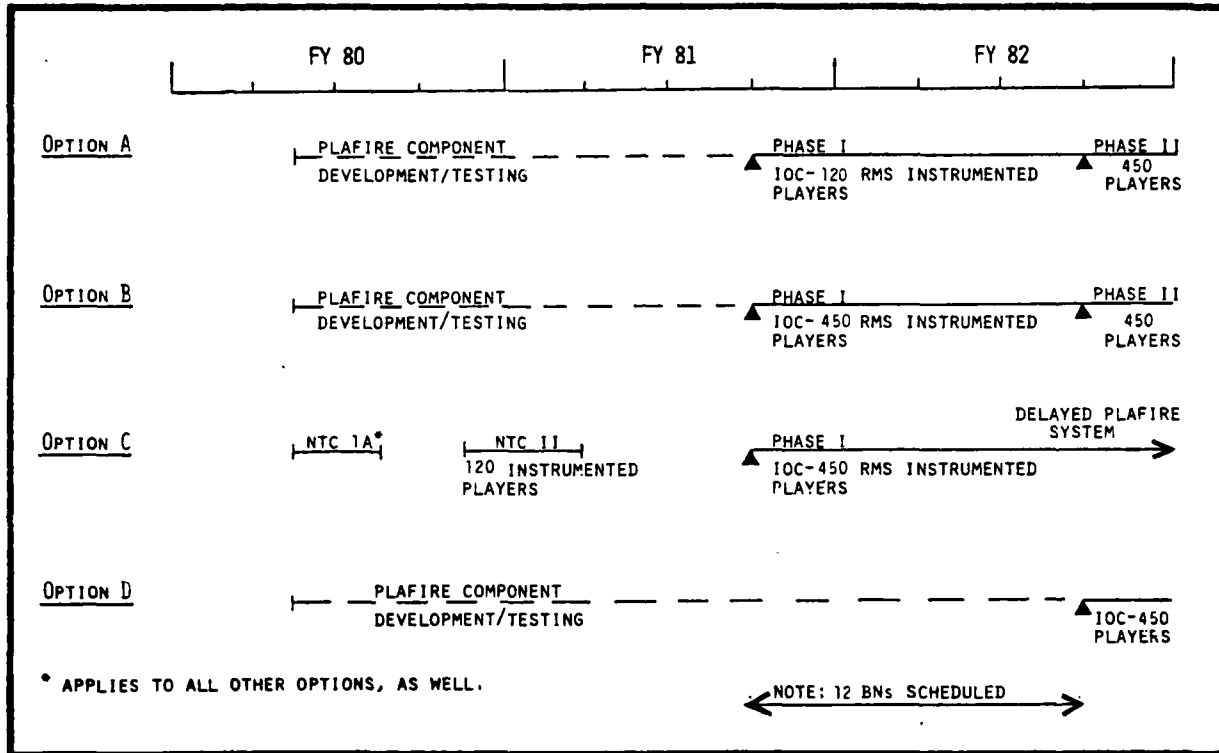


Figure 2. Comparison of NTC Options

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## Systems Integration Support

### PRINCIPAL NTC SYSTEM COMPONENTS

There are seven principal components which must be developed and integrated to establish the total NTC system for Phase I.

The NTC system components needed for Phase I are shown in Figure 3.

Three Instrumentation Subsystem Components - The instrumentation system required for this role has three highly interrelated components:

- Force-on-force engagement simulation instrumentation
- Live fire instrumentation
- Data processing and display systems.

This instrumentation will do the following:

- Record position location
- Simulate and record engagement events
- Transmit real-time control to the field
- Provide data processing and displays for training analysis and feedback (TAF).

Notional Battalion - CPXs or notional battalions will support training of the Brigade as well as the additional Battalion staffs.

OPFOR - The OPFOR will represent a Soviet motorized rifle regiment. The tactics and techniques employed must be those of the Soviets.

Exercise Monitor and Control (EMC) - The EMC is required for many operational functions essential to effective operations:

- Conduct automated instrumentation countdown
- Establish software initialization
- Control OPFOR
- Range safety
- Control electromagnetic emissions
- Administrative kill of players as required
- Check status of instrumentation and software during operations
- Control CCTV and voice recording instrumentation.

Training Analysis and Feedback - TAF post-exercise training will be conducted in After Action Reviews (AAR) which will emphasize training by analysis and feedback of the exercise data.

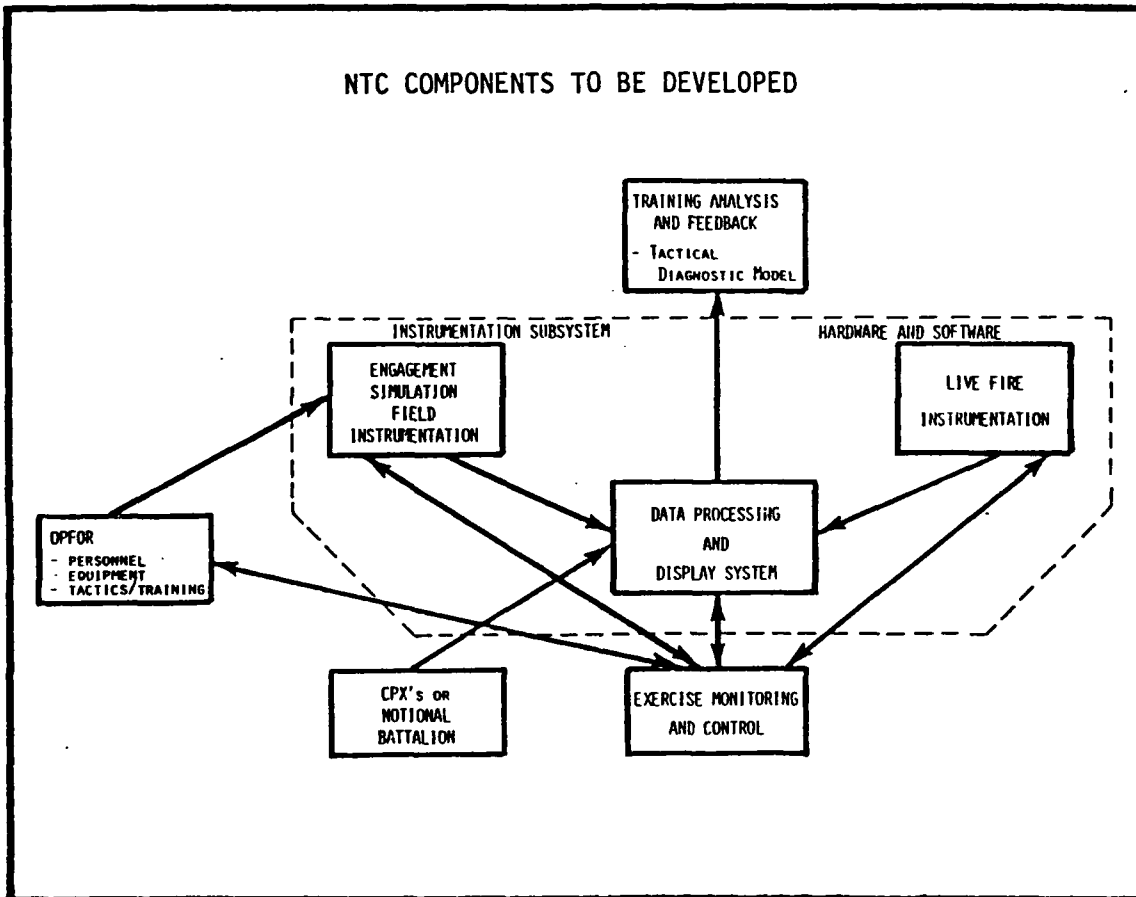


Figure 3. Principal Components to be Developed and Integrated to Establish NTC System

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## Systems Integration Support

### DESIGN AND SYSTEMS INTEGRATION FOR PHASE I

The principal components of the NTC system functionally interact and the NTC Phase I system must be designed as an integrated system.

Integrated System Design - The seven principal components of the NTC have been organized into the total system presented in detail in Figure 4. This figure illustrates the complex relationship which exists among components and emphasizes the importance which must be directed to an integrated approach to planning and implementation of both hardware and software.

PL System/MILES Integration - The position location system operations and MILES engagement simulation will be integrated in Phase I. Figure 4 shows this for the case of the RMS system. The RMS control, command generator, and range/event data collection are shown as key functions under REAL-TIME-SOFTWARE AND DISPLAY. Alternative PL systems may be used.

CDEC PL/MILES Backup - Many of the functions and functional elements presented in Figure 4 are already in operation at CDEC. The CDEC system, developed for the TASVAL test, can handle up to 120 instrumented players. CDEC also uses its own Laser Direct Fire System (LDFS) for engagement simulation. Engagement computation of  $P_k$  and assessment of casualties is conducted in the central computer. The LDFS provides an excellent backup for MILES in Phase I.

CDEC has already conducted training analysis and feedback exercises for TIE, and much of the CDEC software and computer hardware for graphical display is applicable to NTC TAF functions. Under CDEC's participation in NTC 1A Stage I, CDEC will be developing the additional software necessary to support TAF development and instrumentation.

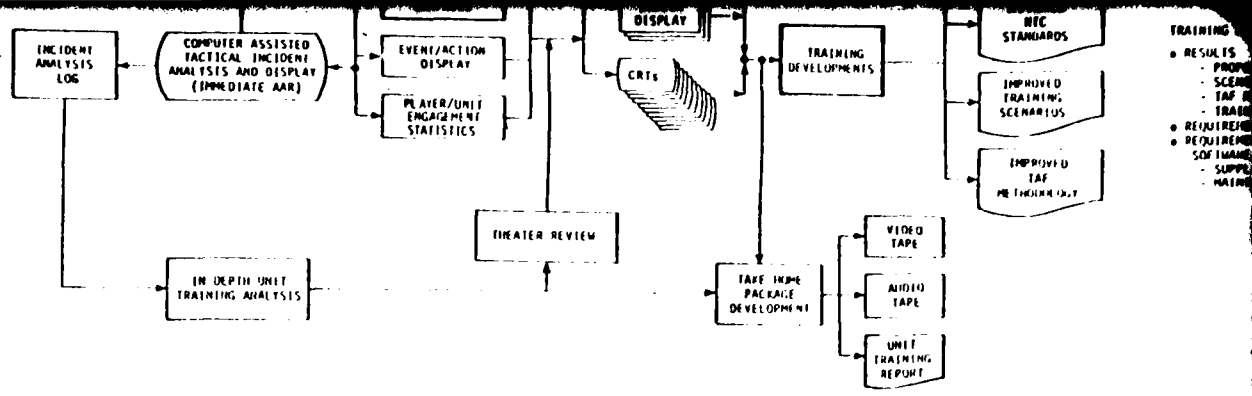
Maximum Effectiveness - The system design provides for all required real-time EMC and TAF functions, operation of field instrumentation and the interaction of the operating system with NTC management. The design of the system maximizes transparency and realism for the players through:

- Lack of intrusion of instrumentation into player activities; and
- Inclusion of all major facets of combined arms operations.

The interaction between operations and management shown in the figure is essential for successful training. The NTC operation is so complex that failure to coordinate plans, maintain equipment or instrumentation, or provide adequate supplies will seriously disrupt training.







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Figure 4. NTC System Concept

TRAINING ANALYSIS AND FEEDBACK

- RESULTS
  - PROPOSED STANDARDS
  - SCENARIO DESIGNS
  - TAF METHODOLOGY
  - TRAINING EFFECTIVENESS
- REQUIREMENTS FOR PERSONNEL
- REQUIREMENTS FOR COMPUTER/SOFTWARE/TRAINING MATERIALS
- SUPPLIES
- MAINTENANCE

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Concept - Phase I

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Representative NTC Phase I Configuration

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Systems Integration Support

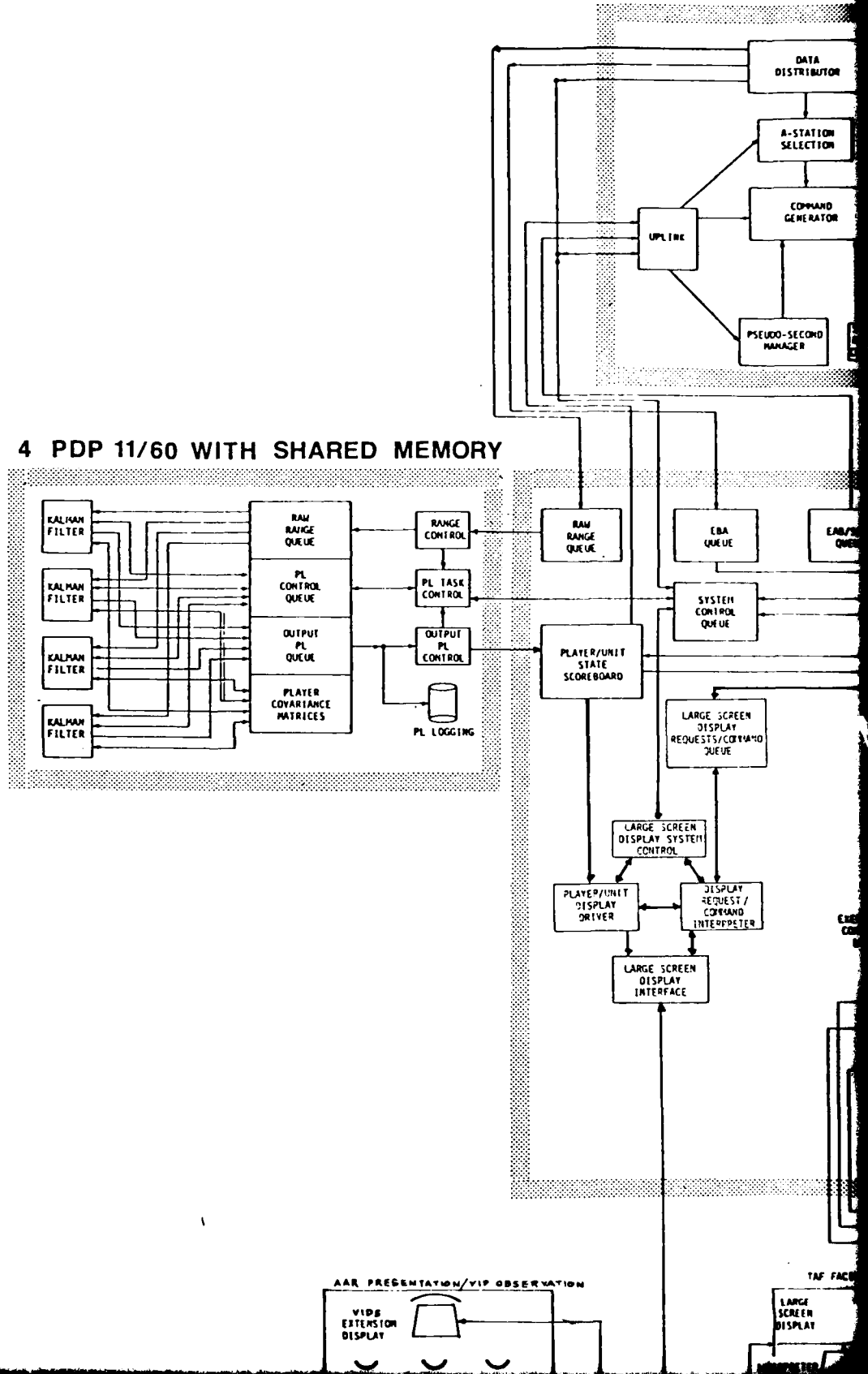
## REPRESENTATIVE NTC PHASE I COMPUTER CONFIGURATION

A representative computer hardware system was developed for NTC Phase I planning.

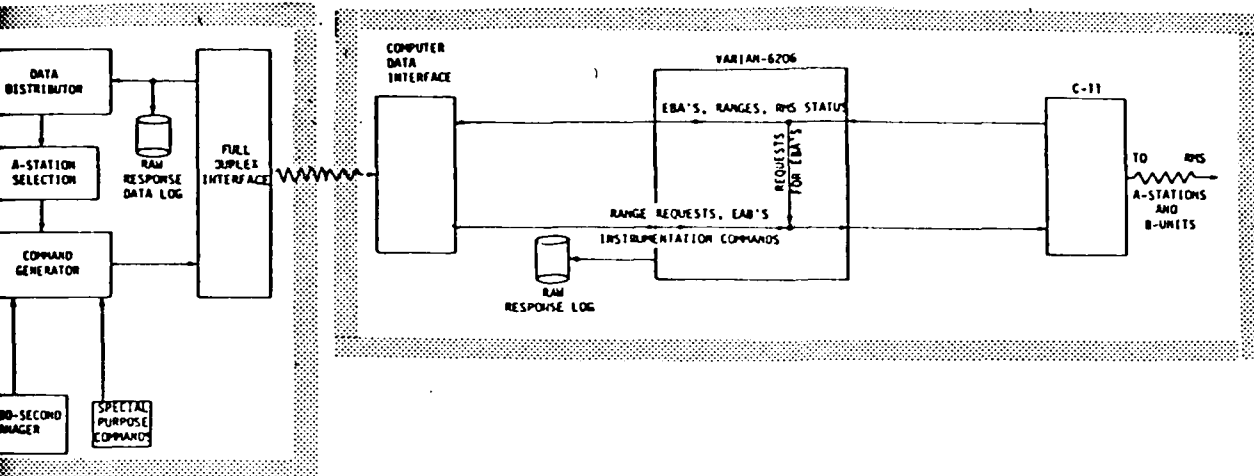
Representative NTC Phase I Configuration - A representative computer hardware configuration to support NTC Phase I consists of equipment compatible with the currently operational CDEC/TRADOC MCS software. The proposed configuration is centered around the Digital Equipment Corporation's VAX-77/780 computer. In addition to the VAX, current NTC parameters suggest that five additional machines such as the PDP 11/60 will be required to support various functions. These machines, especially the VAX system, were designed to be directly upward compatible with the hardware and software currently in use at CDEC.

# NTC PHASE I DETAILED COMPUTER S

## 4 PDP 11/60 WITH SHARED MEMORY

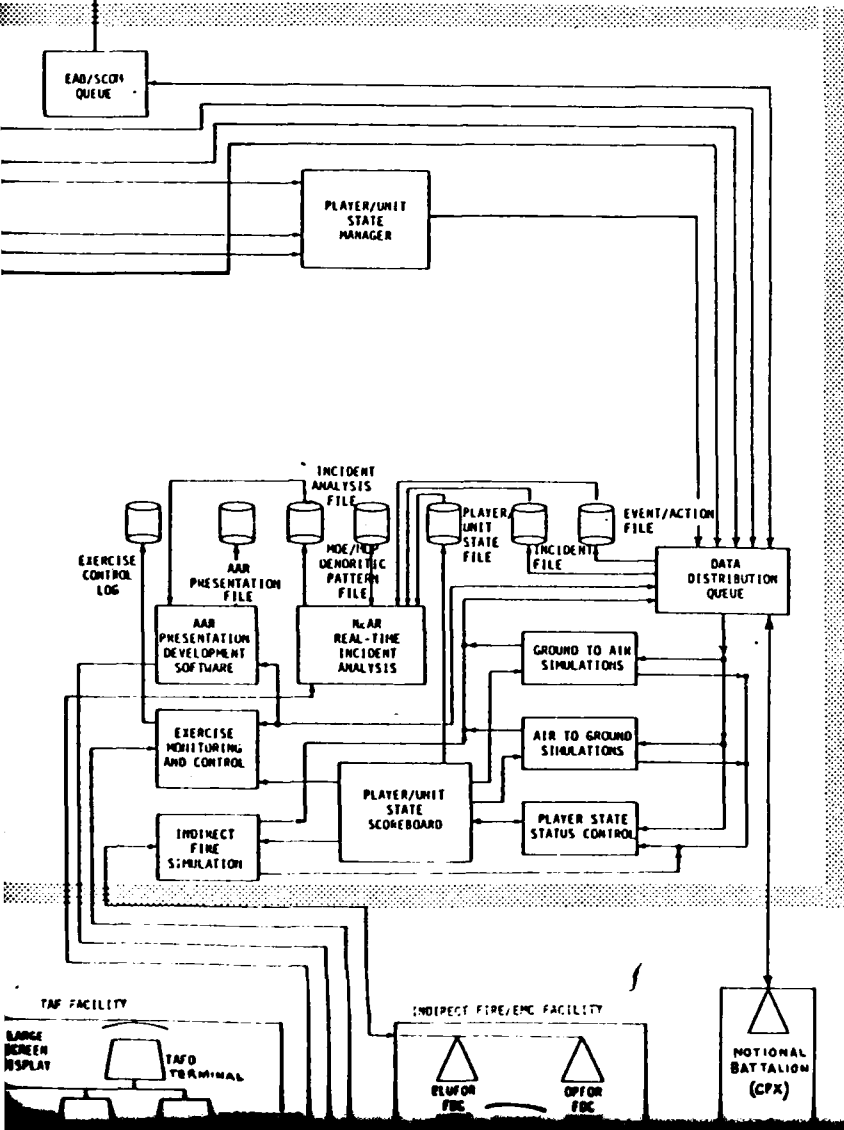


# ER SYSTEM - FUNCTIONS AND DATA FLOWS



PDP 11/60

VAX 11/780



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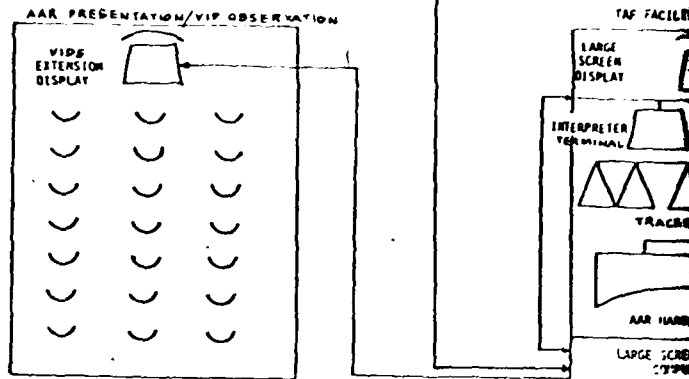
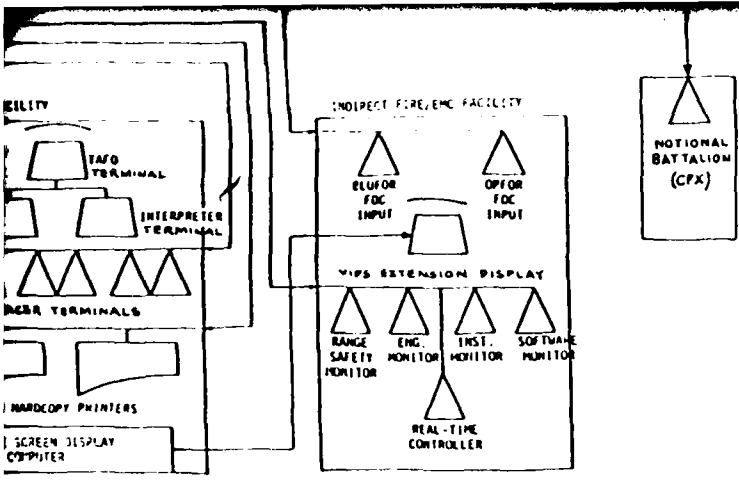


Figure 5. Representative NTC Ph



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Phase I Detailed Computer System

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Command Post Exercises/Notional Battalions

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## Systems Integration Support

### COMMAND POST EXERCISES/NOTIONAL BATTALIONS

Command post exercise (CPX) techniques will effectively generate activities of notional BN CPs and other notional elements.

Brigade Headquarters (BDE HQ) - Realism in exercising BN command and control requires representation of BDE HQ operations. There are four steps to do this:

- Establish realistic BDE HQS for NTC exercises.
- Provide tactical communication interactions with "live" battalion.
- Add interactions with "other" battalions to create realistic combat activity environment in BDE HQs.
- Generate interactions with "other" battalions by simulating BN CP activities.

For the BN TF commander and staff, the interaction with BDE HQ is essential. Interactions with "other" BN TF can be handled in the play of the BDE HQ as shown in Figure 6. Division HQ will be simulated to generate a normal command relationship with BDE HQ.

Support Functions - Elements directly supporting the BN TF, such as the air defense platoon and the artillery battery, will be live units. The associated headquarters of these elements will be notional.

CPX Techniques - There are two approaches to generating realistic command relationships with notional units:

- CPX techniques are implemented through written scenarios under controller direction. They are realistic, but limited in the real-time variations that can be made to the basic scenarios. Minimum resources are required.
- Computer simulations of BN TF action can be done in a manner similar to CATTs. The realism is greater than for CPX, but is gained at great cost in development and operation.

The CPX approach meets the basic requirement for realism. Computer simulations should be added when they have been effectively developed to tie in to the NTC operation.

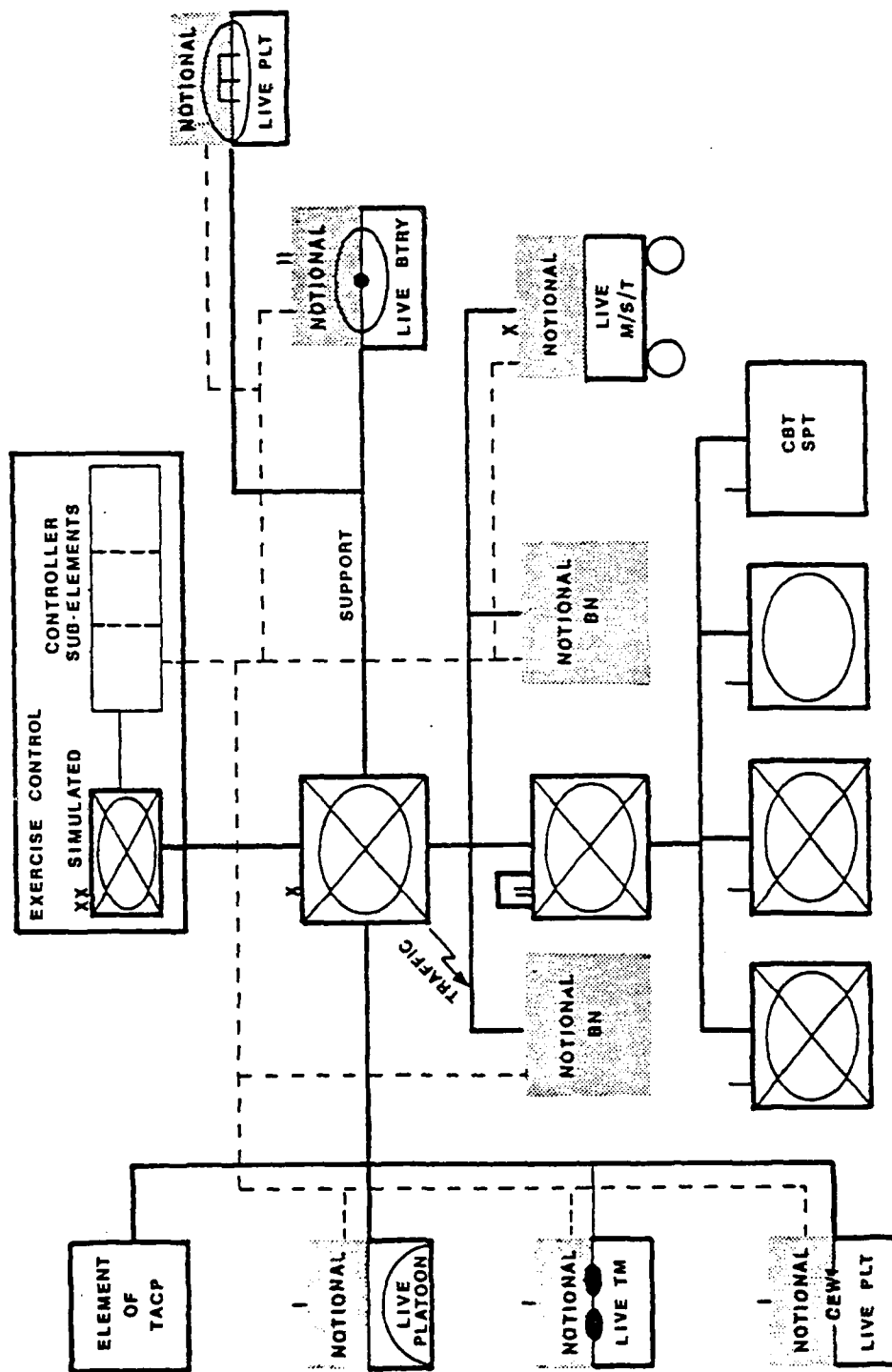


Figure 6. A Combination of Live and Notional Components Will Be Exercised

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## Systems Integration Support

### TRAINING ANALYSIS AND FEEDBACK REQUIREMENTS

Training analysis and feedback (TAF) will address BN TF performance with a variety of data and displays.

Data Requirements - Analysis of the performance of a combined arms BN TF is complex because of the large number of functions that are performed by the unit. Data and information display requirements are determined by the various combat functions, such as maneuver unit, fire support, air defense, and communications; and levels of combat activity in terms of execution, control, coordination, and planning.

Figure 7 shows the components of the BN TF functions for which data are required for training analysis and feedback. The data requirements vary between the execution, control, and coordination levels. Plans developed by BN HQ staff prior to an exercise will be evaluated using the maps and messages generated by the staff.

Control and Coordination Emphasis - The BN TF is primarily a control and coordination unit, with execution of plans carried out by subordinate elements. Execution level data such as position location and real-time casualty assessments describe how well the BN TF performs in a mission. The instrumented engagement simulation data will be essential to diagnosing performance.

Tactical radio net monitoring and BN HQ and CO HQ controllers will provide a significant amount of information at the control and coordination level.

Live Fire Feedback - The live fire exercises, at least initially, will be less sophisticated in terms of instrumentation than the engagement simulation exercises. Data will be available on target scores and supplemented with controller inputs to provide performance assessments of the BN TF.

After Action Reviews of the Data - The instrumented data will be displayed as ground tracks, casualties by unit, pairings between firers and targets, player/unit status, and other measures. These data will be supplemented by video, tactical net voice recordings, and controller inputs through electronic clipboards and manual information.

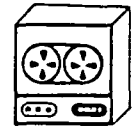
The Training Analysis and Feedback (TAF) staff will monitor much of the data in real time and develop and conduct structured After Action Reviews (AAR). A take-home package will be provided to support follow-on training.

NATIONAL TRAINING CENTER - DATA MATRIX

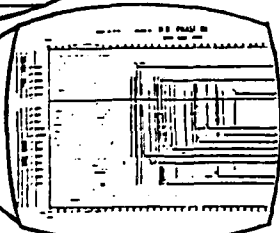
LEVELS	FUNCTIONAL SYSTEMS	MANEUVER	FIRE SUPPORT (FALL OF SHOT)	TACTICAL AIR SUPPORT	ENGINEER	AIR DEFENSE	INTELLIGENCE (EW)	8
EXECUTION	POSITION LOCATION	ALL MANEUVER ELEMENTS FOR BLUE AND OPFOR TO INCLUDE: TANKS, ATOM, APC, INF SQUADS TO INDIVIDUAL MEMBER LEVEL IF DESIRED	ALL P.A. BATTERY AND MORTAR PLATOON TO INDIVIDUAL PIECES	ALL FIRED MISSILE AIRCRAFT FOR BLUE AND OPFOR	ALL ELEMENTS TO SQUAD LEVEL	ALL VULCAN, CHAPARRAL, AND REDEYE SECTIONS	SENSOR, PATROL, AND OBSERVERS	
	EVENT RECORDING	ALL MOVEMENT, ALL FIRING	ALL MOVEMENT, ALL FIRE MISHITS	ALL SORTIES, ALL OBSTACLE DELIVERY, ALL RECON REPORTS	ALL MOVEMENT, ALL ACTIONS (MINE EMPLACEMENT, MINE REMOVAL, ETC), ALL COUNTER-MOBILITY	ALL MOVEMENT, ALL THREATS	SENSOR REPORTS, OTHER FUNCTION SYSTEM REPORTS	
	REAL TIME CASUALTY ASSESSMENT	ALL MANEUVER ELEMENTS AND WEAPONS FOR BLUE AND OPFOR TO INCLUDE PERSONNEL	BATTERY AND MORTAR PLATOON PERSONNEL AND EQUIPMENT	AIRCRAFT AND AM. CREWS	ENGINEER SQUADS AND EQUIPMENT	ADA CREWS AND TEAMS	SENSOR SENSORS	
	AUDIO	CREW/TEAM/SQUAD COMMO, ALL VOICE/INTERCOM/RADIO	BATTALION, BATTERY COMMAND NETS, BATTERY VOICE, BATTERY 2B	FACTO AIRCRAFT COMMO, AIRCRAFT (SINGLE AND FLIGHT)	SQUAD COMMO, SQUAD VOICE	CREW COMMO, TEAM COMMO, CREW AND TEAM VOICE (NON-RADIO)		
	VIDEO	SELECTED ELEMENTS AT SELECTED TIMES TO ILLUSTRATE KEY OPERATIONS	SELECTED ACTIONS AT SELECTED TIMES TO ILLUSTRATE BATTERY OPERATIONS	SELECTED ACTIONS TO DISPECT KEY TION ORIENTED SITUATIONS	SELECTED ACTIONS TO DISPECT EXECUTION ORIENTED SITUATIONS	SELECTED ACTIONS TO DISPECT EXECUTION ORIENTED SITUATIONS		
CONTROL	POSITION LOCATION	WHITTS BLUE AND OPFOR, PLT CO, UNIT TRACER COMMANDERS AND PRINCIPAL STAFF	FORWARD OBSERVERS, BATTERY, GUN, BATTALION FOCES	FACTO ALOS, CAPT, TACT (OAS)	PLATOON LEADER AND COMPANY COMMANDERS			
	EVENT RECORDING	ORDERS, INSTRUCTIONS FOR MOVEMENT, INSTRUCTIONS FOR ENGAGEMENT (ALL UP ABOVE AT EACH COMMAND LEVEL)	TACTICAL CONTROL OF BATTERY MOVES, TACTICAL AND TECHNICAL FIRE DIRECTION	AIRBORNE REQUESTS, FINAL ORDER, NAVIGATION INSTRUCTIONS, TARGET INFORMATION (DESCRIPTION, LOCATION, ACQUISITION)	ORDERS AND ACT OF PLATOON/COMPANY COMMANDERS			
	REAL TIME CASUALTY ASSESSMENT	COMMANDERS AT ALL LEVELS PRINCIPAL STAFF	COMMANDERS, FORWARD OBSERVER, AND FOC PERSONNEL	TACTICAL AIR CONTROL PERSONNEL	PLATOON LEADER			
	AUDIO	COMMAND NETS, COMMANDERS VOICE (NON-RADIO), ALL MANEUVER LEVELS	COMMAND NET, FIRE REQUEST NET, FIRE DIRECTION NET, COMMANDERS VOICE (NON-RADIO)					
	VIDEO	SELECTED ELEMENTS AT SELECTED TIMES DEPICTING CONTROL ORIENTED SITUATIONS	SELECTED ACTIONS AT SELECTED TIMES DEPICTING TACTICAL ORIENTED SITUATIONS					
COORDINATION	POSITION LOCATION	MANEUVER UNIT COMMANDERS, BATTALION COMMANDER, PRINCIPAL STAFF, MANEUVER UNIT TRACKS/NETS	FIRE DATA FOR OBSERVERS					
	EVENT RECORDING	MEETINGS, ORDERS, COORDINATING INSTRUCTIONS, COMPANY AND BATTALION COMMANDERS AND STAFFS						
	REAL TIME CASUALTY ASSESSMENT	COMPANY AND BATTALION COMMANDERS AND STAFFS						
	AUDIO	COMMAND PARTY AND COMMANDERS VOICE (NON-RADIO), PRINCIPAL STAFF						
	VIDEO	SELECTED ELEMENTS AT SELECTED TIMES DEPICTING COORDINATION ORIENTED SITUATIONS						



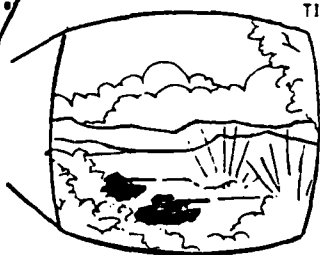
GROUND TRACKS



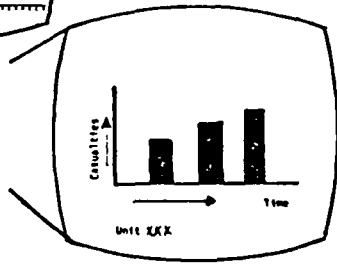
VOICE RECORDING



TIMELINES



VIDEO



CASUALTY DATA

Figure 7. BN Functions for Training Analysis and Feedback

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## Systems Integration Support

### FIELD DATA COLLECTION - ELECTRONIC CLIPBOARD

Manual collection is required for data not suitable for direct instrumentation and provides redundancy for the instrumented system.

Manual Collection - Manually collected data provide human insight into key events and anomalous occurrences. Extremely important, too, is the fact that if the automated data collection system fails, manually collected data will be the only data available for analysis and evaluation. These points are summarized in Figure 8.

Two means of manual data collection are available for use:

- Electronic Clipboard (ECB) with output fed to digital recorder on data collector, or telemetered to central location; and
- Manual data forms.

Both may be used.

ECB - Devices are similar to a hand-held calculator. Each button can be designated to have a specific meaning, and each entry can be time tagged. Use of ECBs in EW/CAS tests have shown accuracies of  $\pm 2$  seconds in recording events with random errors occasionally as large as  $\pm 15$  seconds.

Figure 8 provides a detailed breakdown of ECB equipment and costs which would satisfy NTC requirements for 50 controllers.

#### Manual Data Collection

- Incorporates expert field judgment into the training feedback
- Provides redundancy for the instrumented data collection.

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<u>Component</u>	<u>Number Required</u>	<u>Each</u>	<u>Total</u>
ECB	50	\$2,000	\$100,000
Memodyne Record Play Back Unit	1	2,000	2,000
Modem Interface Repeater (MIR-4)	1	250	250
Modem Eliminator ME-81	1	250	250
A.B. EIA Switch	1	145	145
829 KSR Terminal	1	2,470	2,470
A, B, C, D, Switches	6	335	2,010
<b>TOTAL</b>			<b>\$107,125</b>

Figure 8. ECB Data Collection and Processing System

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MANAGEMENT CONCEPT

- NTC Management Staff
- Field Instrumentation Maintenance

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## Management Concept

### NTC MANAGEMENT STAFF

A total of approximately 75 personnel are required for the NTC Management Staff.

Figure 9 delineates the organization and quantities of personnel required for the NTC Management Staff.

Training and operations will be accomplished by the elements of the Command in accordance with standing policies and procedures of the NTC Operations and Training Directorate.

Interface between NTC and the USAIS (OPFOR doctrine, OPTePs, and OPFORMS) will be through the NTC Training Division. Training analysis and feedback from the TAF staff will be through the Training Division's BLUFOR and OPFOR Branches.

The Personnel and Fiscal Directorate will provide support as required to supplement organic support.

Logistics and Maintenance will provide for the acquisition, receipt, storage, issue, turn-in, maintenance, and property disposal for all elements except the Instrumentation Directorate (not shown in Figure 9).

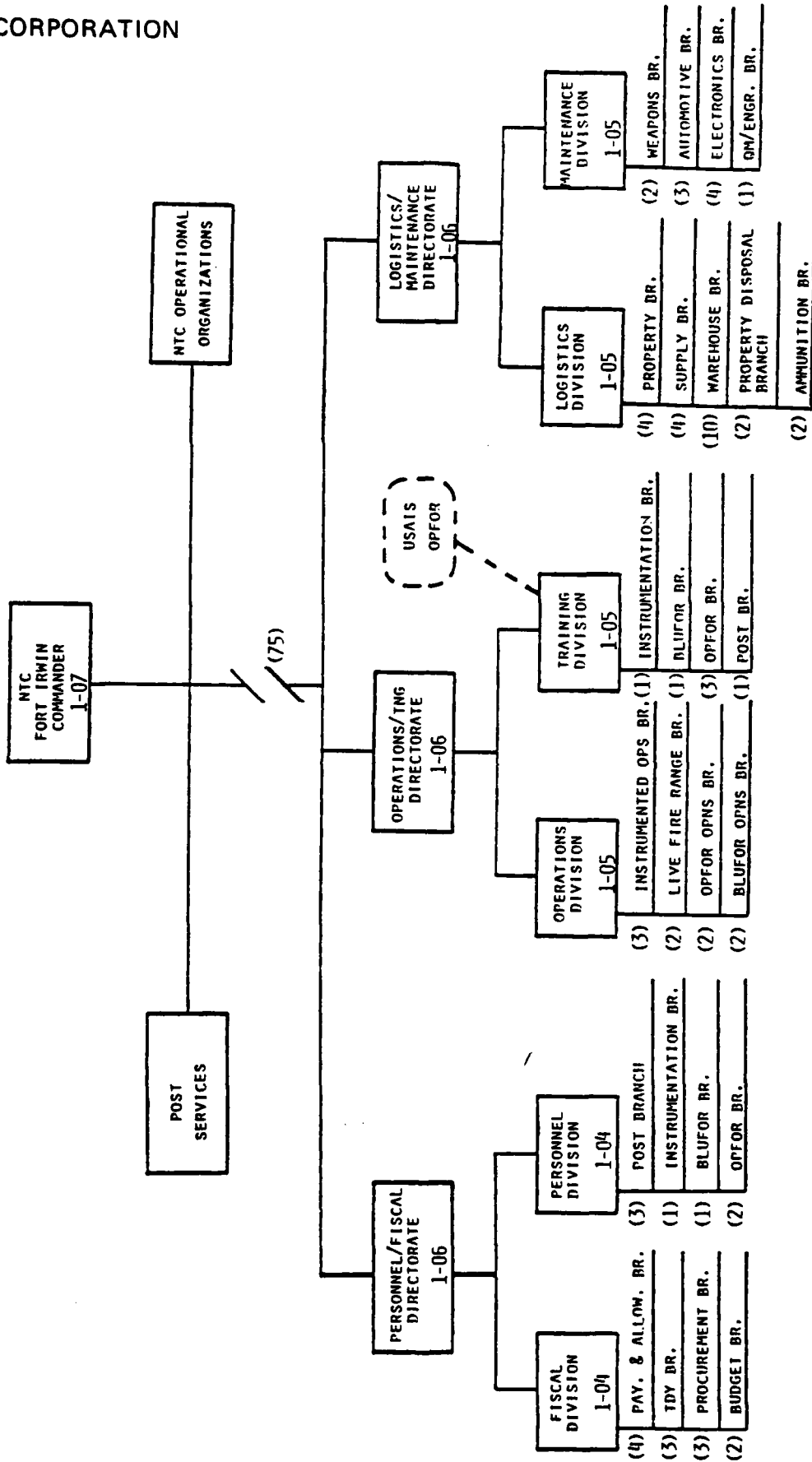


Figure 9. NTC Management Staff

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## Management Concept

### FIELD INSTRUMENTATION MAINTENANCE

Approximately 256 personnel are required to support the maintenance of 450 instrumented player fielded at the NTC.

Figure 10 shows the instrumentation maintenance organization necessary to support the NTC.

The total number and types of personnel are based on CDEC's experience for TASVAL and an average instrumentation reliability of about 1000 hours Mean Time Between Failure (MTBF). The weakest link was the RMS B-Unit (Micro-B) which had an MTBF of 466 hours.

The number of personnel has been categorized as follows:

- Managers - 6
  - Engineers - 23 (including 2 supervisors)
  - Programmers - 25 (including 3 supervisors)
  - Technicians - 164 (including 7 supervisors)
  - Data Analysts - 6
  - Other Support - 32 (typists, Q/C inspectors, logistics, etc.)
- TOTAL 256

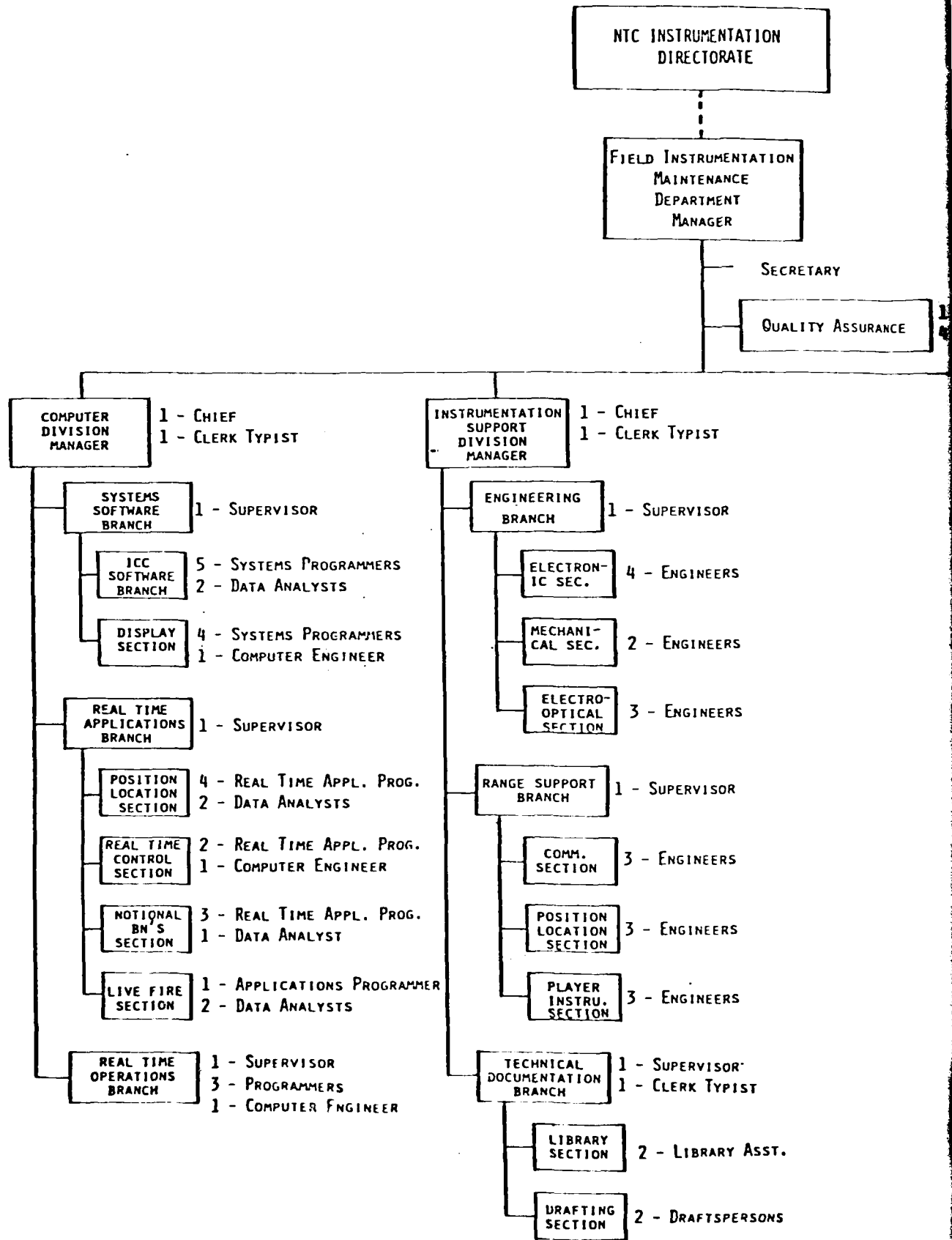
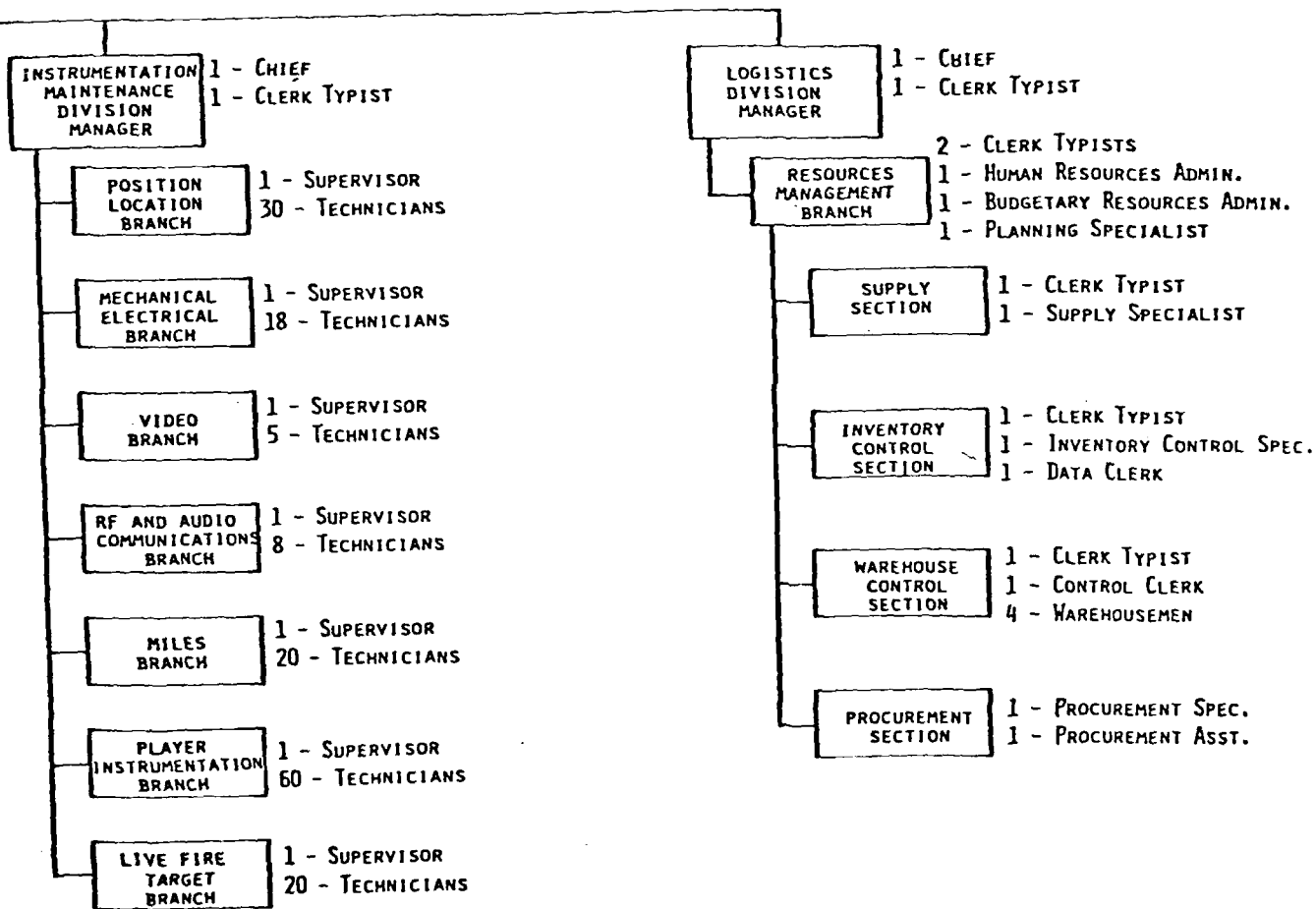


Figure 10. Field Instrumentation

1 - MANAGER  
1 - Q/C INSPECTORS



OPPORTUNITIES TO BE DERIVED FROM NTC 1A

- Summary

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## Opportunities To Be Derived From NTC 1A

### SUMMARY

→ There are several opportunities from which useful information can be derived from NTC 1A for Phase I and II decision making.

Figure 11 summarizes the key opportunities to be derived from NTC 1A.

- There are two, essentially parallel, efforts involved in NTC 1A, Stages I-V. These involve the Core Instrumentation System Demonstration software, and CDEC NTC 1A Stage I ICC software and queueing model. Either, or both, can provide a base for Phase I software growth. The NTC 1A effort can form the foundation for Phase I hardware and software specification development.

In addition, there is an opportunity to continue utilization of the NTC 1A Stage I hardware and software at CDEC, if Stages IV and V must be cancelled for any reason. This alternative could permit the continued development of ICC TAF/EMC operations utilizing scheduled CDEC experiments as the driving scenario (near term experiments include J-CATCH and ARMVAl).

- Human factors information can also be derived from any and all of the above, thus providing needed human factors insights into the EMC/TAF organization work loads, optimum display graphics and data display configurations, After Action Review formatting, etc.

In addition, the identification of training activities which can or cannot be supported has direct implication on the hardware and software configuration and the cost for Phase I.

NTC 1A PROVIDES SOLID BASIS FOR  
PHASE I GROWTH

- CIS HARDWARE/SOFTWARE DEMONSTRATION
- NTC 1A STAGE I ICC
- HUMAN FACTORS INPUT
- IDENTIFICATION OF TRAINING ACTIVITIES WHICH CAN OR CANNOT BE SUPPORTED IN PHASE I
  - PROVIDES OPPORTUNITIES TO OPTIMIZE HARDWARE/SOFTWARE CONFIGURATION FOR PHASE I
  - PROVIDES OPPORTUNITY FOR PHASE I HARDWARE SPECIFICATION DEVELOPMENT
  - PROVIDES OPPORTUNITY FOR PHASE I SOFTWARE SPECIFICATION DEVELOPMENT

Figure 11. Opportunities To Be Derived From NTC 1A