THE NATIONAL TRAINING CENTER
A TOTAL EXPERIENCE TRAINING CENTER

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ABSTRACT

Now more than ever the U.S. Army must be prepared to survive and win in battle. This paper discusses this necessity and how the Army is meeting this need by the development of the National Training Center. An overview is presented on the training, evaluation, and control concepts of the National training Center and how these concepts have been implemented by the NTC Instrumentation System.

BACKGROUND

The Need - The Necessity To Be Ready To Win

"The Army's primary objective is to win the land battle - to fight and win in battles large or small, against whatever foe, wherever we may be sent to war..." "We must assume the enemy we face will possess weapons generally as effective as our own. And we must calculate that he will have them in greater numbers than we will be able to deploy, at least in the opening stages of a conflict." "...We can expect very high losses to occur in short periods of time. Entire forces could be destroyed quickly if they are improperly employed."*

In order to accomplish its objective, the U.S. Army must train in peacetime as it will fight in war. Terrain utilization and and weapons employment are skills that the Army's leaders must have honed to perfection through training. Maneuver and support units must be able to move, emplace and shoot quickly. Night operations must be as familiar as day operations. All units must be able to survive and accomplish their missions in the hostile nuclear, biological and chemical environments as well as that of electronic warfare. Only through peacetime training can these skills be acquired so that the confidence to deal with the heightened challenges of war may be developed.

The Army has structured its training to meet this challenge. The ARTEP provides a collective training program for experiential training based on a TRAIN-EVALUATE-TRAIN model. Yet virtually everywhere it is stationed, the U.S. Army is hard pressed to provide complete resources for such training. Modern weapon systems have changed the tempo, lethality and size of battle areas. The same land area which was once ample for training divisions is now inadequate for exercising brigades. As Army units train for war maneuver areas which are now too small constrain the realism of their training. Manning of a realistic opposing force and an effective control and assessment structure is, for battalion level exercises, beyond typical resources.

*Operations FM 100-5 (Washington, DC, HQDA, 1 July 1976) p. 1-1

Civilian communities adjacent to installations limit the Army's ability to fully utilize electronic warfare and close air support consistent with a realistic battlefield environment.

The foregoing realities and technological advances have laid the foundation for conducting realistic large unit training in a cost-effective manner to help meet the current and future Army training needs.

Historically, as combat units first take up their role in a war, the losses of those units have been very high, compared to the losses the same units suffer later in combat. Intuitively one would expect a combat-experienced soldier or unit to suffer fewer casualties and to be more effective than those without such experience. Certainly, officers and men of all services can look back at their participation in World War II, Korea, and Viet Nam to find validation for such intuition. Moreover, the statistics of units in those wars bear out the conclusion that combat experience improves both the survivability and the performance of units.

Over the years, many attempts have been made to realistically duplicate the combat experience during training when the cost of learning is measured in dollars rather than in lives. Infiltration courses with live machine gun fire only a few feet above the ground and the use of live artillery fires, live close air support and naval gunfire during exercises have been employed.

No training can completely capture the danger - and the associated fear - that is generated by real combat. However, each of the techniques used in the past has been intended to provide some part of the sounds and feel of combat so that in the future, the soldier, sailor, or airman entering combat would not find it completely new and foreign to him.

A major contribution to the technological advancement of training has been the Air Force RED FLAG activity at Nellis Air Force Base. Here the combination of carefully trained and equipped "enemy" aircraft, a highly sophisticated and instrumented airspace, and the ability to capture and replay the aerial combat for the participants has created the type of experiential learning that can approximate air-to-air combat and increase the capability of U.S. pilots to survive and be successful in the early phases of combat.

The Army at the Training and Doctrine Command Combined Arms Test Activity, Combat Developments Experimentation Center, and other test ranges has used modern simulation technology to attempt to create realistic combat conditions, not with the goal of training personnel and units but of testing concepts and equipment under conditions as near combat as possible. These agencies have taken advantage of the capabilities of the laser, the computer, radar and other technologies to reach levels of accuracy and realism that had not before been possible. These tests, however, were designed primarily to provide the realism for the equipment or mechanical function and were limited to small units. The training for combat survival of the individuals involved during these experiments has been of secondary importance.

The Army is now using laser simulations for direct fire weapons to increase the realism in training. For the first time, opposing forces can realistically engage each other in mock combat, inflicting simulated casualties and damage as a direct result of the engagement and not from the use of slow and arbitrary means (i.e., judgemental decisions by umpires).

How NTC Meets The Need

In a statement before the House Appropriations Committee, General Rogers, former Army Chief of Staff, made the point that "the worst thing that can happen is for a soldier and a unit to find themselves on a battlefield, fighting in anger for the first time and never to have experienced anything like it before."

Recognizing the increasing inadequacy of training facilities, the Secretary of the Army and the Chief of Staff stated in their 1978 joint posture statement to Congress that:

"The Army foresees one or more National Training Centers, large military reservations which can support the kind of combined arms training needed to ready the total Army for battle in Europe."

The National Training Center (NTC) is a facility where highly realistic, comprehensive and intensified training will be conducted. Troops will be transported to this facility periodically to become proficient in critical tasks that cannot be accomplished at home stations. Since combat conditions are duplicated with great fidelity at the NTC, it can also be used as a combat proving ground. Battle realism, evaluation and feedback in this environment require engagement measurement and monitoring and control instrumentation coupled with data processing and display capabilities to provide objective assessments and analyses of unit performance with sufficient detail and timeliness to ensure maximum learning. A beneficial by-product of such instrumentation is the ability to answer critical questions of aggregate force readiness trends and effectiveness of doctrine, organizations, equipment and training techniques.

The NTC, with its mixture of various forms of instrumentation and simulations, and with its ability to capture data for later use, offers a training environment that closely resembles real combat while concommitantly providing the ability to rapidly analyze the events that occur during the exercise, to evaluate the general state of a unit's training, to assess their deficiencies and to provide in-depth near-real-time feedback.

It is this concept of using modern technology available to train units by creating a near combat environment that makes the NTC unique. The NTC concept is to train so realistically that the soldier's reactions to combat are learned so well he will act intuitively and decisively in real combat. This process, known as experiential learning, is the goal of the NTC.

The Training and Doctrine Command, in its analysis of the NTC training environment, has developed an array of seven significant training elements to be stressed in the NTC development:

- Battalion Task Force (BnTF). A combined arms team with a staff and a critical task of coordinating combat power on the battlefield.

- Opposing Force (OPFOR). A dedicated unit, sized and equipped to operate against the BnTF in realistic numbers, using Soviet tactics and signatures and operating as part of the control force to ensure proper balance in combat operations. This OPFOR must think and act like Soviets, including less concern for casualties and more for results.

- Electronic Warfare (EW). The use of jammers against U.S. communications and electromagnetic devices in a manner expected of the Soviets in Europe.

- Close Air Support (CAS). The opportunity to plan and execute joint air-ground operations.

- Live Fire (LF). An imaginative use of portable, instrumented targets to provide a realistic threat, both offensively and defensively, to the BnTF under conditions that permit the BnTF to coordinate and control live fires.

- Weapon Engagement Simulation (ES). The use of lasers and computers to simulate fires on the battlefield, including a realistic and believable assessment of casualties.

- Instrumentation. The use of sensors, computers, and data communications to tie together the whole NTC activity and to capture that activity in a manner which permits effective training feedback and assessment.

Together, these elements provide a training environment where Army maneuver battalions can undertake essential combined arms training which cannot be accomplished at home station due to physical limitations and the prohibitive cost for providing an NTC type environment. In addition to

this training role, the NTC also provides an environment to gather data about simulated battlefield performance and the effectiveness of U.S. Army organizations, doctrine, procedures, tactics and weapon systems under realistic simulated combat conditions.

NTC PHASE I CONCEPT - AN OVERVIEW

The National Training Center (NTC) is being implemented in Phases of which Phases I and II have been defined. Phase I, when implemented, will provide a place where Army units can undertake essential combined arms training that cannot be done at home stations because of limitations, or the prohibitive total cost of providing a NTC Phase I type environment at all or selected division installations.

The Training Environment and Concept of NTC

The elements of the training environment for the NTC Phase I include:

- Battalion Task Force (BnTF). The basic building block of mounted warfare is and will be the cross-reinforced tank or mechanized company team or battalion task force. After corps and division commanders have set in motion the necessary concentration of power, they must turn over the immediate direction of the battle to brigade and battalion commanders. The brigade and battalion commanders then must fit the forces to the ground, maneuver against the enemy as the battle develops, and coordinate the concentration of firepower. The battalion task force will be the element that the NTC training environment is designed to train as the initial goals of Phase I. Initially, one battalion engagement exercise will be conducted at a time. Later in Phase I, expanded instrumentation capabilities will allow two simultaneous battalion level exercises.

- Opposing Force (OPFOR). A realistic "enemy" force will be provided by a dedicated unit, sized to achieve force ratios of at least 3 to 1 against a U.S. battalion during defense missions. The OPFOR will use Soviet tactics and signatures, with the vehicles and weapons capabilities of Soviet type motorized rifle regiment replicated. The OPFOR will consist of approximately 1000 men and 230 tracked vehicles equipped with silhouette replicas (VISMOD kits).

- Electronic Warfare (EW). Jammers will replicate ground based threat communication jammers, capable of 1.5 kW operations, on a narrow electromagnetic band targeted against those communications nets found in battalion and brigade. Additional equipment, to be supplied by the Air Force, will duplicate a representative air defense threat in the vicinity of the FEBA.

- Close Air Support (CAS). This will be provided from George AFB and RED FLAG operations at Nellis AFB. It may also encompass Marine and Navy air support from Twenty Nine Palms or China Lake. This NTC Phase I will offer opportunities to practice the joint planning necessary for air-ground operations at the battalion task force level with a real-time casualty assessment system supported by instrumentation.

- Live Fire (LF). This will be conducted at realistic engagement ranges and target arrays, with all elements of direct and indirect fire integrated. Minimum restrictions commensurate with safety will be applied. Targets will be portable and have sufficient instrumentation to provide input for after action review. Targets will respond to live fire hits or laser fire from DRAGONS and TOWS.

- Engagement Simulation (ES). The MILES system will be used down to individual weapon level. Engagement simulation data provided by MILES will be reported by telemetry on selected weapons.

- Instrumentation. The NTC instrumentation components include time-space position location, key event recording, voice and video recording, and appropriate analysis and playback facilities.

Training at the NTC Phase I will be based upon the TRAIN-EVALUATE-TRAIN model with detailed feedback after each mission and a final diagnostic After-Action-Review (AAR) and Take-Home-Package to serve as a basis to guide subsequent home station training programs. The training will focus on improving performance in the five levels of activity within the battalion task force: execution, control, coordination, support and planning.

The NTC Phase I training should be viewed as an extension of and building on home station training with heightened realism in battlefield conditions and objective standards. The NTC Phase I will concentrate on minimum constraint operations at the combined arms task force level and will provide command and staff exercise opportunities at the brigade level.

The NTC training scenarios will be tailored for each unit based on:

- Current status of collective training - proficiency based on ARTEP,
- Resources at home station,
- Contingency plans,
- Training goals, and
- Task organization.

The training experience will be based upon a European analogue. Units will exercise emergency deployment plans; move to and draw POMCUS-like prepositioned equipment; deploy to field positions similar to European defense plans; and execute scenarios of appropriate tactical missions. By 1984 brigade headquarters will be responsible for battle management of a mix of one real and up to two notional battalions. Battalion commanders and their staffs will be exercised in a realistic command environment using CPX role-playing techniques similar to those used in the Combined Arms Tactical Training Simulator (CATTS). Each CONUS armor/mechanized battalion commander and staff will then train at Fort Irwin twice each 18-month period, once without troops on the notional battle facility, and once with the entire battalion.

Evaluation Concept

The evaluation function of the TRAIN-EVALUATE-TRAIN model at the NTC Phase I will concentrate on the phases of the command and control process at the battalion task force level: collection of information, planning, issuing orders, assessing and supervising the progress of operations.

At the NTC Phase I, the primary target of evaluation and corrective training will be the battalion's ability to orchestrate the application of its combat power. A Take-Home-Package for home station training will provide the opportunity for review and remedial training. The evaluation concept is designed to provide:

- An increase in proficiency of battalion combined arms teams as they execute a series of missions.
- A comprehensive assessment of unit training to serve as a basis for subsequent home station training.

The evaluation concept will be based on a determination of what should be collected and measured; what will be the information feedback levels, critique audiences and frequency; and what the evaluation packages are used for.

Instrumentation and Control Concept

The instrumentation and control system has been designed to support the objectives outlined in the training and evaluation concepts. The system will collect and report data during performance of unit tasks; enhance overall realism and control of the exercise; record and process collected data, and provide computer generated imagery or graphic displays for assessment and control of the exercise. Data collection and processing will be objective and primarily based upon instrumentation. Some actions within the levels of activity upon which the training and evaluation will be focused

are not suitable for direct instrumented collection. These shall be collected and processed relying on controllers. The instrumentation system will, however, be structured to support and expedite these controller inputs.

The design of the instrumentation system and the mix of instrumented and controller functions will be based on the system's ability to support the TRAIN-EVALUATE-TRAIN model. The analysis of the evaluation/instrumentation system's ability to support the NTC Phase I will be built around four basic issues:

- What should be collected and measured?
- What can be collected and measured and at what level?
- What are the methods and frequency of feedback presentation?
- What will the data be used for?

The instrumentation system, collection methods and playback techniques are described in the NTC Development Plan published by the Army Training and Doctrine Command.

The Training Mission and Its Implementation

The unique aspect of a National Training Center (NTC) is the total emersion of a battalion task force in a realistic battle environment. The NTC training will be as realistic as technology and safety will permit. Equally important, an instrumented NTC will allow the transparent collection of hard analytical data from which objective battlefield performance effectiveness can be derived.

Training Objectives

The NTC training objectives are designed to fill the gap between home stations unit training and combat. They are intended to serve as a basis for NTC training and evaluations. These specific objectives are:

- Increase the proficiency of brigade and battalion commanders and staffs to plan and exercise command and control of their forces while executing combined arms tactical missions in a realistic threat environment.
- Increase the proficiency of brigade and battalion task forces to coordinate and apply all types of fire and terrain modification to increase force effectiveness and decrease unit vulnerability.
- Increase the proficiency of the battalion task force to employ and coordinate organic and supporting direct and indirect fires, combat support and combat service support systems against a realistic opposing force in a free play exercise.
- Increase the tactical proficiency of the maneuver elements and leaders within a battalion task force in the conduct of their combat missions in a realistic hostile environment, to include: (1) use of tactics, terrain and terrain modification to maximize combat power at critical times and places; (2) employ unit gunnery skills in conjunction with supporting direct and indirect fires in a near-real-combat environment to acquire and service targets representative of an appropriate threat force at realistic ranges and dispersion; (3) increase soldier and leader confidence in their proficiency of maneuvering company team and higher units in close proximity to live fire; (4) exercise EW and NBC counter measures necessary to survive and function on a "dirty" battlefield; and (5) integrate air cavalry and attack helicopters into the scheme of maneuver and to perfect the control and coordination techniques unique to those resources.
- Create an opportunity for brigades and battalions to plan and execute realistic combat service support operations.

In addition to the training objectives discussed above, the NTC will also meet the following evaluation objectives:

- Provide a measure of the increase in combat effectiveness of all elements of combined arms task forces achieved during training at the NTC.

- Provide real-time player feedback which makes possible the compilation of an accurate objective record of tactical performance that can be used in After-Action-Reviews (AARs) for all levels during the NTC training period and after units return to home station.

- Assist in the evaluation of present tactical doctrine, tables of organization and equipment, and training doctrine at the brigade and battalion level.

Units trained at the National Training Center (NTC) will be required to perform a large number of defensive and offensive tactical missions. These tactical missions are listed below.

- Movement to contact
- Hasty attack
- Deliberate attack
- Defend in sector
- Defend from a battle area
- Hasty defense
- Delay in sector
- Disengagement
- Counterattack
- Defend a battle position
- Deliberate defense
- Reconnaissance and security
- Create and defend a strong point

A series of tactical mission analyses and support packages will be prepared for each of the above missions and will be used to conduct and control the exercises.

NTC PHASE II - PRELIMINARY OVERVIEW

Building on the experiences of Phase I it is anticipated that Phase II will move beyond Phase I as the state of the art in training and instrumentation moves to meet the NTC requirements. It is expected that Phase II will include:

- Increase in the number of player units that can be monitored and controlled.

- Upgrading of the MILES system to include new weapons and target acquisition capabilities.

- Improved techniques and instrumentation to address indirect fire, air defense and U.S. Air Force close air support simulation.

- Improved After-Action-Review (AAR) techniques to include development of special presentation methods.

Similar to Phase I, NTC Phase II will provide an order of magnitude increase in the proficiency of the Army's tactical forces through effective and realistic training. It will provide the experiential base which will allow our forces to fight outnumbered and win the first and subsequent battles of any conflict.

NTC INSTRUMENTATION SYSTEM OVERVIEW

Key Requirements - The Design Drivers

Out of the NTC training concept which drove the evolving structure of the NTC Instrumentation System a number of imperative requirements became the bases for the hardware and software designs:

- Future growth must be supported without causing significant redesign and recoding of software;

- Instrumentation must be as transparent as possible;

- The historical data collected must be capable of being recalled and portions selected by training analysts during the course of the exercise for subsequent After-Action-Review (AAR) presentations;

- Instrumented data collection must be supplemented with voice recordings of radio nets, video picture input from the exercise area, and field/observer controller inputs, and

- Technical, schedule and cost risks will be minimized.

System Description

In order to minimize interface complexity, and correspondingly reduce technical risks, a system architecture has been synthesized that consists of three major subsystems: (1) Core Instrumentation Subsystem (CIS), (2) Range Data Measurement Subsystem (RDMS), and (3) Range Monitoring and Control Subsystem (RMCS). This system architecture is presented in Figure 1 along with the allocation of functional areas to all subsystem components (Figures 1A-1C).

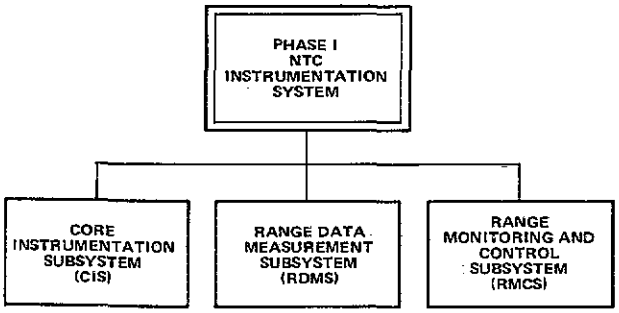

FIGURE 1 NTC PHASE I INSTRUMENTATION ARCHITECTURE

Range Data Measurement Subsystem (RDMS)

The RDMS provides real-time position location and engagement event data on all instrumented players in the Engagement Simulation (ES) and Live Fire (LF) exercises. As shown in Figure 1A, the RDMS is composed of three major components: (1) Tracking and Communication Component (TCC), (2) Computational Component (CC), and (3) Player Unit Component (PUC). The RDMS Player Unit Component includes the Transponder Component (TC) and the Weapon Engagement Simulation Component (WESC) which is the Army's MILES system.

The remote, unmanned Central Station (CS) within the TCC selects the transmission path to Player Units (PUs), provides a two way digital data link to Player Units (PUs) and collects range data. Event messages and slant range data received by the Central Station (CS) are time tagged then relayed to the CC. The CC computes PU position, decodes event data for validity and transmits the position and event data to the Core Instrumentation Subsystem (CIS). Commands from the CIS are relayed to the player unit through the CC and TCC.

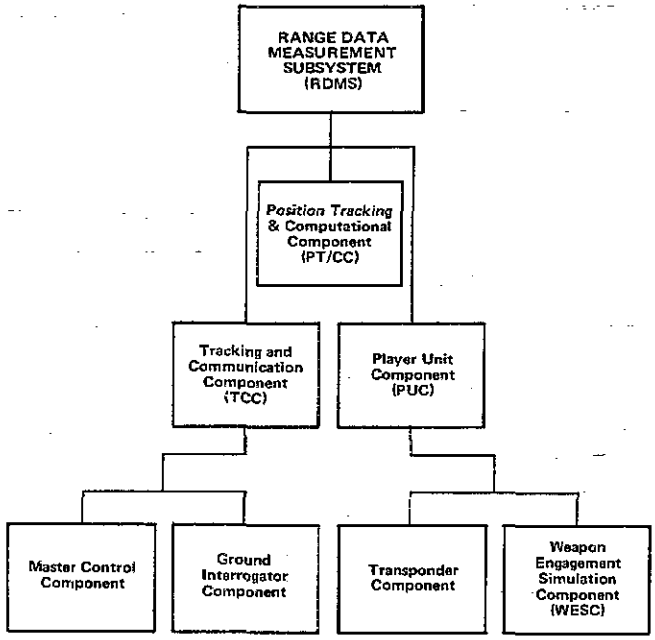

FIGURE 1A RANGE DATA MEASUREMENT SUBSYSTEM (RDMS) SYSTEM ARCHITECTURE

The Tracking and Communications Component (TCC) consists of a number of Micro A and Micro A/D stations located at known surveyed points. The Micro A and Micro A/D stations measure range to the selected player unit and in addition provide a digital data link between the Central Station and the Player Unit. The Micro A/D station acts as a relay to Micro A stations that are not in radio line of sight of the Central Station. The system remains in a quiescent state until a command from the Central Station triggers a ranging interrogation command.

A Player Unit (PU) includes a discretely addressable Micro B unit that serves as a range transponder and communications link. Additionally, a PU contains an Input/Output (I/O) device, and a Transponder Component (TC), attached to a Weapon Engagement Simulation Component (WESC) unit. A PU can receive and store engagement messages from the I/O and TC/WESC, and transmit the data to the CS upon TCC request. Initial operational capability will be 125 player units with expansion to 500 player units occurring later in Phase I.

The Weapon Engagement Simulation Component (WESC) simulates direct fire weapons effects in

support of a free play engagement simulation between battalion TF OPFOR elements. Functions performed by WESC include: simulation of direct weapon firing cues, computation of direct fire casualty and damage, implementation of direct fire effects, generation of firing and weapon effect engagement events and hand-off of this data to the I/O through TC for ultimate transmission to the CIS.

The Computational Component (CC) consists of a multiple-CPU processor and software necessary to compute PU Position Location (PL) data. Initial loading and realtime operations control of the TCC remote, unmanned Central Station (CS) is accomplished by the CC.

Range Monitoring and Control Subsystem (RMCS)

The RMCS provides the means to monitor and control all activities on the NTC Engagement Simulation (ES) and Live Fire (LF) ranges. These capabilities include automated and human sensors and a backbone communications component to tie these sensors together and connect them with the CIS.

As shown in Figure 1B, the RMCS consists of six major components: (1) Range Communications Component (RCC), (2) Spectrum Analyzer Component (SAC), (3) Live Fire Component (LFC), (4) Voice and Video Monitoring Component (VVMC), (5) Field Controller Component (FCC), and (6) Opposing Force Component (OFC).

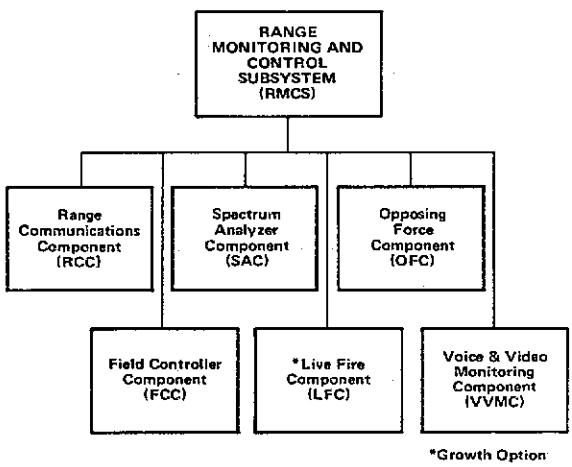

FIGURE 1B RANGE MONITORING AND CONTROL SUBSYSTEM (RMCS) SYSTEM ARCHITECTURE

The Range Communications Component (RCC) provides voice, digital and video communications between RMCS components and the CIS. Specifically, voice communications are provided between the CIS operators and their counterparts in the VVMC, FTFC, FCC and OFC components. Digital communications are provided between the IDCC in the CIS and the SAC and LFC components. Video communications are provided between the IDCC and VVCEC components in the CIS and the VVMC and FTFC components.

The Spectrum Analyzer Component (SAC) provides the means to measure, record and transmit all relevant NTC EM emissions which may interfere with other NTC or non-NTC (i.e., GOLDSTONE) operations. The SAC, under control from the CIS, will continuously monitor an assigned frequency range at an assigned rate. Whenever an emission is detected which exceeds a threshold value set by the CIS, the SAC will report this occurrence (time, frequency and value) to the CIS.

The Live Fire Component (LFC) provides a realistic, simulated, combat environment for NTC Live Fire exercises. Specifically, the LFC simulates a dynamic OPFOR target array and engagement scenario; generates live fire effects cues from the OPFOR; scores and records live fire results (events); and transmits all live fire event data to the CIS.

The Voice and Video Monitoring Component (VVMC) provides both fixed and mobile video recording elements to record key engagement simulation and live fire events. The unmanned fixed video element will be controlled directly from the VVCEC within the CIS. Mobile video teams will be directed from the VVCEC component within the CIS in response to missions assigned by EMC or TAF operators.

The Field Controller Component (FCC) provides nonintrusive observation of the battalion TF during both Engagement Simulation (ES) and Live Fire (LF) exercises. Specific functions performed by the FCC include: enforcement of the rules of engagement; assessment of indirect fire casualties; implementation of indirect fire weapon effects cues (fire marking); assuring range safety and the recording and communication of battalion TF activities based

on human observations. This component will be manned by Army personnel.

The Opposing Force Component (OFC) simulates the opposing force in the free play Engagement Simulation (ES) between the battalion TF and the OPFOR. Specific functions performed by OFC include: the simulation of all OPFOR operations (C^3, maneuver, fire, administration, log, etc.); the observation of battalion TF activities and the communication of these observations to the CIS personnel; and execution of CIS specified OPFOR scenarios to achieve the desired training missions and goals. This component is also manned by Army personnel.

Core Instrumentation Subsystem (CIS)

The CIS provides all real-time data processing and interactive display capabilities needed to monitor, command, and control all NTC Engagement Simulation (ES) and Live Fire (LF) exercise activities. The CIS also provides data processing, interactive display, voice and video editing and training material production capabilities needed to synthesize and present near-real-time After-Action-Reviews (AARs), both in the field and in the CIS AAR theater, and to produce take-home training packages. Finally, the CIS provides the data processing and interactive display capabilities required to support Training Developments (TD) and Combat Developments (CD) research at the NTC.

As shown in Figure 1C, the CIS consists of six major components: (1) Digital Interface Component (DIC), (2) Computational Component (CC), (3) Interactive Display and Control Component (IDCC), (4) Voice/Video Control and Editing Component (VVCEC), (5) Field Training Feedback Component (FTFC), and (6) the Environmental Protection Shelter (EPS). The IDCC is further decomposed into four major functional elements: (1) Exercise Monitoring and Control (EMC), (2) Training Analysis and Feedback (TAF), (3) Command Battle Simulation (CBS) and (4) Experimental Test Bed (ETB).

The Digital Interface Component (DIC) provides the single input/output (I/O) interface for all digital data communications between the CIS and the RDMS and RMCS subsystems, respectively. The DIC

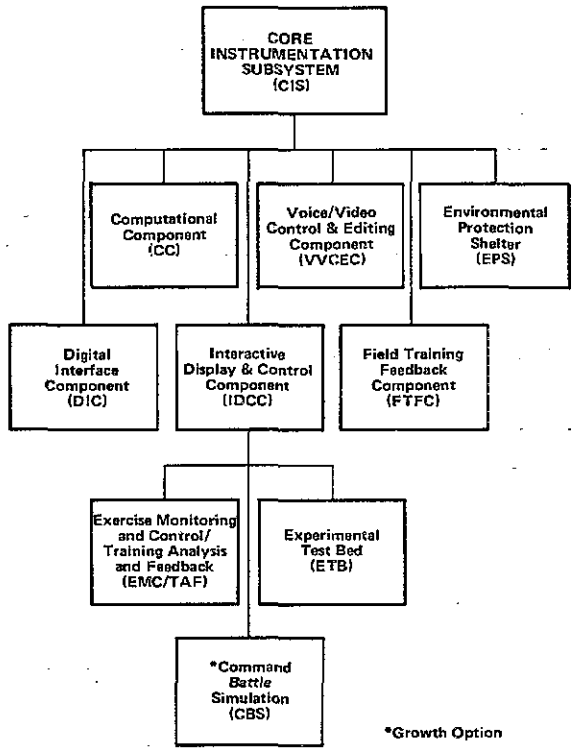

FIGURE 1C CORE INSTRUMENTATION SUBSYSTEM (CIS) ARCHITECTURE

implements digital communications protocol between the CIS and external subsystems. It reformats and provides data buffering for all CIS digital I/O. In short, the DIC centralizes all digital I/O data communications for the CIS and preprocesses these data to transform them into the proper format required by the CIS. The DIC performs a similar function for data output from the CIS to the RDMS and RMCS subsystems.

The Computational Component (CC) performs the mainline computation in support of all CIS exercise monitoring, command, control, and training feedback activities. Specific computational processing performed by the CC include: (1) state estimation for all instrumented players in the exercise, (2) real-time casualty assessment for all direct and indirect fire weapon engagements (those not performed or only partially performed by the WESC), (3) real-time statistical analyses to provide training assessment, (4) spectrum management analyses, and (5) range operations analyses.

The Interactive Display and Control Component (IDCC) provides the real-time interactive data display and control facilities required for CIS controllers to direct all aspects of the NTC training exercise and provides near real-time training data feedback. Specifically, the IDCC provides a digital background map, selectable tactical symbology, engagement event data, statistical performance data, and function key, keyboard and interactive menus to interactively control all aspects of the CIS subsystem. As shown in Figure 1C, the IDCC implements the CIS display and interactive control operations of: Exercise Monitoring and Control (EMC), Training Analysis and Feedback (TAF), Command Battle Simulation (CBS) and Experimental Test Bed (ETB).

The Voice/Video Control and Editing Component (VVCEC) provides all facilities needed to record, archive, edit and replay relevant voice and video data obtained by monitoring battalion TF and OPFOR field operations. Specifically, the VVCEC provides the means to record, edit, and replay BLUEFOR tactical communications. It also provides an interactive software system to assist tactical communications monitors to manually input key COMMO event data. Finally, the VVCEC provides similar recording, editing and replay facilities for all video data collected in the field by a fixed video camera remotely controlled from the CIS and by five mobile video cameras operated by the field video teams directed from within the CIS.

The Field Training Feedback Component (FTFC) provides a self-contained mobile display capability to present field After-Action-Reviews (AARs). The FTFC will provide display capabilities similar to those available within the CIS AAR theater including a large screen display and color monitors. The FTFC display will be generated using TAF capabilities in the CIS under the direction of the field AAR director using voice communications provided by the Range Communications Component (RCC) within the RMCS.

The Environmental Protection Shelter (EPS) provides the operational environment for all CIS personnel and equipment. Specifically, the EPS provides physical security, conditioned power, light, air conditioning and operational and maintenance facilities, equipment and supplies.

Subsystem Interfaces

As discussed the NTC Instrumentation System (NTC-IS) has been divided into three major subsystems (CIS, RDMS, and RMCS) with functions allocated to each subsystem to assure that the functional and physical interfaces between them are simple and straightforward. The system interface diagram for the NTC Instrumentation System (NTC-IS) is presented in Figure 2. As shown, data generally flows from the RDMS and RMCS into the CIS where it is processed and displayed for decision making. Control, on the other hand, tends to flow from the CIS to the two other subsystems (RDMS and RMCS).

Notice that all digital data interfaces are implemented by the Digital Interface Component (DIC) within the CIS. In this design, the DIC provides all hardware and software capabilities to assure data and physical compatability between subsystems. That is, the DIC performs all electronic signal and data transformations required to implement the needed interface thereby decoupling all other data processing functions internal to the respective subsystems. This design approach has provided the flexibility required to carry on development of each of the subsystems in parallel and also provide for future growth.

The digital interface between the RDMS and CIS has been successfully demonstrated during the NTC I-ALPHA Test where the General Dynamics Electronics RMS II and Xerox WESC systems were used to implement the RDMS. Because of this, all data formats are clearly defined (based on well known RDMS capabilities) and the physical interface can be implemented using standard off-the-shelf intercomputer communications equipments similar to those used in I-ALPHA.

CORE INSTRUMENTATION SUBSYSTEM OPERATIONS OVERVIEW

The CIS functions as the NTC Exercise Operations Center during an exercise. Therefore, an operational overview is useful in gaining an understanding of how the engagement will be monitored and controlled.

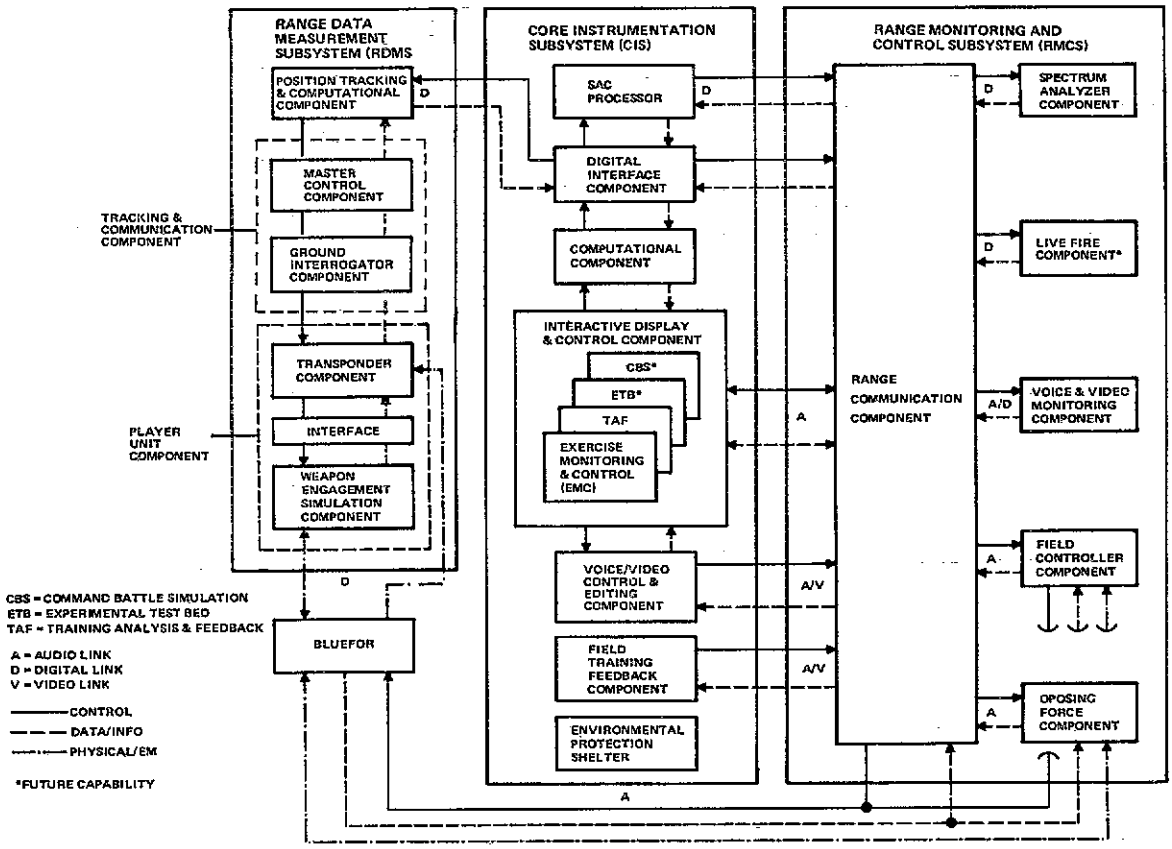

FIGURE 2 NTC INSTRUMENTATION SYSTEM INTERFACES

The heart of CIS operations are the functions performed within Exercise Monitoring and Control (EMC) and Training Analysis and Feedback (TAF). It is therefore useful to explore the functions of the EMC/TAF controller stations and the activities performed within the EMC/TAF Operations Center.

As shown in Figure 3 the EMC/TAF Operations Center is located in the Environmental Protection Shelter (EPS) where the data from the Range Data Measurement Subsystem (RDMS) and the voice radio and video inputs interface with the CIS.

EMC/TAF Operations Center Layout

Figure 4 presents the layout of the operator stations within the EMC/TAF Operations Center. As indicated, there are eight operator stations, each assigned unique functional responsibilities.

STATION 1: TAF OPERATIONS

Operators at this station are allocated the responsibility to analyze exercise data to extract important training feedback data in order to meet the training objectives specified for each exercise segment. The Training Analysis and Feedback Officer (TAFO) and his assistants structure an After-ActionReview (AAR) and build material to fill out this AAR structure during an ongoing exercise segment.

STATIONS 2, 3, and 4: COMPANY OPERATIONS

Operators at these stations are allocated the responsibility to monitor and analyze the activites of each of the three BLUEFOR line companies and their subordinate platoons.

STATION 5: EXERCISE OPERATIONS

Operators at this station are allocated the responsiblity to monitor and control the training environment. These responsibilities include directing the Field Observer/Controllers (FOC), fire marker teams and monitoring the status of the NTC-IS instrumentation hardware and software.

AAR - After-Action Review
A/V - Audio/Visual
CBS - Command Battle Simulation
EMC/TAF - Exercise Monitoring & Control Training Analysis & Feedback
ETB - Experimental Test Bed
PL/ERS - Position Location/Event Registration Subsystem

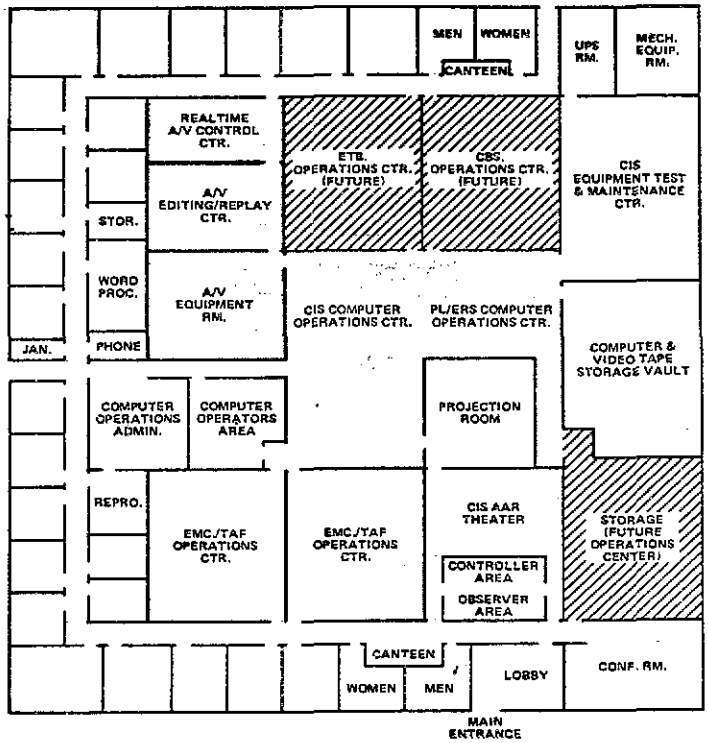

FIGURE 3 FLOOR PLAN CIS ENVIRONMENTAL PROTECTION SHELTER (EPS)

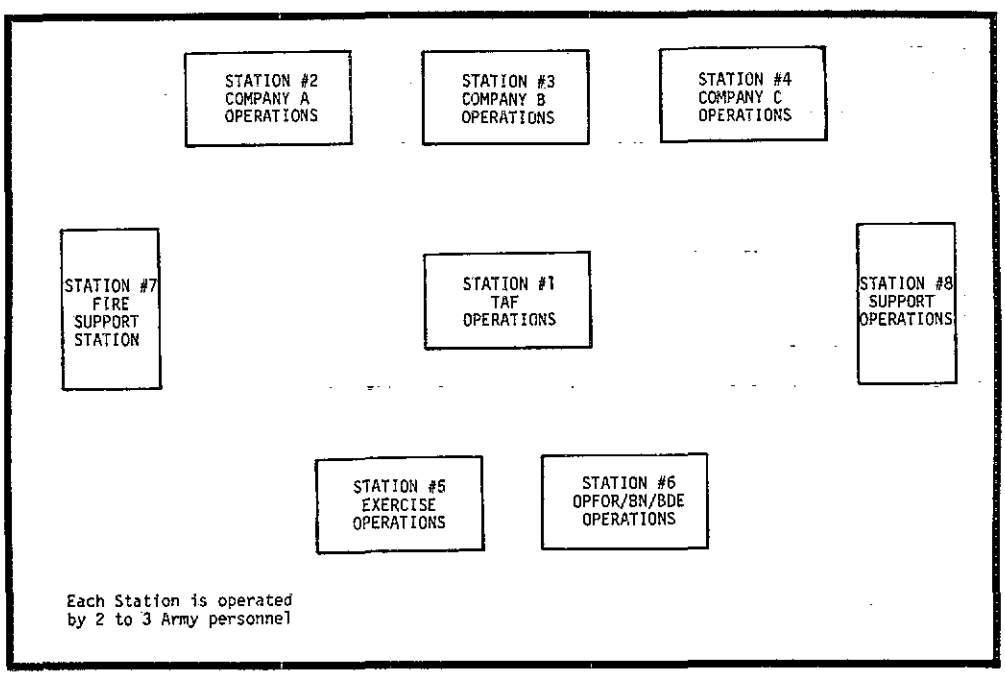

FIGURE 4 EMC/TAF OPERATIONS CENTER LAYOUT

STATION 6: OPFOR, BN and BDE OPERATIONS

Operators at this station are assigned the responsibility to direct the opposing forces (OPFOR) and monitor the battalion TF and brigade (BDE) tactical and intelligence operations. When nuclear, biological or chemical (NBC) effects are played, the NBC operator is accommodated at this station.

STATION 7: FIRE SUPPORT OPERATIONS

Operators at this station are assigned the responsibility to monitor and direct the simulation of indirect fire operations for both the battalion TF and OPFOR.

STATION 8: SUPPORT OPERATIONS

Operators at this station are assigned the responsibility to monitor and analyze all battalion TF combat support and combat service support operations.

Using the controller station capabilities previously described, the EMC/TAF operators are able to perform their particular function in the CIS by monitoring the appropriate radio nets, tagging event data collected by the field instrumentation, directing and prompting the operation and information input of the Field Observer/Controllers, diecting the OPFOR operations, directing and editing the activities of the field video teams and selecting the data and video displays to emphasize and demonstrate specific training objectives for AAR sessions.

SUMMARY AND SCHEDULE

Summary

The National Training Center (NTC) then has been designed to provide to the members of each battalion a total experience which cannot be duplicated at their home stations. The Instrumentation System will provide the means by which the training experience can be controlled and the means by which the data can be collected, recalled and presented so that units will have an appreciation of their state of readiness for combat and can develop a training program to eliminate their weaknesses.

Not only will the NTC provide the opportunity for the units that pass through the 14-day period to improve their training but it will provide an opportunity for the Army to identify better training methods. It will provide a system which will allow a unit's performance to be judged objectively in a realistic combat environment. Home station training will become more effective as a result of units experiences at NTC and as a result of the periodic reviews of their NTC performance by use of their Take-Home-Package of recorded material. The net result will be that over time the performance of battalions at NTC will improve as they learn to train more effectively at home stations.

Schedule

Initial operational capability - 125 player units -	31 Jan 82
Expanded player unit capability -	Oct 82
Phase II implementation -	Incrementally from mid to late 1980's

ABOUT THE AUTHOR

Mr. Richard C. Dickson is a 1956 graduate of the University of Wisconsin. Prior to his retirement from the U.S. Army in 1979 he directed the operational development of the Combined Arms Tactical Training Simulation (CATTS) at Ft. Leavenworth, Kansas. He is currently the System Engineering Manager, National Training Center Project Office, Science Applications, Inc.