DOCUMENTED BRIEFING

RAND

Conducting Warfighting Experiments at the National Training Center

Jon Grossman

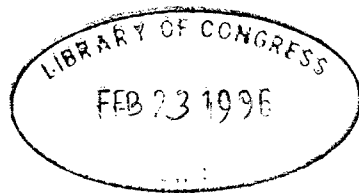*Arroyo Center*

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Conducting Warfighting Experiments at the National Training Center

Jon Grossman

Prepared for the
United States Army

Arroyo Center

PREFACE

This briefing describes ways in which the Army can more effectively use the National Training Center (NTC) for focused rotations and advanced warfighter experiments. The work reported here builds on a decade of Arroyo Center research at the NTC, which has been sponsored by the Combined Arms Center, Fort Leavenworth, and the Armor Center, Fort Knox.

SUMMARY

The Army's Combat Training Centers (CTCs) were founded with a dual purpose: to provide the most realistic training exercises possible short of actual war and to provide "lessons learned" to the Army. Although the CTCs have excelled in the first objective, they have been less successful in generating lessons learned. One reason for this is the absence of an analytic data base capable of establishing the magnitude of a range of problems and helping to determine how they may be solved.

To provide such a data base, the CTCs have begun to conduct focused rotations (FRs) and advanced warfighter experiments (AWEs.) The National Training Center has been using FRs to get a detailed look at battle operating systems and at the effects that specific changes in doctrine, training, organization, leadership, materials, and soldiers (DTOLMS) have on BLUEFORCE performance. An integral part of Force XXI, AWEs have a broader charter to examine the effects of multiple DTOLMS changes.

The NTC is an appropriate site for warfighting experiments. It provides an intense training environment in which units fight against a world-class opposing force (OPFOR). The NTC's operations group is able to perform independent performance assessments, with the help of extensive instrumentation. But the NTC is a complex laboratory, and tremendous care must be taken if meaningful experiments are to be performed there.

RAND's many years of conducting research at the NTC have granted it substantial expertise in conducting effective experiments at the NTC, both quantitative and qualitative. RAND's methodology for conducting research at the NTC can be used to plan AWEs. Primarily, the AWE must have objectives that can be adequately demonstrated at the NTC. If some of its measures of effectiveness cannot be measured or are compromised by the limitations of the NTC's training environment, then those objectives should not become the basis for an FR or AWE. If the research objectives are suitable, a train-up plan is needed. The plan should produce units that are well trained in the areas to be tested. In addition, the test plan should make maximum use of archived data, and the data-collection mechanisms should be established and verified before the test.

The single-rotation AWE concept, however, even at its best, is limited in what quantitative results it can provide. RAND has found that at least 12 rotations' worth of data is needed to provide statistically meaningful

results. The AWEs, however, can readily provide significant qualitative results. An example of this sort of experiment would be to provide a unit with digital reporting equipment and determine if there is enough bandwidth in the current combat radio nets at peak reporting times during the battle. While the AWE would not establish absolute bandwidth requirements, it would establish the need to relook at the combat radio net requirements for a "digital" brigade.

After the FR/AWE has been conducted, analysis is needed to deal with the qualitative results obtained. It should establish what changes observed in the exercise are worth pursuing; simulations can help refine the expected magnitude of these changes in non-NTC environments. This briefing supplies an illustration of the methodology applied to a feasibility analysis of the M1A2 tank.

The NTC's training mission has several implications for the planning of FRs/AWEs. It is a training environment, and although it approximates actual combat, it does not replicate it. The OPFOR is the best-trained enemy in the world, and its advantages must be considered when planning FRs/AWEs. Moreover, the BLUEFORCE, facing this opponent, loses most of its engagements. This promotes highly effective training, since units learn better lessons from losing than from winning, but planners must account for the reality that DTOLMS improvements gained in an FR or AWE are not likely to result in a BLUEFORCE victory. Other NTC training limitations also need to be considered in the design of an AWE. BLUEFORCE units are likely to be organized differently than they would be in actual wartime. Training at the NTC focuses only on certain missions. A battlefield operating system that receives relatively less emphasis should not be the focus of testing. Finally, the data-collection procedures at the NTC support the training mission, not analysis. Planned upgrades to NTC instrumentation are expected to provide more complete and more detailed data, allowing better analysis and links to simulation systems.

The analytic community and the NTC can both benefit from a strong relationship. Simulations can be used to increase the effectiveness of FRs/AWEs; the intensity of the NTC training supplies a rich empirical data base for the analyst to draw on in creating simulations.

Conducting Warfighting Experiments at the National Training Center

This briefing reports the results of a study to determine ways in which warfighting experiments conducted at the NTC could be improved.

Briefing Outline

> » **Background**

» **Methodology for conducting effective AWEs at the NTC**

» **The NTC as an environment for experiments**

» **Strengthening the relationship between the NTC and the analytic community**

This briefing is divided into four sections. The first section discusses the background behind the current Army effort to conduct AWEs at the NTC. The second section shows how effective AWEs can be conducted at the NTC. The third section describes some of the more important AWE issues arising from the NTC's training mission. The last section discusses how the analytic community and the CTC can each benefit from a stronger relationship.

**The Army's Combat Training Centers
Have a Dual Purpose**

» Conduct realistic, high-intensity training exercises

» Capture lessons learned
  – Conduct focused rotations (FRs) and advanced
    warfighter experiments (AWEs) as a way of
    providing analytic research data to the Army

The Army's Combat Training Centers (CTCs) were founded with a dual purpose: to provide the most realistic training exercises possible short of actual war and to provide "lessons learned" to the Army.

The CTCs have excelled in their first objective. They have been less successful in generating lessons learned. Here, an important contributing factor is the absence of an analytic data base capable of establishing the magnitude of a range of problems and helping to determine how they may be solved.

In an attempt to provide such a data base, the CTCs have begun to conduct focused rotations (FRs) and, more recently, advanced warfighter experiments (AWEs). For five years the NTC has used FRs as a way of getting a detailed look at battle operating systems and at the effects that specific changes in doctrine, training, organization, leadership, materials, and soldiers (DTOLMS) have on BLUEFORCE performance at the NTC.

An integral part of Force XXI, AWEs have a broader charter to examine effects of multiple DTOLMS changes.

Why Conduct These Experiments at the NTC?

» The intensity of NTC training exercises for heavy brigades is as close to war as is possible in peacetime

» NTC provides independent assessment of units' performance

» NTC has extensive instrumentation

For several reasons, the NTC is an appropriate site for warfighting experiments. The exercises have been designed to represent the conditions of war as closely as possible. Units fight 8 battles in 14 days against a world-class opposing force (OPFOR). Many Desert Storm veterans have said that their experience in ODS was good training for how to fight at the NTC. As part of its training mission, the NTC has developed an operations group that consists, in part, of observer-controllers (OCs) who independently assess the performance of each NTC unit, from platoon to brigade level. Moreover, to help the OCs perform this assessment, the NTC has developed extensive instrumentation.

However, the NTC is a complex laboratory, and tremendous care must be taken if meaningful experiments are to be carried out there.

RAND has conducted both qualitative and quantitative research at NTC for over a decade. We have learned how to select topics that are important to the Army and can be adequately researched in this "dirty laboratory." RAND research in each topic has identified systemic problems within BLUEFORCE that significantly affect its combat performance at the NTC. We have successfully designed and conducted experiments at the NTC to determine feasible solutions to these problems. The results of this research have led to changes in Army doctrine, training, organizations, and materials. RAND has published reports on each topic as well as an overview on how we conduct research at the NTC (see the table below for a list). This documented briefing is based on this successful research.

Topic	RAND Report #
Tactical reconnaissance	N -2628-A
Ground-to-ground fratricide	N-2438-A
Artillery targeting accuracy	N-2984-A
TOW missile system utilization at the NTC	N-3137-A
Mortar utilization at the Combat Training Centers	N-3358-A
Battalion and below C2 issues	MR-496-A
Quantifying the Battlefield: RAND Research at the National Training Center	MR-105-A

Briefing Outline

» **Background**

» **Methodology for conducting effective AWEs at the NTC**

» **The NTC as an environment for experiments**

» **Strengthening the relationship between the NTC and the analytic community**

This section shows how effective AWEs can be conducted at the NTC. A methodology and an example of how to use it to design and conduct an AWE are presented.

The NTC's training mission, which will be discussed in the next section, imposes constraints on what can be tested at the NTC. Understanding the training mission, and how it is implemented, is required to determine what can be tested at NTC. If the training mission seriously affects what is being tested, it may be possible that the AWE rotation can change some of these constraints to more effectively test a new concept or system.

Care must also be taken in selecting measures of performance. An example of this is the loss-exchange ratio, LER. The BLUEFORCE fights until no further training can be gained. Given the high attrition rate for the BLUEFORCE, the LER will be highly influenced by when the exercise was stopped. If it was stopped because the forward companies were attrited and the reserve company was too far back to get in the battle, a better LER will be obtained than if all the companies were involved in the fight. Another factor that affects the LER is that artillery lands precisely on the coordinates given in the call for fire request. This unrealistic accuracy often favors the OPFOR, whose knowledge of the NTC terrain results in more accurate calls for fire. This will clearly impact the LER. Another problem exists with MILES (multiple laser engagement system). The OPFOR trains with MILES over 100 days a year, as opposed to the BLUEFORCE, which typically receives less than 10 days a year of MILES training. The OPFOR's superior ability to use MILES against the BLUEFORCE will also adversely affect the LER.

The concept of a single-rotation FR/AWE further limits the NTC's analytic usefulness. RAND has found that data from at least twelve rotations are typically needed to provide statistically significant results. Unfortunately, in most cases no baseline data exist, and it is difficult to derive statistically meaningful results from one rotation. Even when there are baseline data for a specific measure of effectiveness (MOE), large changes in the MOE during the rotation are needed to yield statistically valid results at the .05 confidence level. The AWE must therefore be planned to take advantage of the archived data and select MOEs that are expected to change significantly during the AWE rotation. Ideally, the critical items of the AWE could be tested over a year's worth of rotations, which would allow statistically significant results for even small changes in the MOE.

This is not to suggest that FRs/AWEs are limited in their usefulness to the Army. They can supply important insights into how changes in doctrine, training, organization, leadership, materials, and soldiers (DTOLMS) can affect BLUEFORCE performance. In many cases this may be the only way to gain these insights. Quantitative results are also possible, but a structured analytic approach is required to design an AWE that can produce meaningful quantitative results.

It is also important to note that the insights are qualitative. Further analysis is required if the results are to be quantified. AWEs need to be designed with realistic goals, given the difficulty of obtaining quantitative results.

> ### The Training Mission Introduces Particular Limitations for Focused Rotations and AWEs
>
> » Training missions stress only certain parts of the brigade
>
> » Test results for training and equipment are confounded
>
> » NTC rules of engagement can limit the effectiveness of both the new equipment and the training

The NTC is not a testing and evaluation center. Although the NTC operations group is extremely helpful in conducting FR/AWEs, they will not compromise their training function.

In the next section I show that BLUEFORCE units are deployed to NTC with an organizational structure different from the one that would be used in a real war and that this presents a particular problem at brigade level. The limited set of missions performed by an NTC brigade stresses some battlefield operating systems (BOS) more than others. This limits not only what can be tested but also to what level additional objectives can be tested.

When new equipment is being tested, the situation is even more complex because at NTC it is difficult to separate training problems from equipment problems. That is, the equipment may work as expected but the battle may still be lost because the units could not use it to the level needed to influence the battle.

NTC rules of engagement can also limit the effectiveness of a new concept. For example, increasing the accuracy of artillery-delivered mines (FASCAM) would have little impact on the battle, since the rules of engagement require that no obstacle prevent the direct fire battle. In practical terms, usually only the first vehicle in each column is played as being attrited by the FASCAM in the NTC exercise.

The above are just some of the factors designers must take into account when FRs or AWEs are to be conducted at the NTC.

Selection Criteria Should Be Applied to FRs and AWEs

```
                              NO              NO
                                      YES
 ┌────────────┐   ┌──────────────────────┐   ┌────────────┐   ┌──────────┐
 │ Objectives │→  │ Are objectives        │→  │ Test plan  │→  │ FR/      │
 │ of FR/AWE  │   │ feasible?             │   │ Train-up   │   │ AWE      │
 └────────────┘   │                       │   │ plan       │   └──────────┘
                  │ • Can be demonstrated │   └────────────┘        │
                  │   at NTC?             │                         ↓
                  │ • Can be measured     │                  ┌──────────────┐
                  │   at NTC?             │                  │ Post-FR/AWE  │
                  │ • Have similar        │                  │ analysis     │
                  │   measurements        │                  └──────────────┘
                  │   been done at NTC?   │
                  │ • Limitations of NTC? │
                  │ • Will substantially  │
                  │   improve             │
                  │   BLUEFORCE performance│
                  │   at NTC?             │
                  └──────────────────────┘
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RAND has developed over the last decade a methodology for conducting research at the NTC. The chart shows how this methodology can be used to plan AWEs.

If the objectives of an exercise cannot be adequately demonstrated, or if their MOEs cannot be measured or are compromised by limitations of the NTC, that exercise should not, without modification, become the basis for an FR or AWE at the NTC. Even if the objectives are feasible, they should result in substantially improved BLUEFORCE performance, given the expense of conducting FRs/AWEs.

After the objectives are established, a train-up plan is needed. The plan should produce units that are well trained in the areas to be tested. This will help separate training issues from equipment issues. Wherever possible, the test plan should make maximum use of archived data, and the data-collection mechanisms should be established and verified prior to the rotation.

After the FR/AWE has been conducted, a substantial analytic effort will be required to deal with the qualitative results obtained. The analysis should establish what changes observed in the exercise are worth pursuing. Simulations can help refine the expected magnitude of these changes.

Feasibility Analysis for the M1A2 Tank

M1A2 has CITV, POSNAV, IVIS, and an improved
gunner's sight

» **Can be demonstrated at the NTC?**

- 64 M1A2s built

- M1A2 crew training program in place

- Field exercises limited

- Draft of *Tactics, Techniques, and Procedures*
  manual available

» **Armor M1A2 TF can be demonstrated**

The M1A2 tank can be used to illustrate the methodology. A
significantly improved version of the M1A1, the M1A2 is equipped
with a commander's independent thermal viewer (CITV); POSNAV, an
inertial navigation aid; the intervehicle information system (IVIS), a
computer-based reporting system; and an improved two-axis stabilized
gunners' sight. The M1A2 has been used in three FRs at the NTC. The
feasibility analysis presented here shows how the M1A2 will impact
only a small part of the NTC training exercises.

Sixty-four M1A2s have been built. An M1A2 training program has
been in place for over a year, and more than 100 tank crews have been
qualified on the M1A2. However, qualifying a crew does not ensure
that it will perform well in the NTC environment. The small number of
available M1A2 tanks has limited the amount of time that units have
spent in field exercises with the tank. Success at NTC correlates with
the number of field exercises performed by the unit at home station.
Success at NTC also requires good tactics. The *Tactics, Techniques, and
Procedures* manual for the M1A2 was recently released in draft form,
but it is new and unproven, and it is not clear how effective it will be.

Thus, although it is technically possible to demonstrate an M1A2 TF at
the NTC, there are likely to be some training and tactics issues that will
reduce the tank's effectiveness in a focused rotation.

Feasibility Analysis for the M1A2 Tank
(cont'd)

Key M1A2 Improvements

Measure of effectiveness	Simnet demonstrated improvement?	Measurable at NTC?	Credible measurement at NTC?
Mission time	20%	Yes	No
Reporting accuracy	70%	No	No
Target acquisition range	45%	20% of time	Yes
Loss-exchange ratio	60%	At end of mission	No

The mounted warfare testbed at Fort Knox has used Simnet to show several areas where the M1A2 offers major improvements over the M1A1, but the MOEs are not all measured at the NTC. Mission time and loss-exchange ratio are measured after the mission has exhausted all training opportunities. They are therefore inaccurate, since NTC battles are run far longer than real battles would last.

Reporting accuracy is subjectively rated for each battle by the OCs. Quantified data on the accuracy of reports on enemy and friendly positions are not taken at NTC. Target-acquisition range is measured only when the tank kills a target, and then only if the Star Wars computer determines a pairing, which occurs for approximately 20 percent of the kills.

Feasibility Analysis for the M1A2 Tank (cont'd)

» **Limitations of the NTC?**
- OPFOR use of terrain during battle
- Live-fire safety
- Limited night operations

» **Will substantially improve BLUEFORCE performance at NTC?**
- NTC limitations will significantly reduce the expected improvements during battle
- ~50% improvement should be observable in counter-recce operations

At the NTC, the terrain itself imposes constraints on tanks. With a choice of wide-open desert or mountain passes, the OPFOR tends to force the battle to occur in the passes, where target ranges are less than two kilometers. At these ranges, the optical sights for both the OPFOR and the BLUEFORCE are roughly comparable.

Live-fire safety requires that tanks fire only in their assigned sectors. Because the operations group felt that commanders using CITV could inadvertently call for fire out of sector, the CITV system was "slaved" to the gunner's sight, thereby limiting the target acquisition time to that of an M1A1. Moreover, at the NTC, force-on-force battles are rarely conducted at night, so the superior thermal sights on BLUEFORCE vehicles do not contribute as expected.
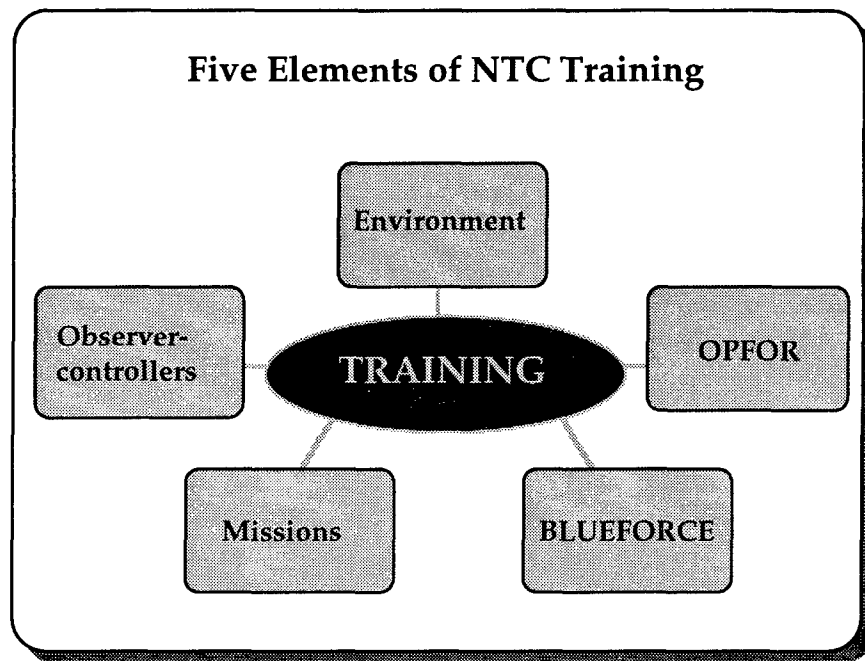
Overall, NTC limitations clearly affect the potential improvements the M1A2 could demonstrate in a real war. Since many of these improvements are in the range of 20 to 40 percent, it is possible that the M1A2 might not exhibit any improvements over the M1A1 during NTC battles. The only part of the training exercises that is not subject to the constraints discussed above is the counter-reconnaissance fight, which occurs at night. Because the OPFOR does not know where the BLUEFORCE is, its ability to exploit terrain is limited.

In this case, the methodology indicates that the M1A2 focused rotation should concentrate on the counter-reconnaissance part of the training exercise.

Briefing Outline

» **Background**

» **Methodology for conducting effective AWEs at the NTC**

» **The NTC as an environment for experiments**

» **Strengthening the relationship between the NTC and the analytic community**

The methodology presented in the previous section highlights the difficulties in conducting experiments at the NTC. The difficulties are the result of NTC's primary goal of providing world-class training to the U.S. Army. In accomplishing this goal the NTC has limitations that can adversely impact any AWE's objectives. This section presents some of the more significant limitations. In many cases the AWE can be modified to overcome these limitations, but there are cases in which they will compromise the AWE's basic objectives. Understanding the limitations is therefore required to determine if the NTC is the appropriate site for the AWE.

Five Elements of NTC Training

Environment

Observer-controllers

TRAINING

OPFOR

Missions

BLUEFORCE

NTC training comprises five basic elements. The issues associated with each element will be discussed in this section.

The NTC Training Environment

Desert and mountain terrain is unpopulated

Casualty levels are unrealistic

» Battles run until no additional training opportunities exist

» Fear of death is not a factor

Safety is a primary concern

» There are few force-on-force night battles

» Live-fire scenarios are limited

MILES has limitations

» Doesn't fully replicate all weapon systems

» Affects OPFOR and BLUEFORCE differentially

The NTC is a desert warfare environment with few buildings and no indigenous population. Thus it is an inappropriate site for exercises centering on urban warfare, jungle terrain, etc.

As a training facility, the NTC approximates, but does not replicate, actual combat. In particular, two characteristics of NTC exercises have important implications for FRs and AWEs. First, battles are run until no further training opportunities exist. The OPFOR does not allow BLUEFORCE units to retreat, and battles are often fought until fewer than 10 percent of the BLUEFORCE units are alive. This means measures of effectiveness such as force-exchange ratios are suspect because they include battle segments that no longer represent realistic scenarios. Second, in NTC's force-on-force training exercises, the units have no fear of dying. Soldiers frequently perform "heroic" feats that they would not attempt in a real war. This does train the troops to seize the initiative in battle, but does not generate realistic data for the researcher.

Safety is emphasized at training sites. Therefore, there are few force-on-force night battles for the heavy task forces, and live-fire scenarios are limited.

In force-on-force battles, the Multiple Integrated Laser Engagement System (MILES) is used for scoring, and the relative ability of OPFOR and BLUEFORCE to exploit MILES has a substantial effect on battle

outcomes. For example, the MILES unit that replicates the TOW missile system is difficult to align, and the alignment is difficult to maintain over time. Through constant, long-term practice, the OPFOR has learned how to properly use (TOW) MILES. The BLUEFORCE does not have this capability. Therefore, TOW exercises performed at the NTC are compromised by MILES, which presents a fundamental problem for analysts.

Aviation assets are not fully instrumented with MILES. Close Air Support currently does not use MILES but instead is scored by observer-controllers. Most helicopters have some form of MILES, but it does not replicate their weapon-system capabilities to the level that other MILES-equipped weapon systems achieve. Moreover, MILES units on helicopters often fail to perform to specifications. Overall, this suggests that there will be problems in FRs/AWEs that utilize extensive aviation assets.

OPFOR Is the Best-Trained Enemy in the World

» **Is a Soviet-style enemy with limited infantry strength and BMP troop-carrying capability**

» **Wins five out of six engagements**
- **Uses 1960s- and 1970s-era equipment**
- **Training, tactics, experience, and procedures compensate for equipment limitations**
- **MILES can make OPFOR's equipment superior to BLUEFORCE's equipment**

An FR or AWE selected for the NTC must take into account the unique nature of the OPFOR. It is the best-trained enemy in the world. It is also a very specific type of enemy whose operations are based on Soviet doctrine. A pure mechanized force with limited BMP troop-carrying capability, the OPFOR sometimes uses National Guard troops or other visiting units as foot soldiers, primarily deployed with AT-5s to defend a pass or other key terrain.

The OPFOR achieves victory in five out of six battles. It wins because it trains more than 100 days a year in the field, has tremendous knowledge of the terrain it is fighting on, and knows exactly what it and the BLUEFORCE can do in this terrain. Its advantages in operating the MILES system have already been discussed.
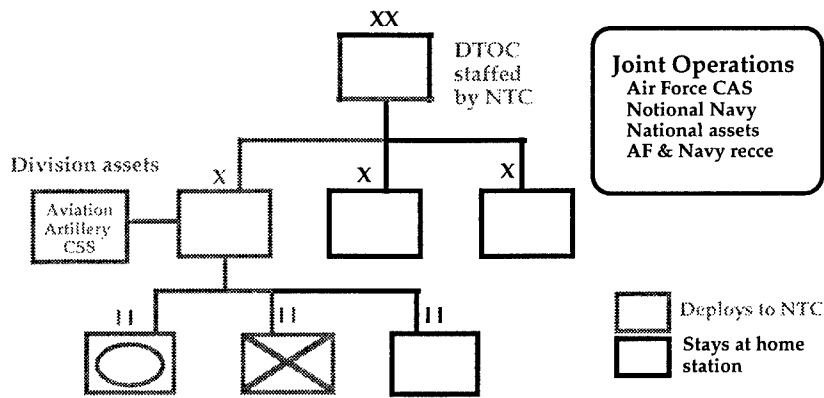
One possible approach to minimizing the OPFOR's impact on the AWE would be to replace it with a BLUEFORCE unit for that rotation. The unit would receive the same amount of training as the AWE unit but would not have its changes in DTOLMS. The AWE would then more accurately show the change in performance possible with the new DTOLMS.

BLUEFORCE Learns by Losing

» Enhanced training and weapon systems are generally expected to lead to victories

» NTC's premise is that units must do everything right to win

» Design of FRs and AWEs must take into account a probable BLUEFORCE defeat

Although it is generally understood that enhanced training is provided and advanced weapons are acquired to help assure victory, an underlying premise of NTC exercises is that BLUEFORCE must do everything right to win against the OPFOR. This premise enables highly effective training, since units will learn better and more lasting lessons from losing than from winning. As a result, the training gained in an FR or AWE conducted at the NTC is not likely to result in a BLUEFORCE victory, and planners must take this into account.

BLUEFORCE Units at the NTC Are Organized Differently Than for Wartime Deployment

Brigade operations are a fairly recent activity at the NTC, and among the echelons participating in exercises at the NTC, brigades are the most constrained. They deploy to the NTC with more division and fewer battalion assets than they might normally have during a war. They also deploy without adjacent or supporting brigades. Their division TOC is staffed by NTC personnel, and it generally issues flawless orders and only slightly distorted versions of near-perfect intelligence.

This results in a brigade with assets it does not normally use. Its operation is only notionally coordinated with that of adjacent brigades; it is artificially coordinated with the division, and it is not coordinated with a native population or with joint forces. The Army's experiences in Panama, Grenada, Kuwait, and Somalia indicate that coordination is now one of the most critical tasks to ensure brigade-level success in today's conflicts.
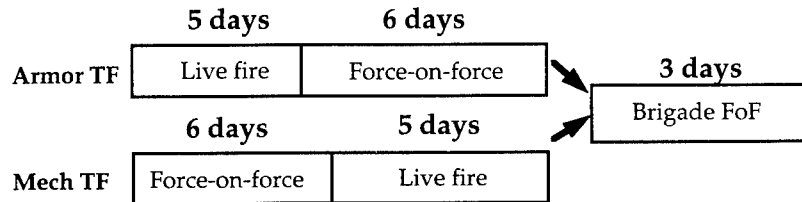
Maneuver battalions deploy to the NTC with the assets they would take to war. Given that most battles are at the battalion level, the NTC battalion receives more attention from the brigade than it might normally receive during a real war. There are also times when the brigade is involved with the other battalion's operations and gives less attention to the battalion. Also, for most battles a battalion does not need to coordinate with adjacent battalions.

A limited number of joint operations are performed at the NTC. Nellis Air Force Base provides A-10s and F-16s for close air support. Naval gunfire is notionally provided by having the master computer in the "Star Wars" building fire the missions and score their effectiveness.

Reconnaissance assets are routinely used. Because the master computer knows all vehicle locations, reconnaissance assets can also be notionally deployed. Upon request, the division can receive information about what a recce flight would have seen had it flown a given mission.

The bottom line is that the NTC provides realistic battalion-level training, but training at the higher echelons is less realistic. FRs and AWEs should account for the fidelity of the training at each echelon.

There Are Four Primary Training Missions at the NTC

	5 days	6 days		3 days
Armor TF	Live fire	Force-on-force		Brigade FoF

	6 days	5 days
Mech TF	Force-on-force	Live fire

Missions performed

Defense-in-sector   Deliberate attack

Movement-to-contact   Hasty attack

BLUEFORCE units train for 14 days at the NTC. At the start of training, one battalion goes to live-fire exercises while the other goes to force-on-force exercises. Each task force (TF) fights three battles. Then they switch. After 11 days the TFs unite to fight two force-on-force battles.

Typically, the units are given only four types of missions: defense-in-sector, movement-to-contact, deliberate attack, and hasty attack. Although special units such as division cavalry will be given different missions—e.g., guard or screen missions—appropriate to their METL (mission essential task list), the majority of battalions perform the four missions cited above during their NTC rotation.

NTC Training Missions Do Not Replicate All Battlefield Operating Systems Equally

» **NTC missions center on the direct fire fight**

Heavily replicated	Less replicated
Maneuver Command and control Intelligence Mobility/countermobility	Combat service support Air defense Fire support

To maximize training for the mounted warfare community, BLUEFORCE missions emphasize the direct fire fight. Furthermore, the fast-paced OPFOR is a difficult enemy on which to call indirect fire. The result is that the various battlefield operating systems (BOS) are not replicated to the same level. This limits the level of testing for AWEs/FRs that seek to enhance the effectiveness of a BOS that receives less emphasis.

An example is Paladin, the latest self-powered artillery deployed by the Army. Field artillery is of limited effectiveness against the OPFOR because of a lack of timely target reporting. (The OPFOR tends to kill most BLUEFORCE forward observers, such as the FIST teams.) Because its capabilities would not be fully demonstrated at the NTC, Paladin would best be tested elsewhere. It should be noted that if changes were made to more fully replicate fire support at NTC, then equipment like Paladin could be effectively tested at NTC.

The NTC Data Base Supports Training, Not Analysis

NTC Data Sources

Digital data	Nondigital data	OC observations
• Battle replay tapes • Killer-victim scoreboard	• Combat radio nets • Operation orders and written fragmentary orders (FRAGOs) • Fire logs	• After-action review videos • Take-home packages • Focused OC surveys

» The data base was developed to support after-action reviews

» The data base is difficult to use

» Observer-controller records are a valuable source of data

NTC instrumentation was developed to give OCs the necessary information to critique their counterparts. The positions and locations of vehicles during the battle and the times the vehicles fired are recorded in battle replay tapes. Roughly 20 percent of the killer-victim pairings are found by the "Star Wars" computers and are displayed on the tape. The OCs also manually enter into the computer the end-of-battle killer-victim scoreboard. Approximately 20 of the TF combat radio nets are recorded. Written operation orders and FRAGOs are archived. Fire logs are saved by the artillery OCs.

These data are extensively used for after-action reviews and take-home packages. OCs have found that although the instrumentation can show what happened, their direct observations of the battles are needed to determine why those events took place.

RAND researchers have found the NTC data sources, in general, to be incomplete and difficult to use. To adequately quantify a battlefield issue, RAND has utilized focused OC surveys, which ask from 10 to 25 questions about specific aspects of the training exercises observed by the OCs. Data from these surveys are used to quantify issues and to validate or reject RAND study hypotheses. RAND has found that roughly one year's worth of surveys is required to adequately quantify an issue.

Planned Upgrades to NTC Instrumentation Will Enhance Analytic Capabilities

Digitally recorded position-location and shooter-victim data will provide

» **more complete data base for computer-based simulations**

» **potential to more accurately judge unit performance**

» **linkage to Distributed Interactive Simulations (DIS)**

NTC is currently planning to upgrade MILES to the newest version, SAWE-MILES II (surface area weapons effect MILES). This will fully digitize the position-location and shooter-victim data set, thereby allowing additional empirical battlefield data to be available for simulations.

This complete data set may also permit more accurate assessment of the performance of BLUEFORCE units. With the MILES upgrade, measures of effectiveness such as massing of firepower and fraction of vehicles engaging the enemy will be easier to determine. More importantly, the data can be taken as a function of time, which will solve the problem of mixing data taken during the late, "training-only" stages of the battle with that from the more realistic, early part of the battle.

Lastly, the digital data base can be linked to Distributed Interactive Simulation (DIS) systems, which could potentially result in more realistic DIS exercises. Real-time linkage of DIS to NTC exercises could also expand the NTC's training environment to include more Army assets and perhaps even joint operations.

Briefing Outline

» **Background**

» **Methodology for conducting effective AWEs at the NTC**

» **The NTC as an environment for experiments**

» **Strengthening the relationship between the NTC and the analytic community**

This section discusses how the analytic community and the CTC can each benefit from a stronger relationship. The section concludes with a summary of this briefing.

The Analytic Community Can Help Make FRs/AWEs More Effective

Simulations can

» **identify critical features that can and ought to be measured**
- Refine objectives into MOEs
- Estimate MOE values for specific FRs/AWEs

» **compensate for unexpected problems with equipment or soldier performance**

» **further assess the qualitative results obtained from FRs/AWEs**

The M1A2 feasibility example showed how simulations can help determine the objectives of the FR/AWE, and they can be used to refine those objectives into MOEs as well as to estimate what the values of the MOEs could be for the training exercise.

Simulations can also be used to demonstrate "what if's." Murphy's Law seems to apply to warfighting exercises. That fact, combined with the inherent limitations of NTC, suggests that it is unlikely that all the objectives of the FR or AWE will be met. Simulations can play the battle so that equipment doesn't break and troops don't make training errors.

Thus, simulation results can be combined with "dirty laboratory" results from NTC to form a more complete picture of how the FR/AWE DTOLMS changes can affect BLUEFORCE performance. Simulations can also be valuable when NTC results are good because simulations can extend those results to other mission scenarios.

The Intensity of Training at the NTC Is a Unique Asset to the Analytic Community

Provides data on soldier performance in a highly stressed environment

» Empirical inputs to help create more realistic simulations

» End-user feedback to make equipment more effective

» Investigate new concepts

NTC training exercises stress the soldiers at a level comparable to that of war. The exercises therefore represent a rich empirical data base for simulations. For example, in measuring how long it takes the S2 to analyze a spot report and give the TF commander an update, RAND researchers found that a well-trained S2 takes 6 minutes, while others can take up to 30 minutes. Simulations such as JANUS could use these kinds of data to more realistically model the battlefield.

The high-stress NTC environment can also provide end-user feedback on new equipment. For example, soldiers at NTC consistently indicated that the viewing reticule of the Bradley FLIR was too bright. These same soldiers had not identified this problem during home station exercises. The only other time the problem was reported was during Desert Storm.

Even without FRs and AWEs, NTC can help qualitatively assess new concepts. This can be done by using the NTC data base; seeking OCs' comments on new concepts; or, as RAND has done, having the OCs fill out a short, focused survey card after each battle.