# THE FIELD ARTILLERY POSITIONING AND NAVIGATION MASTER PLAN (DRAFT)

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REQUIREMENTS DETERIMINATION DEVELOPMENT INTEGRATION
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# Chapter 1. Introduction

## 1.1 PURPOSE

The purpose of this US Army Field Artillery Positioning and Navigation (POSNAV) Master Plan 2001 is to present information regarding current and objective POSNAV systems architecture and modernization planning.

## 1.2 BACKGROUND

Common grid is required to permit the massing of fires, delivery of surprise observed fires, delivery of effective unobserved fires, and transmission of target data from one to another in order to aggressively neutralize or destroy enemy targets. Components of common grid are the Datum, Ellipsoid or Spheroid, Grid System, and Common or Relative Survey. Prior to the advent of GPS technology, the POSNAV requirements of common survey were satisfied primarily by the Position and Azimuth Determining System (PADS) and conventional survey assets used in conjunction with maps and compasses.

Conventional survey methods are slow, extending survey control at a rate of 2-3km per hour but do provide a backup capability. When used with the PADS, conventional survey is used to determine an azimuth or establish declination stations. PADS can rapidly extend survey, at a rate only limited by the mobility of the host vehicle. This capability allows the PADS to maintain pace on the modern battlefield. However, the PADS is becoming increasingly unreliable due to its age. Maintenance of the PADS is costing the Army approximately $34 million a year. In the absence of the PADS or conventional survey, hasty survey techniques can be used to extend directional control over great distances quickly, but the commander must be willing to accept an azimuth accuracy of ±2.0 mils and either a PLGR or map spotted position that will not be on common survey with adjacent firing units. Both PADS and conventional survey methods require a known survey control point (SCP) in the area of operations from which to extend survey to firing unit locations or starting control must be assumed. Usually, the initial SCPs are thousands of meters from the firing unit's location, forcing commanders into the dilemma of using hasty survey methods or waiting for survey. The more fluid battlefield movement becomes, the more this dilemma is accentuated, making survey planning critical to mission success. The use of PADS, conventional, and hasty survey methods will serve as validation, backup or redundant capability to self-location systems found present in today.

The Global Positioning System (GPS) is a space-based radio navigation system designed to provide continuous accurate position, navigation, velocity, and time (PNVT) coverage worldwide to an unlimited number of users. The PLGR is a hand-held Non-Developmental Item (NDI) that serves as the authorized Army GPS receiver for tactical operations. PLGR provides fully acceptable horizontal and vertical position accuracy for cannons, rocket launchers, and radar systems but does not meet the azimuth accuracies for any FA platform.

GPS technologies integrated with inertial navigation systems (INS), have been fielded to provide Field Artillery units the ability to quickly and accurately perform self-location and orientation without reliance on external survey support. GPS signals are vulnerable to jamming, spoofing, and masking interference. If GPS becomes unavailable, all host platforms can continue to meet mission

requirements by utilizing update points. Update points are points that act as SCPs for self-location systems and must be established to support and facilitate field artillery common or relative survey requirements. Update points also provide a means by which self-location system accuracy performance may be validated against accuracy requirement standards and used as a second independent verification of positioning data. Establishment of these update points will be the primary mission of survey teams using PADS, or its replacement, the IPADS.

The time and accuracy requirements for survey planning are listed in FM 6-2, Chapter 14 and Annex B. The accuracy requirements for all U.S. firing platforms are listed in A-ARTY-P1, Chapter 11, Artillery Survey.

## 1.3 OBJECTIVES

The FA POSNAV Master Plan accomplishes the following:

a. Establishes a formal Field Artillery position on POSNAV systems to reduce the proliferation of systems and provide for cost-effective navigation systems planning and acquisition.

b. Improves FA POSNAV system acquisition and operation through an enhanced awareness of Department of the Army and other POSNAV planning and management initiatives.

c. Formalizes POSNAV definitions, parameters, and descriptions necessary for effective communications within the Army and with other concerned parties.

d. Provides a broad information base for consistent and informed POSNAV management decisions involving planning, budgeting, programming, optimal resource allocation, and implementing actions to satisfy POSNAV requirements.

e. Facilitates the widest possible dissemination of navigation planning information and POSNAV data for the FA.

f. Describes the current and future plans for the Army-wide POSNAV system architecture and mix and distribution of FA systems and equipments.

g. Supports Future Battle Control, Brigade and Below (FBCB2)

## 1.4 SCOPE

This Master Plan provides current POSNAV planning information on FA POSNAV system requirements, objective POSNAV systems, Operational and Organizational (O&O) concepts and uses, and the transition from current systems to objective systems for modernization planning.

## 1.5 RESPONSIBILITIES

Requirements Determination Development Integration, USAFAS is responsible for maintaining the FA POSNAV Master Plan. USAFAS will ensure the currency of the FA POSNAV Master Plan by:

a. Incorporating the POSNAV automated database into the Operational Facility (OPFAC) process no later than November (annually).

b. Announce an annual review of POSNAV requirements as part of the OPFAC process.

c. As part of the OPFAC process, convene an annual Validation Board review of new and revised FA POSNAV requirements. Validated requirements resulting from this annual review will be entered into the OPFAC database.

d. Publish updated FA POSNAV Master Plans on an as needed basis. TRADOC Centers and Schools may submit suggested changes to this POSNAV Master Plan at any time for consideration in the next revision.

## 1.6 SECURITY CLASSIFICATION

a. General. The overall FA POSNAV Master Plan is UNCLASSIFIED.

b. Accuracy requirements. Enroute and terminal accuracy requirements contained in Chapter 2 of this document are UNCLASSIFIED.

# Chapter 2. POSNAV Requirements

## 2.1 GENERAL

The Field Artillery must be prepared to conduct operations on a worldwide basis at any time, through all levels of conflict. The ideal POSNAV system that supports these operations should have the following capabilities:

- o worldwide coverage
- o passive (no electronic signature)
- o deny enemy use
- o support an unlimited number of users
- o resists jamming, spoofing or countermeasures
- o meet same survivability standards as the forces and weapons they support
- o real-time response
- o support combined and coalition operations
- o no frequency allocation problems
- o support common grid : multiple datum, ellipsoidal, and coordinate reference systems
- o position accuracy that is neither degraded by changes in altitude, time of day, or year
- o maintained by operator
- o not solely dependent on external signals
- o continuous availability
- o advanced security modules (i.e., SAASM) integration
- o feed into FBCB2 to provide situational awareness
- o interface and support digital maps

Currently there is no single system or combination of systems that possess all of these capabilities. The nature of military operations require that essential positioning and navigation services are available with the highest possible confidence that these services will meet or exceed mission requirements. Availability of essential navigation services requires that military operators use a mix of internal, self-initiated, and external-referenced systems and procedures to provide primary and redundant capability. The FA will develop systems and procedures that will allow these

independent systems to provide synergistic benefit through data integration. Although general military requirements remain fairly constant, continuous review is necessary because of the impact of emerging technology, weapon system modifications, the dynamics of national policy interests, and the nonmilitary environment to which the military must be prepared to conduct its operations.

## 2.2 SPECIFIC POSNAV REQUIREMENTS

NATO Document A Arty P-1, Annex A, specifies user requirements for POSNAV accuracies. These requirements are shown in Table 2-1. Horizontal position is expressed in terms of circular error probable (CEP), vertical position in probable error (PE), and direction (azimuth) in probable error (PE.) Position/direction accuracies and munitions effectiveness are considered parts of the error budget for indirect fire weapons and for target acquisition systems. Navigation accuracy requirements are based on specific mission requirements. For example, direction (azimuth) accuracy is the critical requirement for howitzers.

| SYSTEM | HORIZONAL POSITION (M) CEP (50%) | VERTICAL POSITION (M) PE (50%) | DIRECTION (MILS) PE (50%) |
|---|---|---|---|
| 105T How | 17.5 | 10 | 0.4 |
| 155T How | 17.5 | 10 | 0.4 |
| 155SP How | 17.5 | 10 | 0.4 |
| MLRS | 8 | 3.6 | 1 |
| BFIST/Striker | 30 | 20 | 2 |
| Q-36 | 10 | 10 | 0.4 |
| Q-37/Q-47 | 10 | 10 | 0.4 |
| Q-25A/Q-58 | 43.7 | 10 | 3 |
| MMS | 114 | 10 | 9 |

**Table 2-1. FA POSNAV Operational Requirements**

## 2.3 POSNAV SYSTEM PERFORMANCE PARAMETERS

The accuracy of an estimated or measured position of a vehicle at a given time is the degree of statistical measure of conformity of that measurement with the vehicle's true position. Since accuracy is a statistical measure of performance, a statement of the accuracy of a navigation system must include a statement concerning the probability level of the estimate of measurement. The POSNAV accuracy requirements listed in Table 2-1 are expressed in circular error probable (CEP) and probable error (PE). These are expressions of a 50% probability. To convert CEP to either 2 drms (2 times distance root mean square) or 95% probability, use 2.5 as an average multiplier. This multiplier has been adopted by both the CJCS and the Federal Radio navigation Plan.

## 2.4 OPERATIONAL SURVIVABILITY REQUIREMENTS

POSNAV systems must be as survivable and enduring as the forces and weapon systems they are designed to support. Terrestrial-based systems must employ physical security measures that

reduce vulnerability to sabotage or terrorist attack. Physical security measures must be adequate to prevent destruction or impairment of the user segment of GPS systems.

# Chapter 3. Fielded Systems

## 3.1 GENERAL

This chapter provides basic reference material on the various FA POSNAV systems that have been or are being fielded. While the individual systems and equipments represented the state of the art at the time of their introduction, the current FA POSNAV system architecture consists of a number of systems and equipment that are aging and becoming increasingly expensive to maintain and operate. Several of the systems suffer from limitations in availability and capability.

The systems listed in paragraph 3.2 represent a significant capability. Despite the technological advances embodied in most of these POSNAV systems, military forces will always have a basic and fundamental requirement for the ability to read and use maps. The Fielded Systems discussed in this chapter and the Objective Systems presented in the next chapter will not supplant the need for military maps. Rather, POSNAV systems are directed at augmenting the basic map reading capability required for mission success. Refer to Annex A for the current FA systems distribution and quantities.

## 3.2 FIELDED FA POSNAV SYSTEMS

### 3.2.1 COMPASS (M2 and Lensatic)

a. Application/Description - Provides the user with magnetic azimuth to point within the user's field of view for land navigation and can serve to validate the azimuths of determined by other means. Currently issued throughout the FA as a navigation aid.

b. Accuracy - +/- 3 degrees

c. Lifecycle – in production, phase out unknown.

### 3.2.2 M2A2 AIMING CIRCLE

a. Application/Description – Provides weapon orientation, hasty survey, aircraft compass checks, and used as backup or second independent verification of GLPS azimuth. Currently issued to FA firing batteries, radar teams, survey sections, and mortar platoons.

b. Accuracy – Elevation: 1 mil, Horizontal: 0.5 mil, Magnetic compass for north orientation: 6 mil if declinated.

c. Lifecycle – production complete, phase out unknown.

### 3.2.3 SURVEY NORTH SEEKING GYROSCOPE (SNSG)

a. Application/Description – Man portable, north seeking gyroscope capable of determining grid north. Used by survey sections to conduct survey operations. Currently issued to survey sections.

b. Accuracy – 0.15 mil/cosine latitude

c. Lifecycle – in production

3.2.4 MODULAR AZIMUTH POSITIONING SYSTEM (MAPS)& HYBRID (MAPS/H)

a. Application/Description - Provides the FA the continuous capability to determine accurate position and direction for wheeled and armored vehicles without extensive battlefield survey. The MAPS/H integrates GPS aiding to eliminate the need for Zero velocity Updating (ZUPT) every 27 km. Currently being fielded to M109A6 howitzers and Q36/Q37/Q47 radars.

b. Accuracy - Horizontal: 10 meters CEP < 4 km; .25% distance traveled (DT) for distance > 4 km, Altitude: 6.7 meters PE < 4 km; .067% DT PE for distance > 4 km

c. Drift Rate - unknown

d. Initialization time - 4 minutes

d. Lifecycle - in production

3.2.5 POSITION AND AZIMUTH DETERMING SYSTEM (PADS)

a. Application/Description - A self-contained inertial navigation system used to provide FA survey data critical to weapon systems and target acquisition platforms. Currently fielded to FA survey sections. Due to be replaced with the IPADS starting in FY 03 / 04.

b. Accuracy – With a 5 minute ZVEL : horizontal- 4 meters CEP, vertical- 2 meters PE, azimuth- 0.4 mils PE, With a 10 minute ZVEL: horizontal- 7 meters CEP, vertical- 3 meters PE, azimuth- 0.4 mils PE

c. Drift Rate - Not Determined due to mission accuracy requirements

d. Initialization time - 30 minutes

e. Lifecycle - production complete, FUE 1981.

3.2.6 IMPROVED STABILIZATION REFERENCE PACKAGE (ISRP)

a. Application/Description - Provides north seeking and pointing functions as well as full 3-dimensional land navigation and location capability for the M270 MLRS and Army TACMS.

b. Accuracy - Horizontal: .4% DT or 10 meters CEP, Altitude: .4% DT or 10 meters CEP, Azimuth: .67 mil PE, Elevation: .34 mil PE, Roll: .7 mil

Drift Rate - 4 mils/hour

Initialization Time - 7.5 minutes

c. Lifecycle - in production, fielded

### 3.2.7 PRECISION LIGHTWEIGHT GPS RECEIVER (PLGR)

a. Application/Description - A handheld, lightweight GPS receiver that provides 3-dimensional position and orienting functions for land navigation. Currently issued throughout the FA as navigation aid and integrated as the GPS receiver for INS systems (i.e., MAPS/H).

b. Accuracy - Horizontal: With a Figure of Merit (FOM) 1 provides 10 meters CEP , Vertical: 7 meters linear error probable (LEP) (with crypto keys loaded)

c. Drift Rate - NA

d. Initialization Time - 1-5 minutes

e. Lifecycle - in production, fielded

### 3.2.8 GUN LAYING AND POSITIONING SYSTEM (GLPS)

a. Application/Description - Man-portable, north-seeking gyroscope with integrated GPS (PLGR) capable of determining position, azimuth, and deflection to provide quick gun laying data to towed and non-Paladin howitzers. Current BOIP is one per firing battery or platoon.

b. Accuracy - Position: same as PLGR, Azimuth: .4 mil PE

c. Drift Rate - NA

d Initialization Time - 3.5 minutes

e. Lifecycle – in production, fielded

### 3.2.9 GPS GUIDANCE PACKAGE (GGP)

a. Application/Description - A compact, lightweight, cost effective, GPS-aided inertial navigation system capable of determining quick, accurate 3-dimensional navigation data and azimuth. A POSNAV system for the BFIST, Striker, and ATACMS

b. Accuracy - Position: 16 meters spherical error probable (SEP), Azimuth: 1.0 mils PE

c. Drift Rate - unknown

d. Initialization Time – N/A

e. Lifecycle – Funded.

### 3.2.10 POSITIONING AND NAVIGATION UNIT (PNU)

a. Application/Description - A Line Replaceable Unit (LRU) in the M270A1/HIMARS launchers that replaces the current M270 ISRP/PDS system. The PNU provides launcher position and navigation data via a self-contained strap-down inertial platform system, an embedded GPS receiver module, and associated GPS antenna.

b. Accuracy – Position 10 meters CEP, Altitude 10 meters PE, Azimuth: .25 mils PE, Elevation: .17 mils PE, Roll: .17 mils PE.

c. Drift Rate - .05 mils/hour.

d. Inititialization Time -

d. Lifecycle – Funded

3.2.11 BFIST/STRIKER EQUIPMENT MISSION PACKAGE (EMP)

a. Application/Description – The BFIST/STRIKER EMP provides the BFIST and STRIKER vehicles with 3D position location and azimuth, using an Inertial Navigation System (INS), PLGR/DAGR, and a Vehicle Measuring System (VMS).

b. Accuracy –

c. Drift Rate - Not yet established

d. Inititialization Time - 15 minutes.

c. Lifecycle - Funded and in production.

# Chapter 4. Objective Systems (Near Term).

## 4.1 GENERAL

No single system is currently capable of meeting future FA position and navigation requirements. In addition to INS with GPS integration, the FA's POSNAV objective system architecture must also include a smaller number of specialized POSNAV systems capable of fulfilling specific mission requirements.

Many FA mission applications require continuous position and/or navigation information under a variety of stringent operating conditions. A single, stand-alone POSNAV system cannot always fulfill these stringent requirements. The objective FA POSNAV architecture envisions extensive employment of hybrid POSNAV systems, which will combine the outputs of two or more POSNAV systems to fulfill primary and redundant capabilities to meet any operating requirement. Hybrid systems exploit the complementary features of each of the component systems to produce an integrated system which provides synergistic improvements in POSNAV performance. For example, a system having high accuracy and a low fix rate might be combined with a system with a lower accuracy and higher fix rate. The combined - hybrid - system would demonstrate capabilities of a system with both high accuracy and a high fix rate.

Government and industry are sponsoring research and development into potentially promising technologies. Significant improvements have already been made to positioning and navigation systems and equipment. Promising technologies will continually be evaluated for application in FA POSNAV.

## 4.2. OBJECTIVE FA POSNAV SYSTEMS

The discussion below lists current and future technology for system integration. Those systems which are designated for possible integration onto major weapon systems will be discussed. Refer to Annex B for the distribution plan and projected quantities of these systems.

### 4.2.1 IMPROVED POSITIONING AND AZIMUTH DETERMINING SYSTEM (IPADS)

a. Application/Description - The next generation of PADS that will offer a significant improvement in maintenance reliability.

b. Accuracy – With a 5 minute ZVEL: Horizontal 4 meters CEP, vertical 2 meters, and azimuth of .4 mils PE. With a 10 minute ZVEL: Horizontal 7 meters CEP, Vertical 3 meters, and azimuth of .4 mils PE.

c. Drift Rate: TBD

d. Initialization Time: 10 minutes (between 65° N latitude and 65° S latitude) with a Hot start re-initialization ability of 5 minutes.

c. Lifecycle – Funded starting in FY04.

4.2.2 GPS TACTICAL RECEIVER (GTR)

a. Application/Description - The next generation of GPS receivers will provide 3-dimensional navigation information to users throughout the FA and serve as the GPS receiver for other POSNAV systems. The GTR will come in a variety of types, ranging from the stand-alone model, to replace the PLGR, to Line Replaceable Units for precision munitions and high performance aircraft.

b. Accuracy: Horizontal: 10.5 meters with 95% probability, , Vertical: 8.7 meters with 95% probability, Directional accuracy of 1.16 mils, and a time accuracy of 200 nanoseconds..

c. Drift Rate: Not yet established.

d. Initialization Time: Not yet established.

e. Lifecycle – Unfunded

4.2.3 Tactical Advanced Land Inertial Navigator (TALIN)

a. Application and Description. TALIN is a stand-alone, 3D inertial navigation system intended for use on the Crusader self-propelled howitzer. The system can provide position coordinates, waypoint navigation information, azimuth, and pitch and roll data.

b. Accuracy: Horizontal – 12-60 meters CEP (Depending on model); Vertical – 7 meters-30 meters PE (depending on model); Azimuth – 0.7 mils – 20 mils (depending on model)

c. Drift Rate: 0.15 mils to 1 mil per hour

d. Initialization Time: 6-10 minutes (depending on model).

e. Lifecycle:

4.2.4 IMPROVED MISSILE GUIDANCE SYSTEM (IMGS)

a. Application/Description – An inertial navigation system with an Embedded GPS Receiver (EGR) for more accurate in-flight guidance corrections and improved accuracy. The IMGS contains the inertial sensor assemble, an electronics assembly, and the EGR that improves missile accuracy over extended ranges. The IMGS performs all the inertial navigation, guidance mission control, and built-in-test functions. The IMGS is also the central communications control point within the missile.

b. Accuracy: The ATACMS Block IA Missile using the IMGS will autonomously (no missile in-flight update allowed) deliver the warhead to a total system delivery accuracy not to exceed 150 meters CEP from minimum range to 107 km. The delivery accuracy will not exceed 1.4 mils at ranges greater than 107 km. With in-flight updates, CEP will

c. Drift Rate: Not yet established.

d. Initialization Time: Not yet established

e. Lifecycle: In development.

4.2.5 TOWED ARTILLERY DIGITALIZATION (TAD)

a. Application/Description – a GPS aided and VMS aided inertial navigation, position location, and howitzer orientation Fire Control System. A preplanned product improvement for the joint USMC/Army XM 777 Lightweight Howitzer Program. TAD is the objective digital fire control system designed to provide the towed howitzers with PALADIN-like self-locating and orientation abilities.

b. Position Accuracy: Horizontal: < 10meters CEP, Vertical: <10 meters PE, Orientation: 1 mil Standard Deviation (SD) and not less than .5 mil SD for Elevation.

c. Drift Rate: Not yet established.

d. Initialization time: Not yet established.

e. Lifecycle: funded, FUE FY 06.

4.3 OBJECTIVE FA POSNAV SYSTEMS (FAR TERM)

Industry continues to developed technologies for precise geo-positioning and navigation using GPS and inertial navigation systems. Next generation GPS will incorporate the Selective Availability Anti-Spoofing Module (SAASM) and addition of a third GPS channel that will be available to military users only will provide great improvements in accuracies. The earth will be referenced to only a handful of datums, making common grid much easier to maintain.

Similar improvements to reduce equipment size and weight, component and end item reliability, and overall system performance are expected in the future. The FA must exploit the success of the achieved miniaturization while avoiding proliferation of POSNAV systems. The FA POSNAV system of the future must contain the following features:

- Lightweight (<10 lbs.)
- Small size (<200 cubic inches)
- Low cost (<25K per unit)
- Low power consumption (<30 watts @ 28 volts DC)
- Provide position data via inertial navigation/GPS interface
- Provide azimuth accuracies <.5 mils
- Have sufficient computer RAM to allow FA-wide integration

- Be “in-the-field” reprogram able

- Provide high reliability (MTBF>10,000 hours)
- Be transparent to the user.
- Provide accurate time checks (10 nanoseconds or less)

All future FA POSNAV systems must easily adapt to cannon, radar, or any other FA application. Inertial/GPS interface systems must allow the user to continue the mission despite a GPS outage of any kind (masking, spoofing, etc) with minimal effects. “In-the-field” reprogramming would allow battalion level maintenance to interchange systems between different units. For example, if a divisional MLRS battalion has used all of their Operational Readiness Floats (ORF) and needs another system, battalion maintenance would have the capability to borrow a system from the TAB, reprogram it, and use it on their launchers.

# Chapter 5. Operational and Organizational Concept and Plans

## 5.1 GENERAL

This chapter of the FA POSNAV Master Plan explains the FA’s current Operational and Organizational Concepts concerning the employment of FA POSNAV systems and devices within Army organizations. This chapter also explains FA concepts and plans to fulfill FA POSNAV battlefield and training missions requirements.

## 5.2 OPERATIONAL CONCEPTS

FA operational combat and support forces need:

o The capability to determine accurate, timely, all-weather position and navigation information at any time, anywhere in the world.

o Systems that operate reliably and accurately in an electronic-threat environment.

o Systems to integrate POSNAV data and information accurately among and between positional and navigational users who must report, exchange, or share both common and uncommon location, grid, or position data.

o Resources to satisfy FA Command, Control, Communications, and Intelligence (C3I) and training POSNAV requirements.

o Systems to exchange timely data and information in joint operations.

o Systems that are not solely GPS reliant.

## 5.3 ORGANIZATIONAL CONCEPTS

FA operational force organizations must:

- o Quickly navigate to accomplish tactical operational missions anywhere in the world, in any weather, at any time.

- o Quickly and accurately position weapons, weapon delivery systems, direction-finding systems, and operational forces employing common grid and common survey.

Army Reserve and National Guard Forces with contingency operational and support missions must also:

- o Be equipped with current and modernized POSNAV systems at a rate commensurate to the equipage of active Army forces.

- o Know how each respective organization's POSNAV systems relate to the command, control, and communications systems within which these organizations may be tasked to operate.

## 5.4 DEFICIENCIES

Current POSNAV systems lack responsiveness and redundancy / backup capability.

The PADS has been the means of providing primary and backup survey support to the FA since 1981. Due to its age, the PADS is becoming increasingly unreliable and high maintenance costs are an unsustainable burden on artillery units. This leaves units with Hasty Survey techniques for backup capability. The most common hasty survey technique for computation of an azimuth is the Simultaneous Observation. While a Simultaneous Observation can provide a battalion with a common azimuth, it cannot provide a common or relative surveyed position, required for massing fires. Although very timely, the Simultaneous Observation is only as accurate as the least accurate instrument used (normally an M2A2 Aiming Circle), which provides an azimuth accuracy of ±2 mils and depends on clear weather for observations of the sun or stars.

The PLGR is a handheld GPS receiver used as a navigational aid and as the GPS interface for current self-location systems. Because it provides a 10 meter CEP at the 50% confidence rate, the PLGR should be considered a hasty survey technique and will not be on common survey with other units. The PLGR has been authorized for determination of a horizontal position but cannot be utilized to determine an azimuth for orientation of FA systems. The PLGR must be loaded with crypto keys and observe 5 or more satellites without obstructions or multi-path interference to be used for positional data. A PLGR derived horizontal position must be updated or validated by other survey means to ensure the principles of common grid and common survey are maintained.

## 5.5 OPERATIONAL CONCEPT PLAN

The FA's goal is to update, replace, or acquire POSNAV systems to produce a reduced, modernized POSNAV systems mix that is effective in satisfying the FA's rapid forward deployment contingencies and operational requirements. Existing or in-production POSNAV systems that unnecessarily duplicate or do not meet operational navigation, location, survey, or targeting

requirements will be phased out of the Army inventory. Some current POSNAV systems are under evaluation to determine their suitability to meet current and future FA POSNAV requirements.

The Field Artillery's modernization of POSNAV capabilities within fiscal constraints must conform to planning and force structuring objectives conditioned by the Objective Force operational and tactical battlefield concepts. These concepts provide direction to Army planners and operators who must prepare forces to conduct multiple-threat warfare in mid- and low-intensity conflicts and special operations. FA POSNAV modernization must provide for FA capabilities to participate in joint and combined operations within the context of both strategic and tactical war fighting doctrine.

Heavy and light FA forces that can be deployed at different levels of combat in separate theaters as part of joint and combined operations require that current and future POSNAV systems are interoperable with those of other joint or combined forces.

In contrast, increased threats of regional conflict may be spawned by states supporting terrorism, drug trafficking, or hostile economic or political regimes. These threats may escalate into low intensity conflict levels described in Objective Force Battle Doctrine. FA forces deployed to confront the conflict must have light, accurate POSNAV systems available upon deployment.

In terms of POSNAV operations, the threat and operational scenarios found in current Army doctrine calls for more independent, standalone, tactical POSNAV systems that are highly flexible, multipurpose, deployable, and reliable. Such systems must be introduced into FA training and operations to modernize FA POSNAV capabilities in conformance with the Army's Objective Force concepts within the next decade.

Stand-alone POSNAV systems that possess multiple capabilities with respect to location, navigation, and timing will contribute to more independent force operations in those contingencies where single force organizations are employed. However, POSNAV provisioning must also include capabilities to communicate and exchange position location and movement information under the Army's Tactical Command and Control System (ATCCS), whether single or multiple forces are employed under a given contingency. The ATCCS recognizes five Battlefield Functional Areas (BFA): Maneuver Control, Fire Support Control, Air Defense Control, Intelligence and Electronic Warfare Control, and Combat Service Support Control. To conduct successful operations within the BFA's, either independent tactical forces or combined/joint forces communicate and exchange standardized position and navigation information. POSNAV systems that operate within BFA's during tactical deployments selectively must be able to use and exchange Universal Transverse Mercator (UTM), Universal Polar Stereographic (UPS), Latitude/Longitude, and/or Military Grid Reference System (MGRS) grid coordinates to obtain force multiplier effects in combat. Future systems will provide the capability to operate with one grid reference system in joint and/or combined operations.

Since fielding of GPS-aided inertial navigation systems, a reduction of survey personnel and equipment assets has occurred in the FA. This reduction will redefine the roles of survey personnel on the modern battlefield. By utilizing the GPS/INS self-location capability of the GLPS, MAPS/H, and PNU into the non-Paladin howitzer, M109A6, and MLRS units respectively, the Field Artillery has the capability to maintain pace with the maneuver elements it supports. The need for the PADS/IPADS becomes a priority in the event that GPS becomes unavailable. If GPS signals become unavailable, any system utilizing GPS/INS integration will require an update or survey control point to continue operating. In this role the PADS/IPADS team can dot the battlefield with update points for howitzers and launchers, establish survey control points for other systems (i.e. GLPS if GPS is unavailable), establish alternate firing positions, and/or provide data to an attached asset (i.e. radar). For example, the MAPS in the Q36 radar requires an update point every 27 km.

Further elimination of FA surveyors (MOS 82C) or equipment is not conducive to FA battlefield

success as a survey subject matter expert will continue to be needed to provide common grid components.

Table 5.1 explains the current personnel and equipment distribution and Table 5.2 explains the projected reductions that will result as FA GPS-aided platforms are fielded.

EDITOR'S NOTE: THE TABLES HAVE NOT BEEN MODIFIED AND CAN BE FOUND ON THE ORIGINAL (DCD) VERSION OF DOCUMENT