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LOGISTICS SUPPORT REQUIREMENTS: A CASE ANALYSIS OF THE TACTICAL QUIET GENERATOR

by

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March 2000

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Recent trends in technological advances have resulted in the commercial sector leading the military sector in many areas of technological development. As a result, there are many readily available components and end items that can be designed, integrated and assembled into military hardware that will satisfy the stringent requirements of the tactical battlefield. Use of commercial or non-developmental items compresses the overall acquisition time, but currently reduces time available for logistics planning and preparation. The result is new systems being fielded without the necessary support structure in place. Proper use of warranties, Contractor Logistics Support, and Prime Vendor support might improve equipment readiness and ensure the gap is bridged between a newly fielded system and a mature supply support system for optimum benefit to the Department of Defense (DoD) and the taxpayer. Good logistics support planning in the early phases of the acquisition process will reduce the life cycle costs and increase operational availability. Applying these approaches to the Tactical Quiet Generator (TQG) would seem to provide significant benefit and offer other acquisition and logistics professionals valuable insights into the planning of future support arrangements.

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LOGISTICS SUPPORT REQUIREMENTS: A CASE ANALYSIS OF THE TACTICAL QUIET GENERATOR

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ABSTRACT

Recent trends in technological advances have resulted in the commercial sector leading the military sector in many areas of technological development. As a result, there are many readily available components and end items that can be designed, integrated and assembled into military hardware that will satisfy the stringent requirements of the tactical battlefield. Use of commercial or non-developmental items compresses the overall acquisition time, but currently reduces time available for logistics planning and preparation. The result is new systems being fielded without the necessary support structure in place. Proper use of warranties, Contractor Logistics Support, and Prime Vendor support might improve equipment readiness and ensure the gap is bridged between a newly fielded system and a mature supply support system for optimum benefit to the Department of Defense (DoD) and the taxpayer. Good logistics support planning in the early phases of the acquisition process will reduce the life cycle costs and increase operational availability. Applying these approaches to the Tactical Quiet Generator (TQG) would seem to provide significant benefit and offer other acquisition and logistics professionals valuable insights into the planning of future support arrangements.

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A. PURPOSE

The purpose of this research is to examine the provisioning, procurement, production, maintenance concept, and distribution of spare parts required for sustaining maintenance and support of a new system or piece of equipment throughout its life cycle. A case study of the Tactical Quiet Generator (TQG) is used to illustrate the issues that affect logistics support of a newly fielded piece of equipment. It then analyzes the research data, to recommend factors that should be considered when making spare part support determinations to ensure the gap is bridged between a newly fielded system and a mature supply support system. Finally, it recommends areas for change in current policy and procedures for optimum benefit to the Department of Defense (DoD), the Government, and the taxpayer.

B. BACKGROUND

As the Tactical Quiet Generator is being utilized, there is an ongoing maintenance and support capability that needs to be installed and in-place to ensure that the system continues to be available when required. The Army fielded this system using the Total Package Fielding (TPF) concept. The initial spare parts package was supposed to maintain the system until the supply system matured to support the equipment. Additionally, the system was covered by a limited warranty during initial fielding. This warranty was designed to ensure the Government received a quality product. Problems developed when the initial push package of parts were consumed and material procurement lead times forced delays in repairing equipment. Further problems developed when parts needed were not part of the initial fielding package and were not available through the supply system. This situation was further aggravated when units were faced with a long-term deployment to Kuwait and the supply system was not ready to support the Tactical Quiet Generator.

C. RESEARCH QUESTIONS

1. Primary Research Question:

Based on lessons learned from the Tactical Quiet Generator, what are the critical aspects of a logistics support plan in order to bridge the gap between initial fielding and a mature system?

2. Secondary Research Questions:

a. How did the Project Manager of Mobile Electric and Power determine the provisioning, procurement and production of spare parts required for sustaining maintenance and support of a new system?

b. What is the current policy towards determining the requirements for spare parts to support a new system?

c. How can the initial push package of parts for a new system be improved?

d. How is DLA equipped to meet surge requirements for newly fielded equipment (i.e. major deployments)?

e. What interim support capability should be maintained to cover material procurement lead times?

f. What can we do if total maintenance and support requirements exceed initial expectations?

g. What are the current policies and procedures for life cycle support after initial fielding?

h. How does the current policy affect life cycle support after initial fielding?

i. How do the current procedures affect units that receive new equipment?

j. What are item managers' incentives and what are they rated on?

D. SCOPE OF THE THESIS

The researcher has analyzed the provisioning, procurement, production, and distribution of spare parts required for sustaining maintenance and support of a new system from a logistics officer's perspective, using the Tactical Quiet Generator as a case study. The research includes a literature review of various ways to support equipment throughout its life cycle. This thesis will result in recommendations to affect future policy and procedure changes.

E. METHODOLOGY

The first objective of this research paper is to provide an overview of the fielding of the Tactical Quiet Generator through the Program Management Office (Mobile Electric and Power-PM) as well as current means of logistical support. This will be accomplished through a literature review of sources including, but not limited to, the following:

- Unclassified Department of Defense publications;
- Published academic research papers;
- References, publications, and electronic media available at the Naval Postgraduate School library;
- General Accounting Office reports and testimony before Congress;
- Internet websites and homepages (DoD, commercial, and academic).

The next objective is to study equipment readiness data on the Tactical Quiet Generator as provided by the Logistics Support Activity (LOGSA) and the issues involved in collecting this data. This will be followed by an analysis of the initial fielding package of repair parts and the current fielding package. Both packages will be compared to current demand history to see their utilization. This will be followed by a study of the Defense Logistics Agency's procedure for stocking repair parts for newly fielded items. Finally, personal interviews will be conducted of selected military officers and Government civilian officials in selected DoD Service component and agencies, as well as key defense industry officials to get opinions and recommendations on changes to policy and procedure. Lessons learned will be extracted from the case analysis of the TQG.

F. ORGANIZATION OF STUDY

- Chapter I. Introduction The introduction identifies the focus and purpose of the thesis and states the primary and subsidiary research questions.
- Chapter II. Tactical Quiet Generator This section provides an overview of the acquisition and background history of the Tactical Quiet Generator.
- Chapter III. Operations and Maintenance of New Equipment This segment presents an analysis of the readiness rates of a few selected models of generators. Next, maintenance issues and trends are studied. Finally, the initial fielding package of repair parts and the current fielding package are studied. Both packages will be compared to current demand history from Ft. Campbell and the Defense Logistics Agency to look at usage rates.
- Chapter IV Analysis of Alternative Means of Support This section will analyze the pros and cons of warranties, Contractor Logistics Support, and Prime Vendor as a means of support for life cycle support.
- Chapter V. Summary, Recommendations, and Conclusions Summarizes the findings of the research, and answers the research questions.

G. BENEFITS OF STUDY

This study will provide some answers as to how to bridge the gap in life cycle support between initial fielding of a system and supply system maturity thereby avoiding a breakdown in support, and providing a methodology to handle deployment surges.

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II. THE TACTICAL QUIET GENERATOR

A. INTRODUCTION

Electricity is something we all take for granted nowadays, but it is something that is essential to every aspect of our lives. Little did Benjamin Franklin and other famous scientists realize how much the modern world would depend on their discoveries. The widespread use of electricity as a source of power is largely due to the work of such pioneering American engineers and inventors as Thomas Alva Edison, Nikola Tesla, and Charles Proteus Steinmetz. Thomas Edison, whose development of a practical electric light bulb, electric generating system, and other inventions had profound effects on the shaping of modern society. [Ref. 1] Beyond the simple need for lighting, the tremendous technological advances in modern warfare since World War II that have led to the ever increasing need for electricity by the military to power all the latest equipment. These advances in technology have allowed battlefield commanders ever-greater situational awareness and command and control. Unfortunately, these modern marvels have caused a dependency on electricity, without which, the modern commander could be rendered helpless and blind. As we move into the 21st Century, the requirements for electric power are growing exponentially. [Ref. 2]

The Army's current answer to our electricity dependency is the latest generation of military generators-- the Tactical Quiet Generators (TQG). They were developed in response to the changing military threats, new strategies, and fiscal constraints, which dictated improved battlefield survivability, enhanced deployment/maintainability, and reduced operating and support costs. This case study of the Mobile Electric Power's

TQG fleet includes a short history in the development of the Project Manager's (PM-MEP) office, military generators, and the requirements that today's military has for generators. Next, the PM-MEP's acquisition strategy and problems will be presented. Finally, the case study will investigate the production, fielding, and operational support of the 5-60kW TQGs.

B. BACKGROUND OF MOBILE ELECTRIC AND POWER

In Korea, the Army's Mobile Army Surgical Hospital (MASH) units relied heavily on the use of diesel generators to provide the needed electricity to save countless lives. During Vietnam, the same need for electric power was present. The increasing complexity of command and control structures far outpaced any Department of Defense (DoD) development of a standard family of electrical generators. To supply their increasing demand for electrical power, the U.S. Forces relied on a veritable potpourri of over 2000 different makes and models of electrical generators. [Ref. 3] Standardization and interoperability, even within each branch of Service, was virtually non-existent. In 1967 DoD created a Multi-Service Working Group to identify possible solutions to the electrical power generator situation. The Working Group's study recommended that DoD standardize generator use throughout all Services.

As a result, DoD promulgated DoD Directive 4120.11 (Standardization of Mobile Electric Power Generating Sources) and created the office of the Project Manager Mobile Electric Power (PM-MEP) to provide single project manager leadership to the DoD for the acquisition of Mobile Electric Power Generating sources (MEPGS) and enforcement of DODD 4120.11. The U.S. Army, being the largest user of MEPGS, became responsible for program management, to include support of other Services.

PM-MEP's mission statement is as follows:

> Provide a modernized standard family of mobile electric power generators for all Services throughout the Department of Defense. Accomplish this mission through a coordinated inter-service effort to develop, acquire and support Mobile Electric Power generators from small, 0.5kW manportable generators to large, 920kW prime power generating systems. [Ref. 4]

The PM-MEP's first order of business was to standardize the existing fleet of generators and gain some control over the logistics required to maintain this fleet. The PM did this by identifying 69 different makes and models, both diesel and gasoline, that constituted the "core" of DoD's Standard Family of Generators.

The development of a true Standard Family of Generators, now known as Military Standard (MIL STD) began in the late 1960's. These generators were designed and developed by the Government and during the early 1980s, further reduced the number of makes and models in the core family to 37. These generators ranged from 0.5kW to 750kW, both diesel and gasoline, and served all branches throughout the 1970s, 1980s and early 1990s. As these generators began to fail due to age, the PM-MEP began its current tasking of providing a second generation of the DoD family of MEPGS.

The push toward "jointness" among the Armed Services was an essential factor in the design of this family of generators, as was the need for equipment that was more reliable, maintainable, cheaper, and more mobile than the previous generation of equipment. DoD also mandated the use of single fuel types (diesel/JP) in all ground equipment, necessitating the standardization of fuel among the next generation of generators.

C. REQUIREMENTS FOR NEW FAMILY OF GENERATORS

PM-MEP defined, via MIL-STD 1332B, the criteria used in classification of engine generator sets, which make up the DoD Standard Family. The Family is broken down into two general types and two classes. Type 1 (Tactical) are tactical generators designed for high mobility in direct support of military forces where output of the generator is normally used at generated voltage without further transformation or distribution. Type 2 (Prime) are generators designed for long term use in semi-fixed locations for extended periods of time, with size, weight and mobility considered secondary to long life and reliability. Type 2 output is generally high voltage and requires transformation and power distribution systems.

Class 1 (Precise) is generators designed to provide close control of voltage and frequency performance for critical applications. Class 2 (Utility) is generators designed to provide power for general-purpose applications. This class is further subdivided into Utility A, B, and C, ranging from compatible with commercial distribution systems (Class 2A) to that required for utilitarian purposes where requirements for voltage and frequency control are minimal. [Ref. 5]

The second generation of MEPGS that PM-MEP was to undertake was a family of Tactical Quiet Generators (TQG) from 3-60kW, which would have performance far superior to any previous MIL STD generator of these sizes. These TQGs were to surpass their predecessors with greater mobility, better reliability and maintainability, enhanced survivability against a High Altitude Electromagnetic Pulse (HAEMP), reduced infrared and acoustic signatures, lower acquisition cost, and lower operation and support (O&S) costs.

Certain performance parameters were uniquely challenging to PM-MEP due to the political atmosphere surrounding DoD programs. With the advent of DoD 5000.2-R, and acquisition reform, as well as the movement away from military specifications, PM-MEP was forced into an acquisition strategy essentially dictating the use of commercial products with an Operational Requirement Document (ORD) that called for HAEMP survivability, an aural signature of less than 400 meters, infrared detection minimization for increased survivability, reduced fuel consumption, and lighter weight.

There are three other features that make military generators unique. First, based on DoD's single fuel policy, all generators must be Diesel or JP fueled. Second, a 24-volt system is required for compatibility with the military's vehicle fleet to provide the capability to start vehicles. Third, unlike most commercial generators, these generators must be able to operate in extreme environments, ranging from temperatures from -25°F to 125°F, with storage in temperatures ranging from -60°F to 160°F. Appendix A shows each type of generator from 5kW to 60kW and information about each model.

D. ACQUISITION STRATEGY

From the outset, PM-MEP tried to provide DoD with the "best value" generators it needed at minimal cost, and they did this by attempting to use commercial items for military applications.

> "A commercial item is:
>
> 1. any item, customarily used for nongovernmental purposes, that has been sold, leased, or licensed to the general public or that has been offered for sale, lease, or license to the general public.
>
> 2. an item that evolved from a commercial item described in paragraph 1 above.
>
> 3. an item that meets the description in paragraph 1 above, but with minor modifications to meet DoD needs or modifications of type normally done for commercial customers.
>
> 4. any combination of items meeting this definition of commercial item, if it is normally combined and sold commercially.
>
> 5. a service bought to support commercial items.
>
> 6. a service of a type offered and sold competitively in the commercial market at catalog or market prices.
>
> 7. any item or service described in 1 through 6 above, even though it is transferred between separate divisions of a contractor.
>
> 8. an item developed at private expense and sold in substantial quantities, on a competitive basis, to state and local governments." [Ref. 6]

When commercial products are not available or appropriate, the military tries to use non-developmental items (NDI). Below is the definition of NDI.

> "A non-developmental item is: (1) any previously developed item of supply used exclusively for governmental purposes by a Federal Agency, a State or local government, or a foreign government with which the United States has a mutual defense cooperation agreement; (2) any item described in (1) that requires only minor modification or modifications of the type customarily available in the commercial marketplace in order to meet the requirements of the procuring department or agency; or (3) any item described in (1) [previously developed item for a Federal Agency, a State or local government, or a foreign government] or (2) [a modified item] solely because the item is not yet in use." [Ref. 7]

Sometimes a commercial or non-developmental end item may not meet the military's requirement. In such circumstances, integration of commercially available components within the military design may be a good option to achieve the end result, which is meeting the user's requirement. In this case the integration of commercially available parts are used in creating an item that meets the government's specifications. From this point forward this will be defined as Technology Integration. The PM-MEP describes the use of Technical Integration in his Master Plan as:

> "There are many readily available components that, when properly designed/integrated and assembled into a new set, will satisfy stringent physical and performance requirements of the tactical battlefield. This approach relies on the use of either currently available commercial technologies or integration of new technologies, as they become mature and accepted in the commercial market place." [Ref. 2]

The PM-MEP has not had tremendous success along these lines and has suffered several setbacks due in part to the requirements established for the TQG family and the push to save research and development (R&D) money via the use of commercially available equipment. Appendix B outlines the Federal Acquisition Regulation's definition of a Commercial Item and Non Developmental Item. The decision process a

Project Manger must go through before embarking on a developmental acquisition strategy follows the definition.

The PM-MEP conducted numerous market surveys and investigations to determine if commercially available technology could meet their stringent requirements. Every survey and investigation concluded the same: commercial machines lack the necessary robustness, features, characteristics, and performance required in military generators. Yet, early on, they attempted to develop a generator from commercially available parts.

In 1988 and 1989, the PM-MEP developed and released purchase descriptions for a new family of generators, the TQGs. Libby Corporation won the contract to develop the 5-60 kW generators. It only took Libby nine months to design the 5-60kW system using NDI and Technology Integration. [Ref. 8]

Fermont Corporation won the contract for a new 3kW TQG. Unfortunately, due to strict user performance requirements and an overly optimistic assessment of available technology by the PM-MEP, a generator set that matched DoD's specifications was never manufactured. In March 1992, a draft solicitation was issued for a two-step R&D program aimed at designing a 3kW generator that was capable of meeting the Government's needs. However, funding was never made available and the solicitation was cancelled. [Ref. 9] Ultimately the 1989 3kW generator contract was terminated in March 1995 for convenience of the Government due to the technical difficulties discovered.

While PM-MEP has had difficulties throughout its existence, they continue to rebound from failures, develop new strategies, and incorporate Acquisition Reform (AR) in nearly all aspects of business. PM-MEP's self-proclaimed approach to AR is based on several tenets:

> A common sense approach (don't do dumb things in the name of AR);
> Challenging previous paradigms (but don't "throw the baby out with the bath water");
> Measured, continuous improvement (do what we can, but don't let the process impede progress);
> Tailoring AR to our unique industrial base sector (recognize its unique problems/challenges);
> Balancing AR with our DoD Standardization objectives;
> AND always remember that the customer's needs remain pre-eminent. [Ref. 10]

The PM-MEP continues to focus on what they call the "BIG ELEVEN" principles of AR: Empowerment, Teamwork (Integrated Concept Teams/Integrated Production Teams/Partnerships)(ICTs/IPTs), Performance Objectives and Thresholds, Acquisition Tailoring, Cost as an Independent Variable (CAIV), Preference for Commercial Products/Components, "Best Practices," Minimizing Government Specifications and Standards, Hierarchy of Materiel Alternatives, Best Value Awards, and Value Added Test and Evaluation. ICTs were used in the redesign of the 3 kW TQG ORD, essentially using a minimum of mandatory thresholds coupled with desired objective requirements to give the industry the flexibility it needs in the development of a generator set that meets DoD's needs and permits "Best Value" assessment of offers. Mil Specs on the 3kW TQG were reduced from 199 to 80. Roughly, 85-95% of the components in most of the military generator sets are commercial.

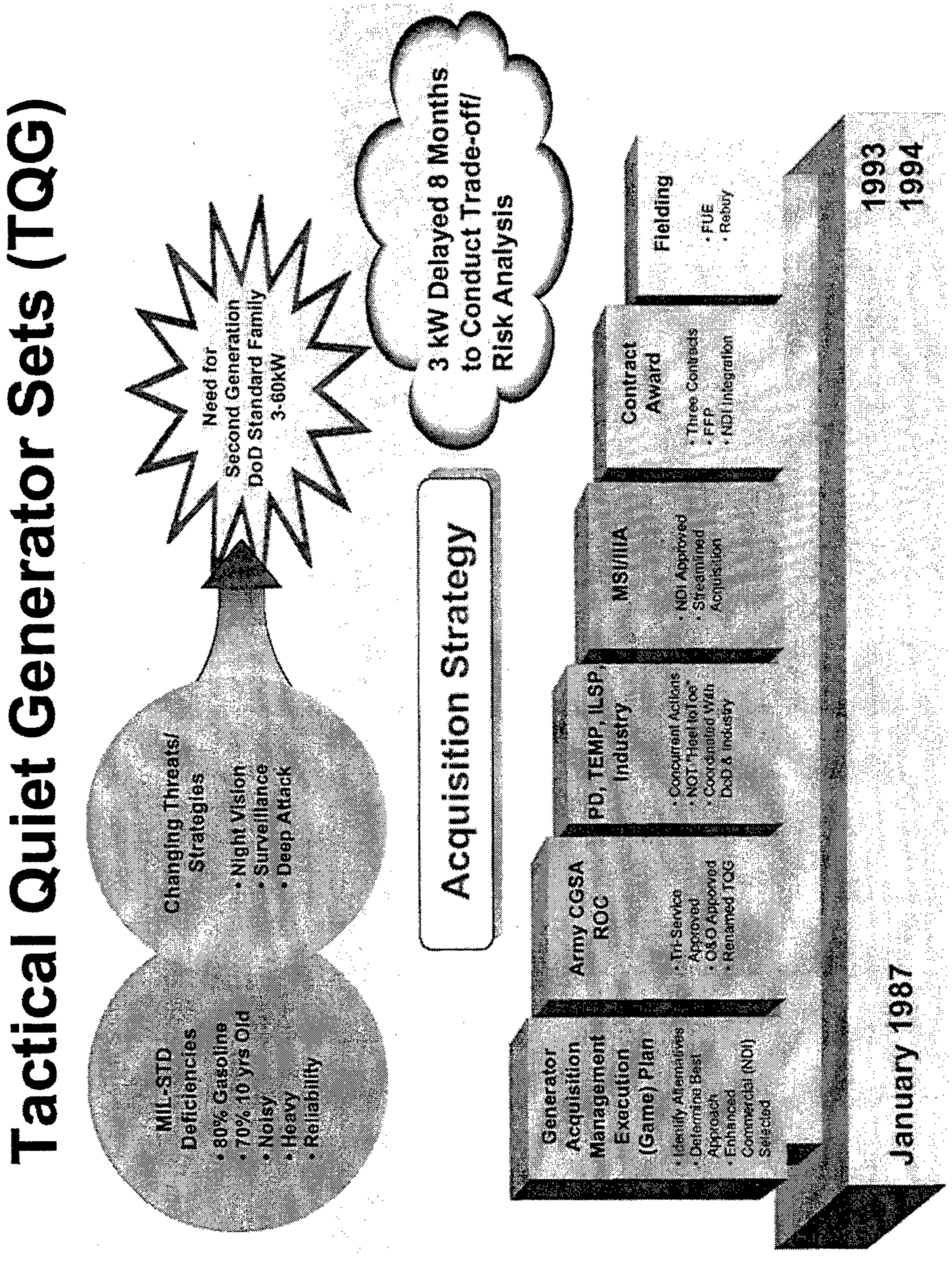


Figure 1. Acquisition Strategy [From Ref. 2]

E. PRODUCTION/FIELDING

Most people are unaware of how large and extensive the DoD generator fleet is. The DoD fleet from 2kW to 920kW consists of 83,099 generators and is worth in excess of $1.4 billion. Of this fleet, the Army is the largest user with 63,976 generators, of which, 37,961 generators are in the 5kW to 60kW ranges and 25,458 are in the 2-3kW size. Accordingly, producing, fielding and supporting this many generators is a huge project. [Ref. 11]

The first fielding of TQGs was the family of generators from 5-60kW, which began in December 1993. Since then, the Army, Air Force, Marine Corps and several allied nations have purchased and fielded TQGs. The following figure was the schedule for the initial Production/Fielding of the 5-60kW TQGs:

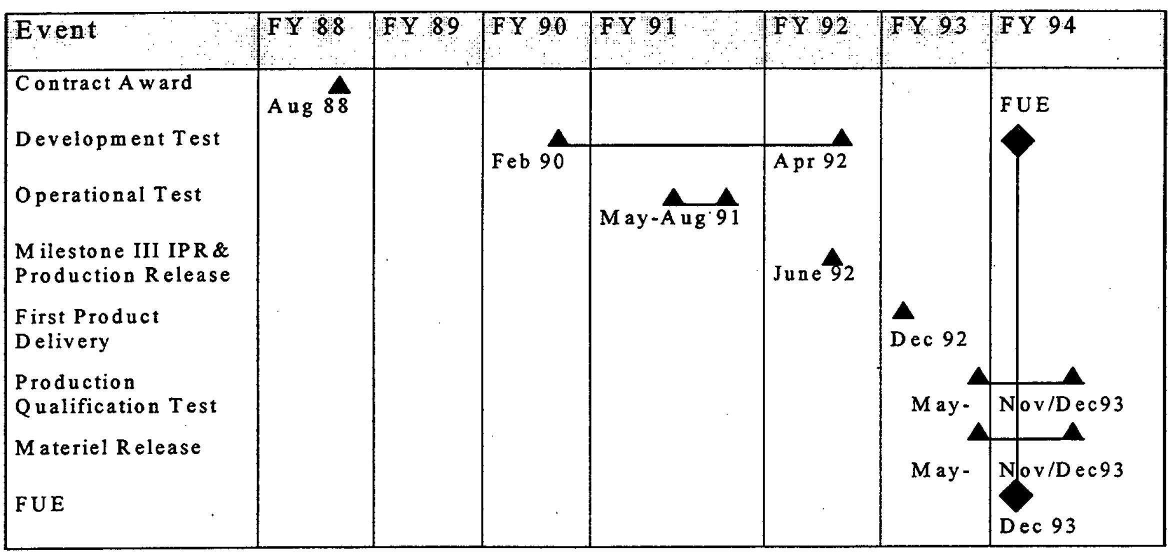


Figure 2. Initial Production/Fielding Plan for 5-60kW TQGs [From Ref. 12]

F. PROVISIONING, PROCUREMENT, AND PRODUCTION OF INITIAL SPARES

The Army uses the Total Package Fielding (TPF) process to field new material systems and their needed support items. [Ref. 13] This process was,

> designed to ensure thorough planning and coordination between Combat Developers/Trainers, Materiel Developers/Fielding Commands and the gaining Major Army Commands and using units involved in the fielding of new materiel systems. At the same time, it is designed to ease the logistics burden on the using and supporting Army troop units. [Ref. 14]

> TPF minimizes the workload associated with fielding of new equipment by requiring the Materiel Developer/Fielding Command to do the up-front determination of all requirements, the funding and requisitioning of nearly all needed items, the consolidation of the support items into unit level packages, and the coordinated distribution of the major system, its Associated Support Items of Equipment (ASIOE) and the support packages to a central staging site or the unit itself. [Ref. 14]

All fieldings are conducted in accordance with formal Materiel Fielding Plans (MFP). The MFP is a memorandum of agreement between the PM-MEP and the Major Command. It covers the "who, what, where, when, and how of the fielding process." The Materiel Requirements List for the new equipment shows everything needed to use and support the new system. It includes the new system, comprising all component major items and Basic Issue Items, ASIOE, Special Tools and Test Equipment (STTE), Test Measurement and Diagnostic Equipment (TMDE), computed and authorized initial issue spare/repair parts (for the Authorized Stockage List (ASL) level only), and a starter set of technical publications. Furthermore, the TPF finalizes the staging, handoff, and New Equipment Training (NET) schedule and locations with the gaining unit. [Ref. 14]

An ASL is stored at the direct support maintenance level and is comprised of essential repair parts and major assemblies required to support the force as far forward in the combat area as the supported units can tactically secure. ASL items are determined by demand history, resupply turnaround time, and cargo lift availability. It is normally a 30-day supply of parts. During fielding a push package of parts is given to the direct support unit for inclusion in their ASL until the demand history is built up. In the case of the 101st Airborne Division, the 801st Main Support Battalion was given an ASL push package, but the Forward Support Battalions did not receive a push package. The push package contains items that are needed based on predicted Mean Time Between Failures (MTBF) of the components, Developmental/Operational testing (DT/OT) testing, and service requirements.

Prescribed Load List (PLL) is a 15 day supply of parts that is demand supported (need to be ordered three times in 90 days.) The repair parts are normally stored at the Battalion level motor pool. The parts are normally for services on equipment and repairs at that level. For the purpose of this study the actual parts given to units for their PLL is not discussed, since the amount is insignificant.

TQGs were fielded under the TPF process. The MFP described the elements necessary to complete a successful fielding. The fielding process began with advance party from the PM-MEP arriving to negotiate with the fielding unit six to nine months ahead of fielding. Deprocessing and handoff procedures were established; facilities arranged for training; and PLL/ASL/Manuals requirements were validated to ensure the correct quantities were delivered. The next step was on-site deprocessing, New Equipment Training (NET), and handoff of generators, manuals, parts, STTE, TMDE, and ASIOE. [Ref. 15] Figure 3, is the schedule for the major logistics activities during the Engineering and Manufacturing Developmental Phase of the 5-60kW generators. This supported the First Unit Equipped (FUE) (December 1993) at Fort Bragg, NC. The total package and handoff in white triangles at the bottom of the schedule reflect what happened at Fort Campbell, KY.

Event	FY 88	FY 89	FY 90	FY 91	FY 92	FY 93	FY 94
LSA	Guid Conf	Nov 88		Apr 91			
Provisioning				Apr –Aug 91	Jan/Mar/Jun 92 SSR	Jul 93	
Tech Manuals		Sep-	Nov 89		Apr/Jun/Sep 92	May 93	Nov 93
Training		Mar 89	May 90		May 92	I&KPT Nov/Jan 93 Aug 93	NET CAMP Oct 93 Jun 94
Materiel Fielding Plan		Aug 89	Sep 90		Mar 92	Mar 93	
Total Package							MRL FIN Mar/Apr/Jul
Handoff							Aug 94

Figure 3. Initial Total Package Fielding Plan for 5-60 kW TQGs [From Ref. 12]

G. THE CRUNCH

Although the TPF concept briefed well, there were some problems with the concept. One of the problems of the TQG fielding was the ASL stock for initial fielding. Originally, the logistics managers for the PM-MEP looked at the support list allowance card, the provisioning master record, and data on every part from the contractor, as well as failure rates during testing. From this they came up with a list of 105-120 line items to be used as ASL for the fielded units. The Army would not allow the system to go to materiel release until the information was run through the SESAME computer model. So, the ASL stock for the initial fielding was based on the SESAME computer model, which considered part criticality and failure modes/rates from

Developmental/Operational testing. The SESAME computer model was not really designed for this purpose. Rather, it was designed to look at what is the actual failure and identifying the smallest part to replace, since it was originally created for budgeting for the repair of end items. For example, if a starter was the part that failed, but it was actually the bearings in the starter that had worn out, the model would recommend that the bearings be stocked, assuming the maintenance activity is able to perform these repairs. The ASL package had to be increased to support the SESAME model predictions. The PM had to take roughly $50,000-$100,000 from the production account in order to increase funding for the repair parts. [Ref. 16]

Another problem was that the program timeline slipped. When the logistics managers had their provisioning conference, the technical drawings for the system were not complete; testing was not finished and the data was incomplete to support provisioning decisions. The logistics planning time and logistics package ended up being the bill payer for the time crunch and were sacrificed in order to keep the project to its original fielding schedule. [Ref. 16]

In addition, the stockage levels in the push packages were not designed with enough depth to sustain maintenance operations until the warranty returns were received nor did they bridge the time until the Defense Logistics Agency (DLA) had enough demands to begin contracting for the parts.

The PM-MEP ensured the initial provisioning/supply support requests (SSR) were provided to and accepted by DLA before the first units fielded. In the case of the 82d Airborne Division at Ft. Bragg, the first unit to be fielded in December 1993, the PM had to pull parts off the production line in order to give the units the full ASL package. [Ref.

16] In the case of the 101st Airborne Division, (the third unit to be fielded the TQGs) the Main Support Battalion was fielded an ASL of roughly 384 parts, worth $10,274.36 in 1994 dollars. [Ref. 17] The problem with the push package was that the highest quantity of any one part received was five, so there was not much depth. Additionally, since the ASL was based on the computer model and operational testing-- it left out the "Snuffy and Murphy rules" factors. The Snuffy rule is that the computer can only compute on average mean failure rates of normal running, not the abuse/misuse of soldiers. Furthermore, the Murphy rule is that the computer cannot forecast for what you really need while you are out in the field, for most often that is when something is going to happen and you need the part right away.

H. WARRANTY

Another way to ease the logistics burden of newly fielded units is to have a warranty that will bridge the time until the Services field enough generators to build up demands. In this case, the PM-MEP did not want the warranty program to become a substitute for the supply support system. The PM-MEP stated that,

> warranties on military systems are not part of the military logistics systems, nor are they intended as supplements or substitutes for them. Warranties are designed to protect the government against major production deficiencies in new military products--and to incentivize quality production by contractors/vendors. In essence, the DoD Warranty Program was not designed to enhance readiness. Thus, the timeframes and processes are developed to support the integrity of the acquisition process, rather than specifically as support to the logistics system.... Second, warranties are very, very expensive to include in contracts.... Depending on the item and terms of the warranty the costs can range anywhere from 1 to 10+% of the acquisition cost. [Ref. 18]

The warranty for the TQGs failed to meet the Fort Campbell needs in three ways. The first was the time limitations. The stated warranty duration was 1800 operating hours or thirty-six months. This was insufficient to meet the Operational Tempo (OPTEMPO) for a division that has a brigade that goes to the field for three weeks of every month. Eighteen hundred hours equates to 78 days of use in the field. A brigade would surpass the operating hour limitations in less than 12 months. The second problem was with the financial charges. Once a part was "found" to be unserviceable it was sent to the contractor. If the contractor found the part serviceable, they would charge the unit $1,000.00. Generators are sometimes the hardest pieces of equipment to diagnose and multiple malfunctions can cause mechanics to misdiagnose parts as being bad. There was no honest broker to determine if the contractor was telling the truth. Finally, the prime contractor had 45 days to provide failure analysis upon receiving the item. Additionally, the prime contractor had up to 60 days to return a repaired or replaced item after the analysis is complete. A time period of 105 days was too long for part replacement. As stated the ASL push package did not possess sufficient depth to wait for items to go through a 105-day cycle for return to serviceable stock in the ASL.

The PM-MEP's solution for the unit was to spend the money and order the part and hope it came in faster than the one from the contractor and put the one that came in from the contractor on the unit's ASL; this could possibly create excess and cause the division to unnecessarily spend money. This was the likely outcome whenever the needed part did not have enough demands for it while it was under review. [Ref. 9]

I. CHAPTER SUMMARY

This case study of the Mobile Electric Power's TQG fleet demonstrates that this piece of equipment, although not as prominent as the Seawolf submarine or B-2 bomber, is nevertheless critical to mission success. The requirements that today's military has for generators will continue to increase as information technology demands ever more electrical power. The need for electrical power crosses every Service line and spans every mission and function of the Armed Forces. The PM-MEP is constantly trying to break technology barriers, develop creative acquisition strategy, and implement programs for the present and future DoD Standard Family of Generators. All this effort is to achieve the goal of ensuring that no commander losses the battle because he or she did not have the right power at the right place and time. It is in the quest of this goal that the PM-MEP has experienced many difficulties in his acquisition strategy and contracting practices. The PM-MEP's pursuit of acquisition reform initiatives and ability to "bounce back" after setbacks in the early 1990s have allowed the office to become an award winning PM-MEP office within DoD. They were awarded the 1995 U.S. Army Materiel Command Project Manager of the Year Award and the 1996 DoD Project Manager of the Year Award. It is apparent that the PM-MEP has made tremendous progress and overcome great obstacles, yet there is still room to improve their way of doing business as they develop programs for the future. The next two chapters will further investigate what really went wrong with the fielding of the TQGs, particularly at Fort Campbell and what could be done to fix the situation.

III. OPERATIONS AND MAINTENANCE OF THE TACTICAL QUIET GENERATOR

A. INTRODUCTION

This chapter will discuss the problems with the TQG fielding at Fort Campbell, KY and analyze maintenance and supply issues that surrounded the fielding. Readiness issues compiled by the PM-MEP's office and Decisions and Advanced Technology Associates (DATA) as well as current readiness reports will be used to illustrate the situation. This will be followed by maintenance reports, which further describe some of the maintenance and supply problems. Subsequently, there will be a discussion about the initial ASL fielding package and how the ASL fielding package has evolved. Early and revised ASL fielding packages will be compared to current demand history. The chapter will finish with a description of the issues surrounding the Defense Logistics Agency.

B. EQUIPMENT READINESS ISSUES OF TACTICAL QUIET GENERATOR SINCE FIELDING

The PM-MEP's office contracted with DATA to collect information on the TQG. DATA found two issues which directly affect the TQG's reliability usage and load utilization. As depicted in Figure 7, DATA found that generators are 7 times more reliable when operated more than 50 hrs per month than those operated less than 20 hrs per month. Although, when looking at their chart, it looks like generators have higher Mean Time Between Unscheduled Event (MTBUE) at 31-40 operating hours. Figure 4 depicts normal equipment utilization. It shows 55% of all generators are utilized less than 10 hrs per month. Generators are operated under feast or famine conditions. Either they have a whole lot of use or none at all. Basically, they are only used when out in the field. As shown in Figure 6, generators are twice as reliable when operated above 60% load utilization compared to those operated at 0-20% load utilization. However, their study revealed that over two-thirds of operation occurs at less than 40% load utilization as depicted in Figure 5. [Ref. 21] Even if generators are operated at the recommended 50 hrs per month, it does not mean that the generators are operating at the full load rate. Underloading causes "wetstacking" which is "the buildup of unburned diesel fuel and carbon residues in the engine and exhaust system of diesel engines including generator sets." [Ref. 22] Solutions to this problem include increasing power loads and reducing the number of generators used. Both such solutions are easier said than done, especially if you are trying to disperse tactically in an area. Underloading is sometimes the only option when you do not have a smaller generator available or anything else to plug into the generator to increase load utilization. Other causes of poor operations and maintenance are the lack of operator and maintenance training. This continues to be a leadership challenge with high personnel turnover rates and short time in between field problems. [Ref. 22]

In general, power requirements for generators are overstated, resulting in generators being operated at low electrical loads. This results in aggravated maintenance and supportability issues that will ultimately drive up acquisition costs as well as operations and support (O&S) costs. There are a number of systemic issues contributing to this problem: users over-estimating power requirements (such as using initial peak power vice sustaining power), poor power load and distribution management, assuming all systems operate simultaneously at maximum load (which is rarely, if ever, the case), and assuming "worst-case" environmental/altitude conditions. Users want to "safe side" their requirements and consequently request too many generators in too large sizes for the applications intended. Also, they want "redundancy" to ensure continuity of operations and the capability to operate independently. [Ref. 2]

The TQG was initially fielded at Ft. Bragg. Figure 8 shows the operational readiness rates over a three-year period at Ft. Bragg and a one-year period at Ft. Hood. The operational readiness (OR) rate is above 90% and in a real world deployment to Haiti, the OR rate exceeded 89%. 90% OR is the Army's standard, but this researcher feels it should be closer to the 98% rate for a new system that has been in use for at least two years. In fact it ranges from as low as 92% to as high as 97.6%. A new system should perform at a consistently high rate. When all models are averaged together, their overall OR rate is 95%. The following figures depict the utilization rates, readiness rates, and mean time between unscheduled events:

EQUIPMENT UTILIZATION

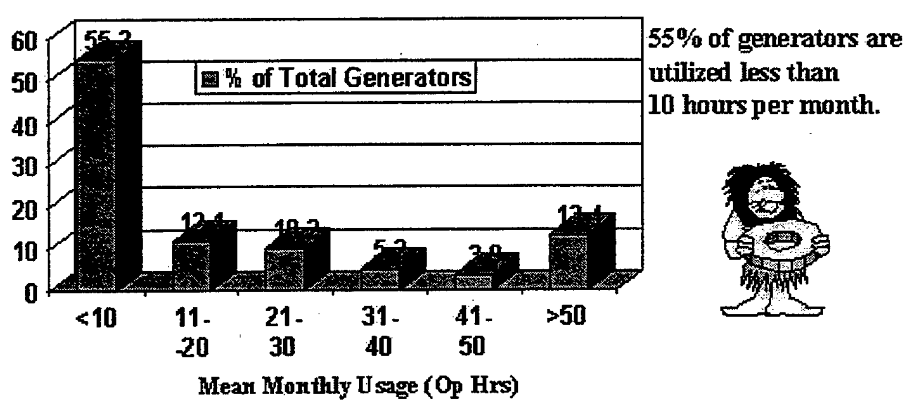


Figure 4. Equipment Utilization [From Ref. 21]

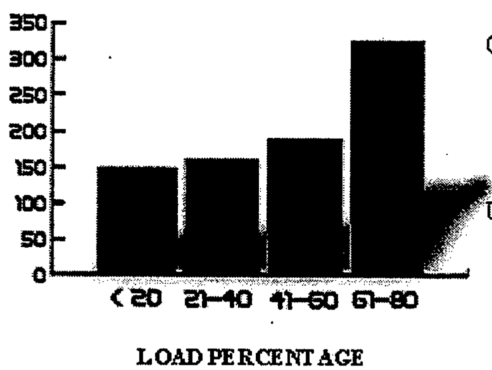
OPERATING LOAD UTILIZATION

GENSET	0-20%	21-40%	41-60%	61-80%	80-100%
5kW	50.8%	27.4%	10.7%	7.8%	3.3%
10kW	37.0%	46.3%	4.8%	8.0%	3.9%
15kW	49.7%	29.7%	15.3%	3.8%	1.5%
30kW	31.4%	35.2%	15.3%	12.4%	5.7%
60kW	59.6%	23.4%	12.8%	4.2%	0.0%

Over all two-thirds, of operations occurred at less than 40% load!

Figure 5. Operating Load Utilization [From Ref. 21]

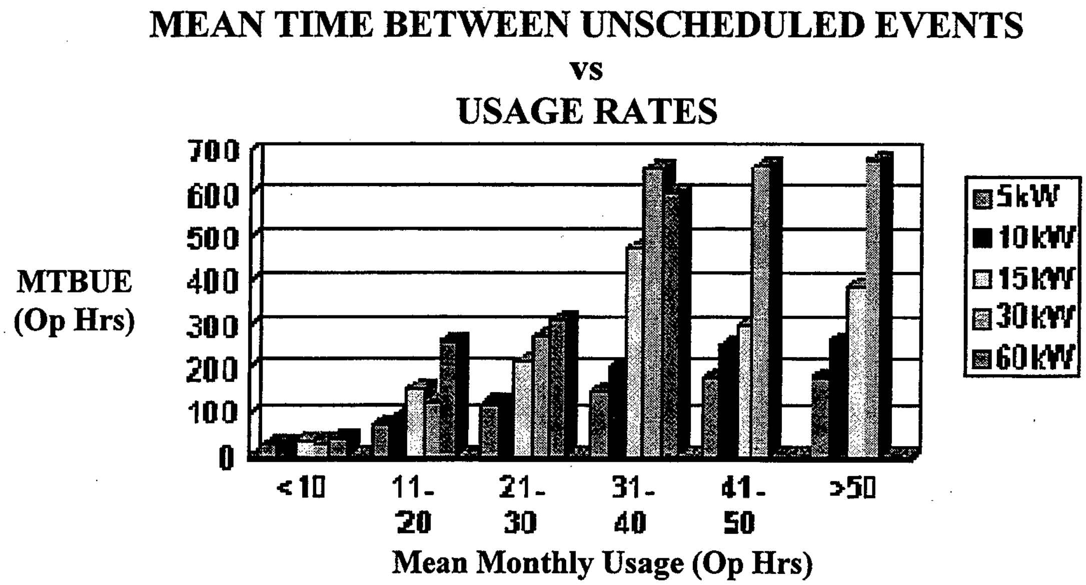
MEAN TIME BETWEEN UNSCHEDULED EVENTS



Generators are twice as reliable when operated above 60% load -- compared to those operated at 0% to 20% load.

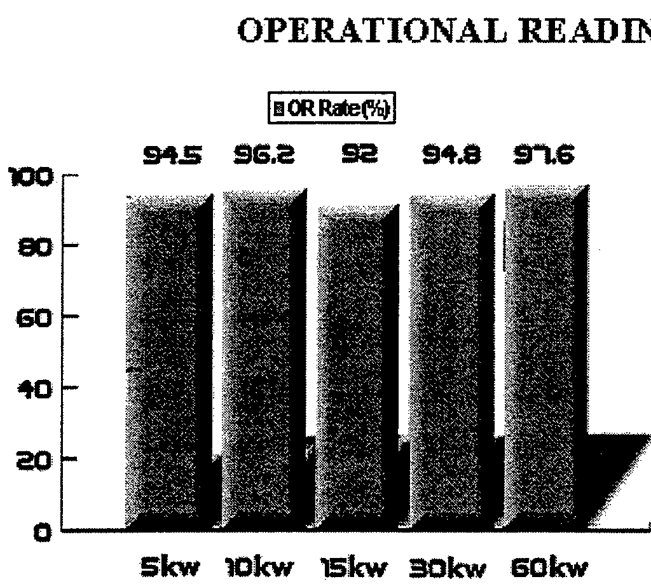
Unscheduled event = any event that occurs, not necessarily critical, nor does it mean that the set won't operate.

Figure 6. Mean Time Between Unscheduled Events [From Ref. 21]



Generators are 7 times more reliable when operated more than 50 hrs/month vs those operated less than 20 hrs/month.

Figure 7. Mean Time Between Unscheduled Events Vs Usage Rates [From Ref. 21]



Overall, TQGs are performing well, with readiness rates averaging about 95%.

Data is from Sample Data Collection population of 1344 sets for 3 years at Fort Bragg and 1 year at Fort Hood.

During hard, real-world use in Haiti, the OR rate exceeded 89%.

Figure 8. Operational Readiness Rates [From Ref. 21]

C. CURRENT READINESS ISSUES OF THE TACTICAL QUIET GENERATOR

Below is a snapshot of statistics complied by the Army's Logistics Support Activity (LOGSA). These statistics were gathered between 1995 and 1998. LOGSA receives all the Army units' monthly readiness reports of reportable equipment. All reports become part of the Readiness Integrated Data Base (RIDB). A normal readiness report depicts a month long readiness rate and is the relationship between the amount of days the equipment is Fully Mission Capable (FMC) (working) and total possible days it could be working. It is expressed as a percentage. The Department of the Army standard is a 90% or better Fully Mission Capable rate. Not Mission Capable for Supply (NMCS) means the item is unserviceable due to a lack of repair part(s). NMCS is also expressed as a percentage and in this case, it is the ratio of days waiting on parts to total possible days the system could be working. Not Mission Capable for Maintenance (NMCM), like NMCS, is a ratio, but it is time spent waiting on a mechanic to fix the equipment to total possible days the system could be working. For example, for a 30-day report period, if a unit has six generators authorized and six generators on hand, the total possible days they could be working is 180 days (6x30). If these generators had only 111 days available, and 62 days NMCS and 7 days NMCM, these generators would have a FMC of 62% (111/180) with a NMCS of 34% (62/180) and a NMCM of 4% (7/180).

Despite the maintenance problems of the TQGs, readiness has stayed above the 90%. The charts below depict a study of seven different models of TQGs -- PU 797 (5 kW), PU 798 (10 kW), PU 802 (15 kW), PU 803 (30 kW), MEP 802A (5 kW), MEP 803A(10 kW) and MEP 805A (30 kW). The reason for using only seven generators instead of the 26 different models in the entire family was that each of these TQGs had more than 200 items fielded to Active Army units. In this case these statistics are just for generators in the U.S. Army Forces Command (FORSCOM). U.S. Army Forces Command is the largest major command in the Department of the Army and comprises the Army component of U.S. Atlantic Command. FORSCOM supervises the training of more than 760,000 active and reserve soldiers to provide a strategic, power-projection ground force capable of responding rapidly and successfully to crises worldwide.

Since this thesis is based on the fielding of Fort Campbell, which belongs to FORSCOM, the FORSCOM statistics were used. As stated in Chapter 2 these generators were first fielded in 1993 to the 82d Airborne Division at Fort Bragg, which is also one of FORSCOM's units. Readiness reporting did not become mandatory until 4th quarter 1995, so some units had their generators for almost two years without reporting their readiness data. These statistics also are rolled up into quarterly averages, rather than monthly reports. As you can see on the graphs below, in the FMC rate varied from as low as 80% to as high as 100%. In the case of the MEP 805A there were 5 generators on hand during the 4th quarter of 1995 and they had a FMC rate of 80%. The low density of generators and the fact that one generator could have been down the whole time would create the poor rating. With these reports, high equipment density may mask long down times. Conversely, low-density statistics may be easily depressed by long down times. With new systems, the norm is to expect high and stable FMC rates. This has not been the case with the TQG. The rates do vary greatly over the four years. Mr. Londene, a LOGSA analyst, said, "if an item is new, one would expect it to run well for a longer period of time before it becomes nonoperational." [Ref. 23]

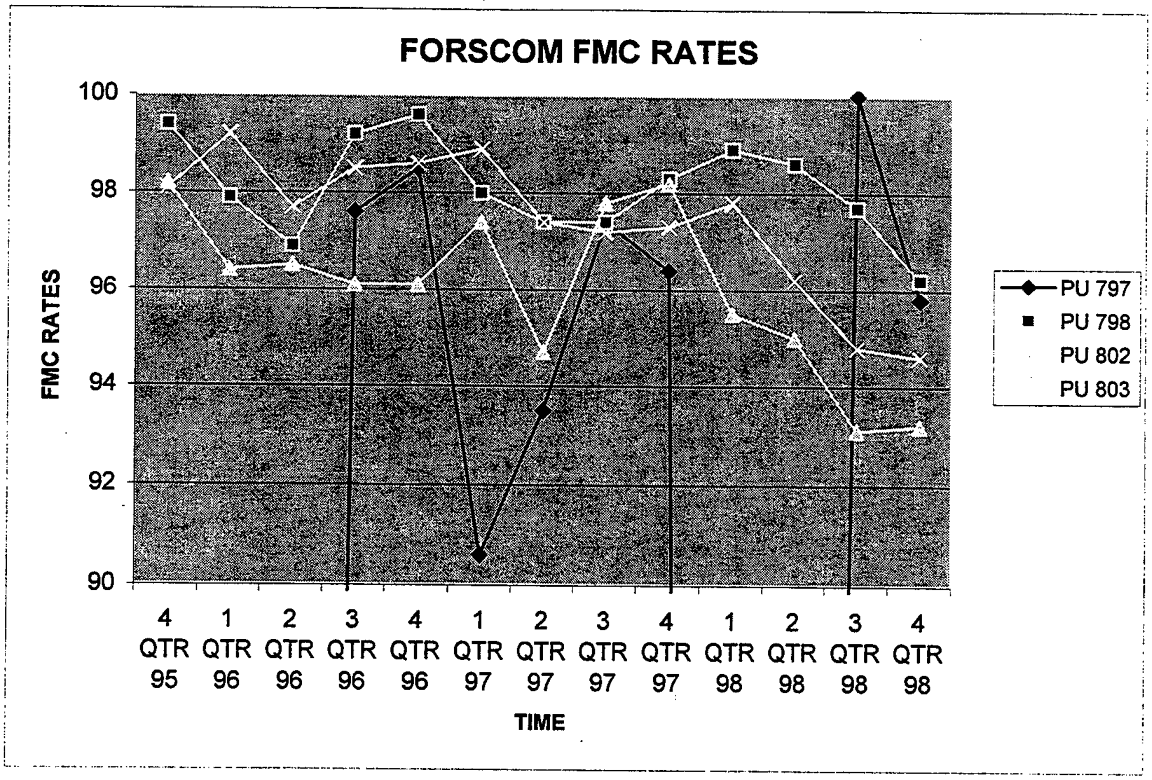


Figure 9. FORSCOM FMC Rates [After Ref. 23]

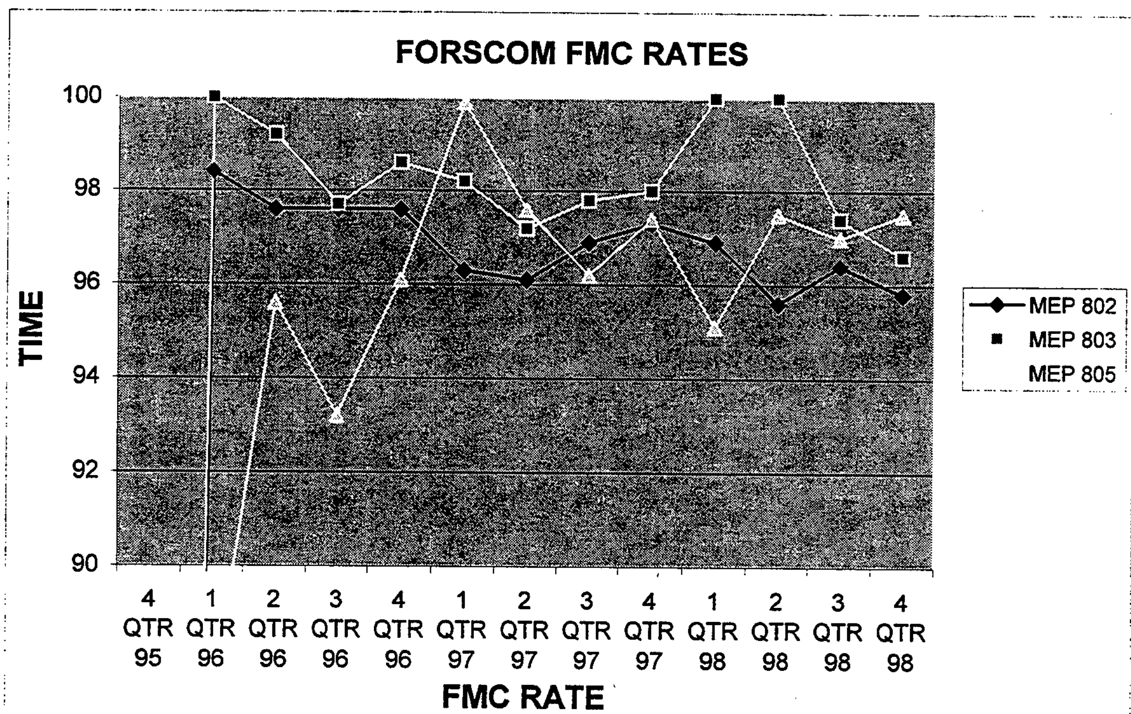


Figure 10. FORSCOM FMC Rates [After Ref. 23]

When looking at the amount of time spent non-mission capable for supply versus maintenance in Figures 11-17 the charts clearly show the supply days are higher. This is an indicator that there is a problem with the supply system, but does not tell us whether it is due to parts not being available in the system or not. In looking for a trend, the curves do not go up or down, just fluctuate. Yet, the days awaiting supply are almost always worse than the days requiring maintenance.

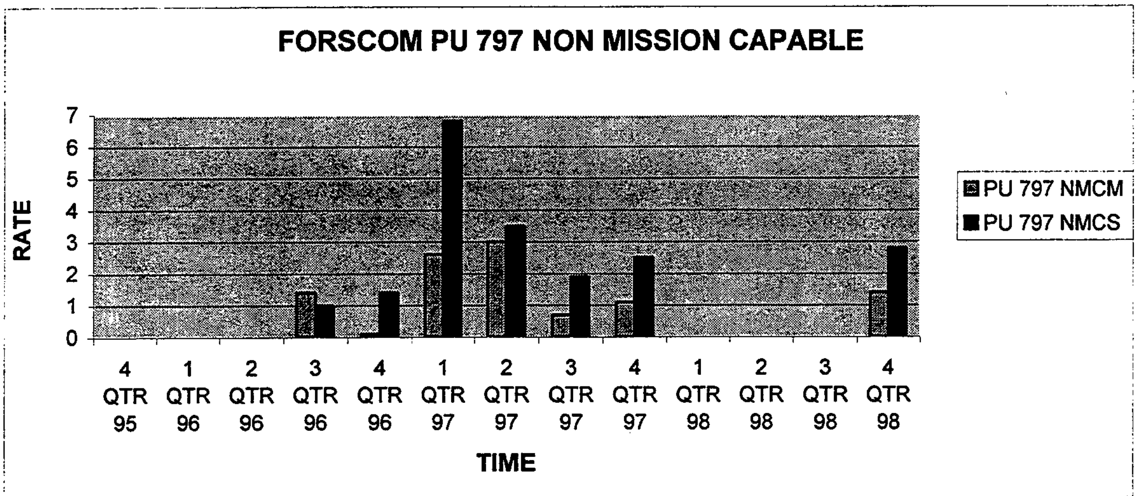


Figure 11. FORSCOM PU 797 Non Mission Capable [After Ref. 23]

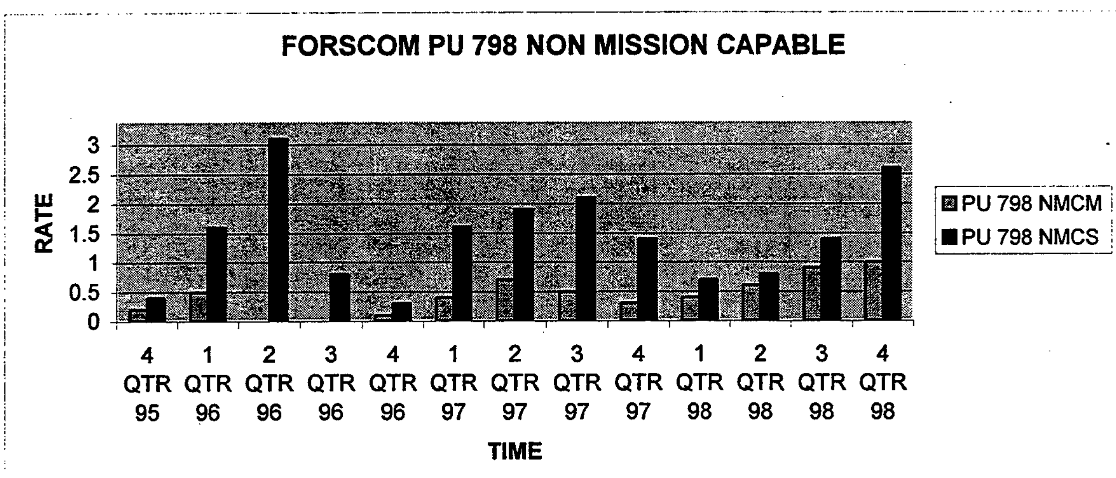


Figure 12. FORSCOM PU 798 Non Mission Capable [After Ref. 23]

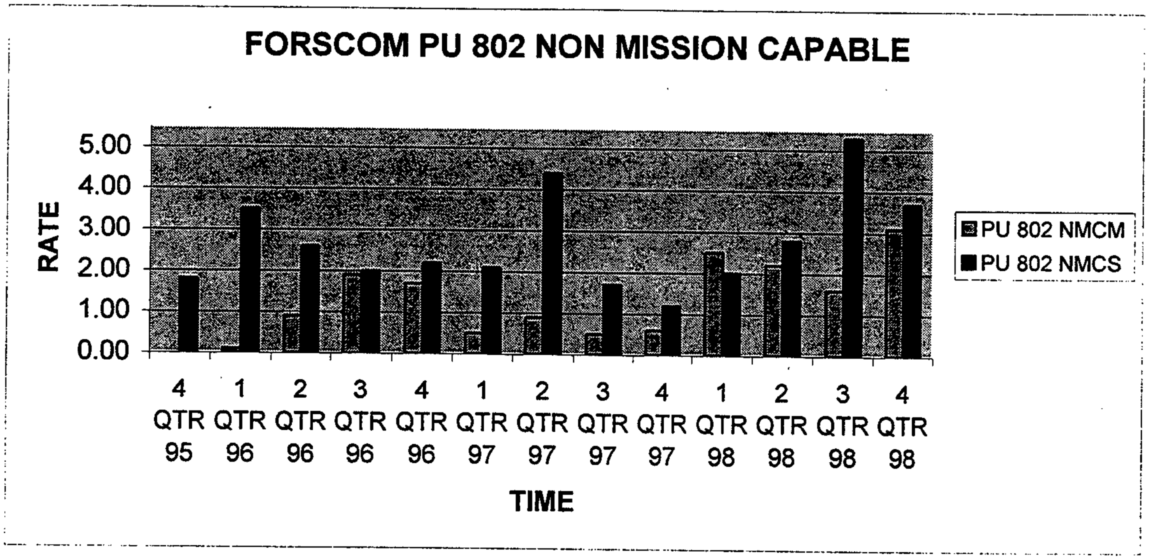


Figure 13. FORSCOM PU 802 Non Mission Capable [After Ref. 23]

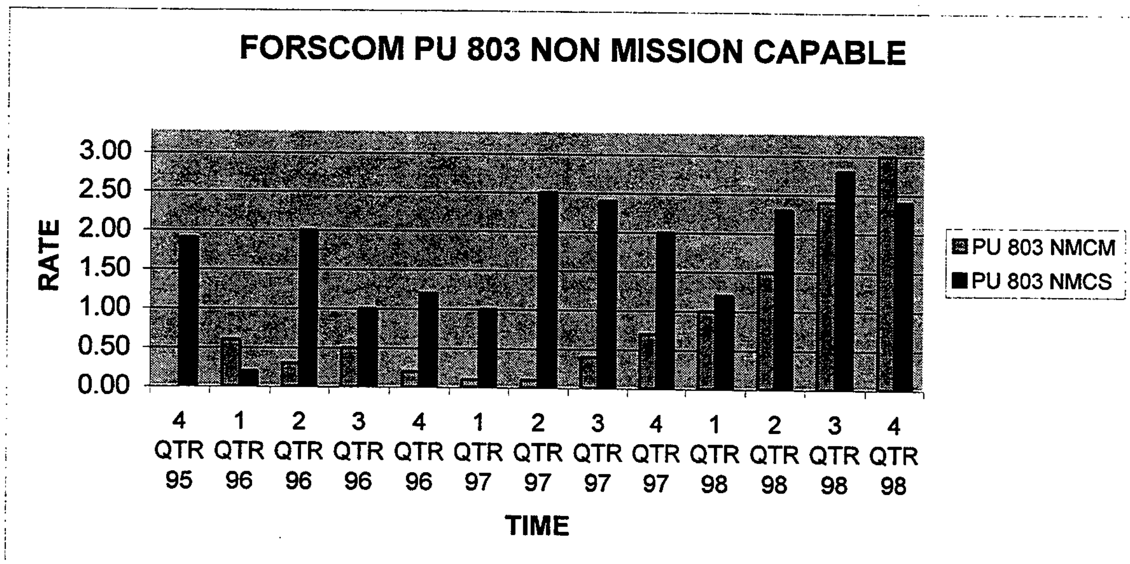


Figure 14. FORSCOM PU 803 Non Mission Capable [After Ref.23]

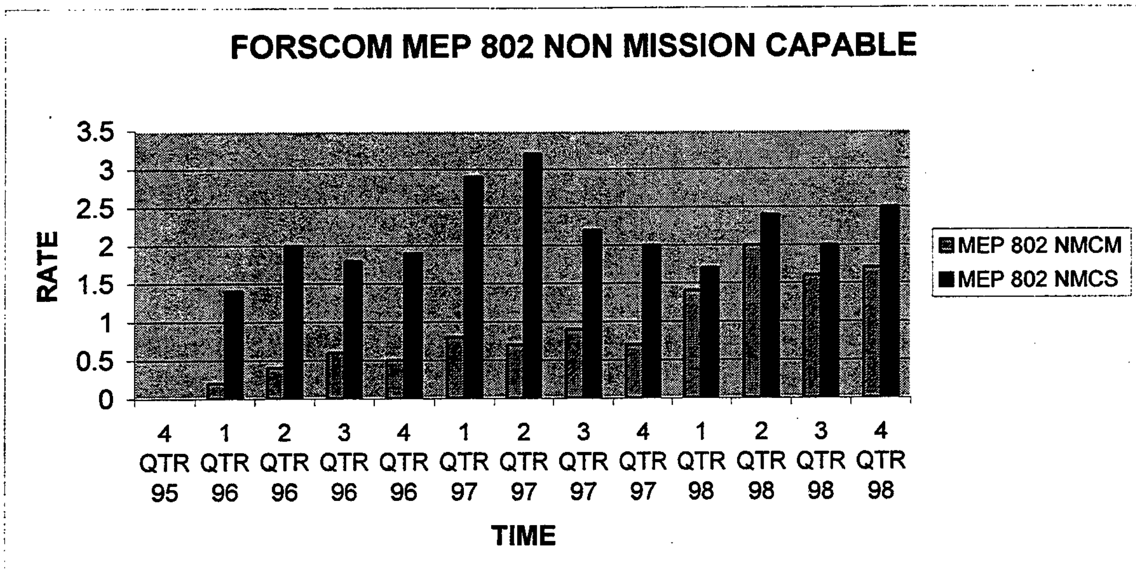


Figure 15. FORSCOM MEP 802 Non Mission Capable [After Ref.23]

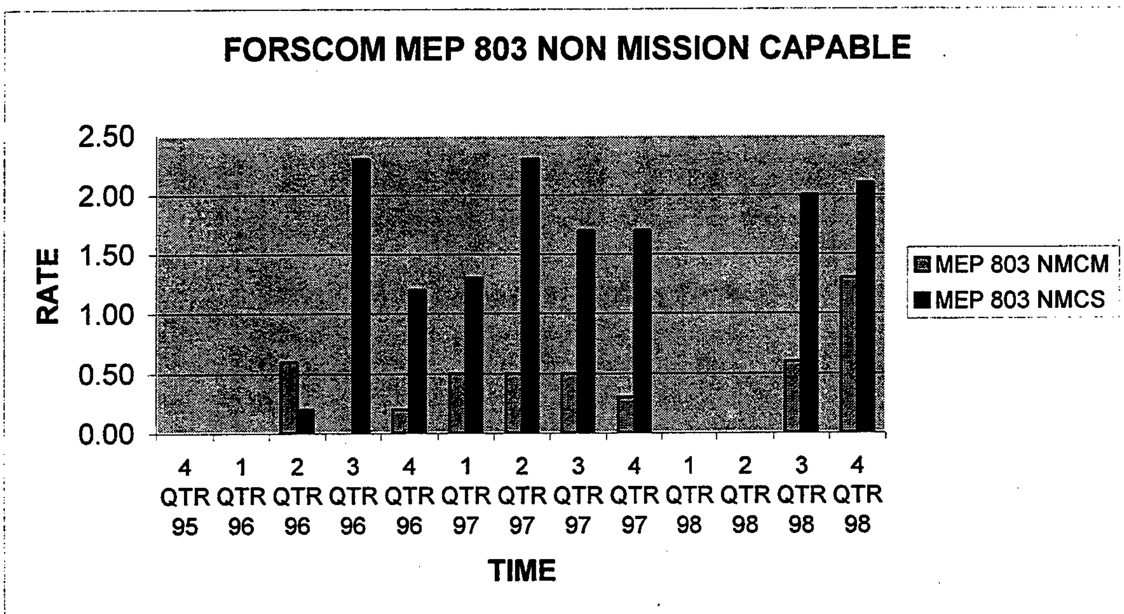


Figure 16. FORSCOM MEP 803 Non Mission Capable [After Ref. 23]

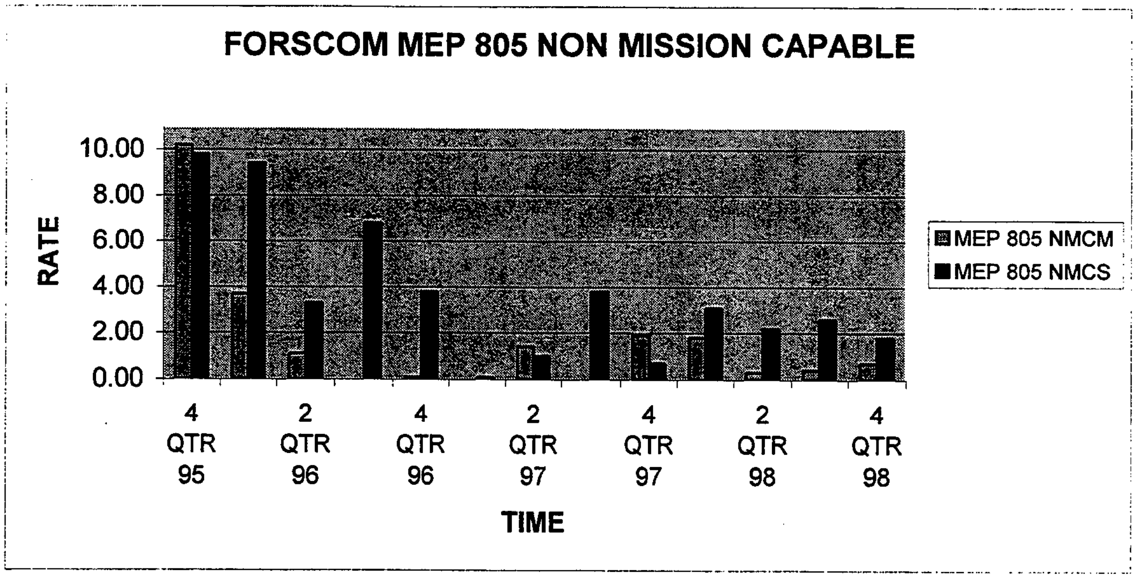


Figure 17. FORSCOM MEP 805 Non Mission Capable [After Ref. 23]

Readiness rates are further aggravated by are variances in the quantities on hand. Figure 18 shows dramatic drops in the quantities reported. Quantities should be flat or rising, but this is not the case. From one period to the next the number of generators on hand normally increases, but in some instances it goes down dramatically. For example, with the MEP 803 from 3d quarter 1997, the on hand quantity went from 414 to 324 and then in 1st and 2d quarter of 1998 went to as low as 13 and eventually back up to 504 in 3d quarter 1998. The statistics demonstrate reporting disparities. Basically, there has been incomplete reporting.

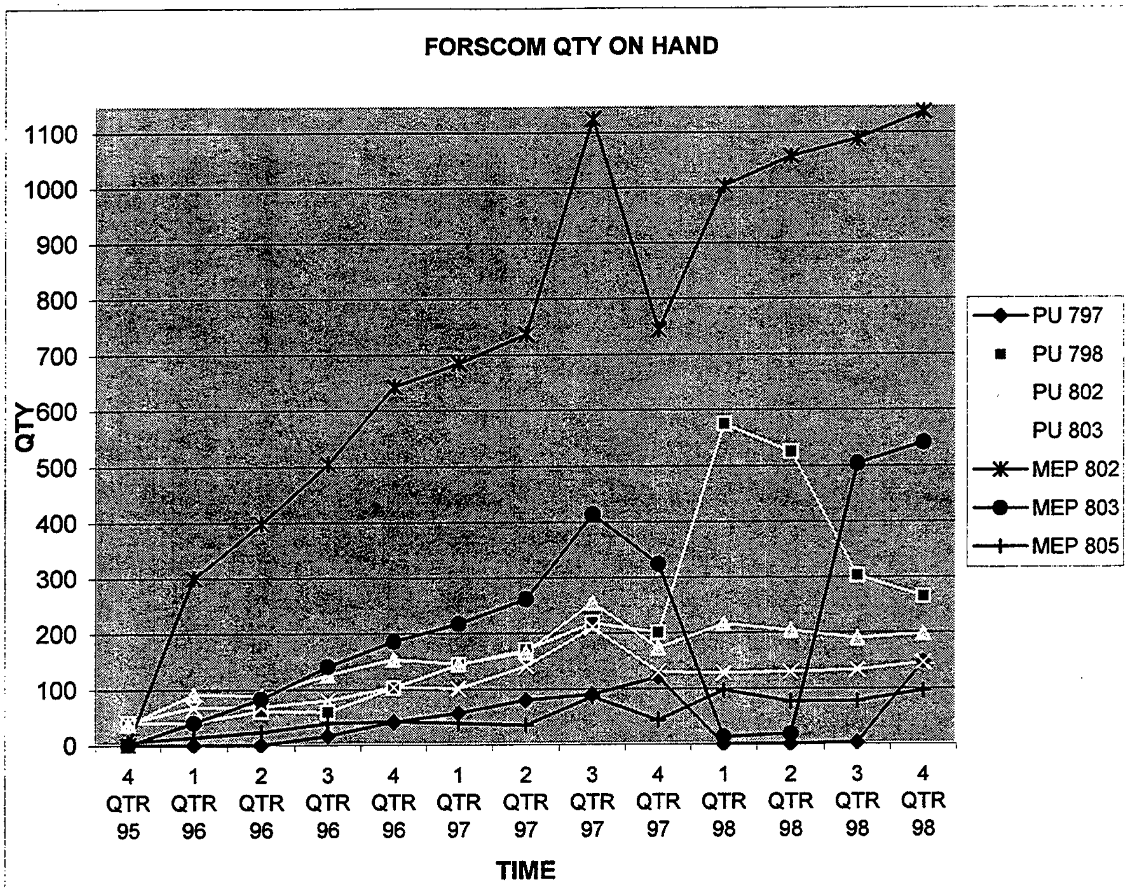


Figure 18. FORSCOM Quantity On Hand [After Ref. 23]

D. MAINTENANCE ISSUES OF THE TACTICAL QUIET GENERATOR

Another source of information on the performance of the Tactical Quiet Generator is to look at the Work Order Logistics File (WOLF). The WOLF is a database of Direct Support and General Support (DS & GS) maintenance actions and related information. Data is gathered from the Standard Army Maintenance System (SAMS), which is used at the DS and GS maintenance units. The WOLF has data available back to 1995 and archived back to 1990. It allows research of Maintenance Turnaround Times (MTAT) and other significant information such as Mean Time To Repair (MTTR)(i.e., wrench turning time), average wait for repair parts, total work orders, total downtime, and total repair parts downtime. In this study, data for six models of generators, the MEP 802A, PU 798, PU 802, MEP 805, PU 803, and AN/MJQ-37 was complied from 1995 to 1998. Looking at the total work order count in Figure 19 below, the annual work order trend is decreasing with a slight increase in 1997. This could be indicative of the system operating better as it matures. Or, it could be poor reporting as is the case in Figure 18.

In Figure 20, the Mean Time to Repair is contrasted against Mean Turn Around Time. This clearly indicates wrench-turning time is not really significant. In fact, the highest is five days, while the highest MTAT is 77.4 days. If you subtract MTTR from MTAT the best is 9.8 days and the worse is 72.4 days. This indicates a problem with the supply system responding with the required repair parts. It could also indicate a problem with actually diagnosing what is wrong with the generator. That is, the mechanics could be ordering the wrong parts, wasting valuable downtime.

Additionally, New Equipment Training (NET) for mechanics and operators often happens six months to a year before receiving the equipment. NET is normally not purposely scheduled to occur so far in advance, but fielding often gets pushed back after training has been conducted. The time between training and fielding can aggravate the NMC statistics, not to mention making the learning curve steeper for both mechanics and operators.

Figure 21 depicts the average days waiting for parts. The worst case is 35.13 days, with the best being 4.33 days. This clearly depicts a problem with the supply system responding to the needs of the mechanics. By 1998 the supply system should have been able to react and the supply statistics should have looked relatively flat. The

WOLF statistics depicted in Figures 19-21 clearly show there is a supply problem and the situation does not appear to be getting any better.

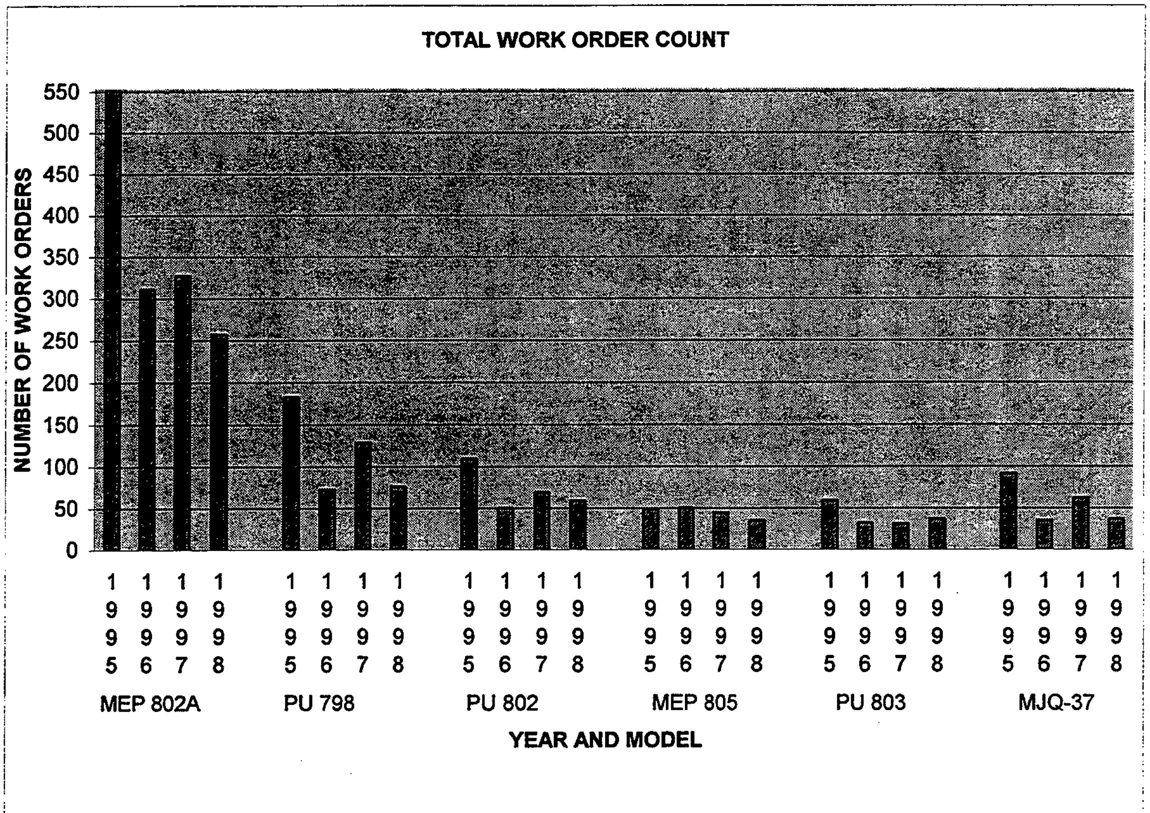


Figure 19. FORSCOM Work Order Count [After Ref. 24]

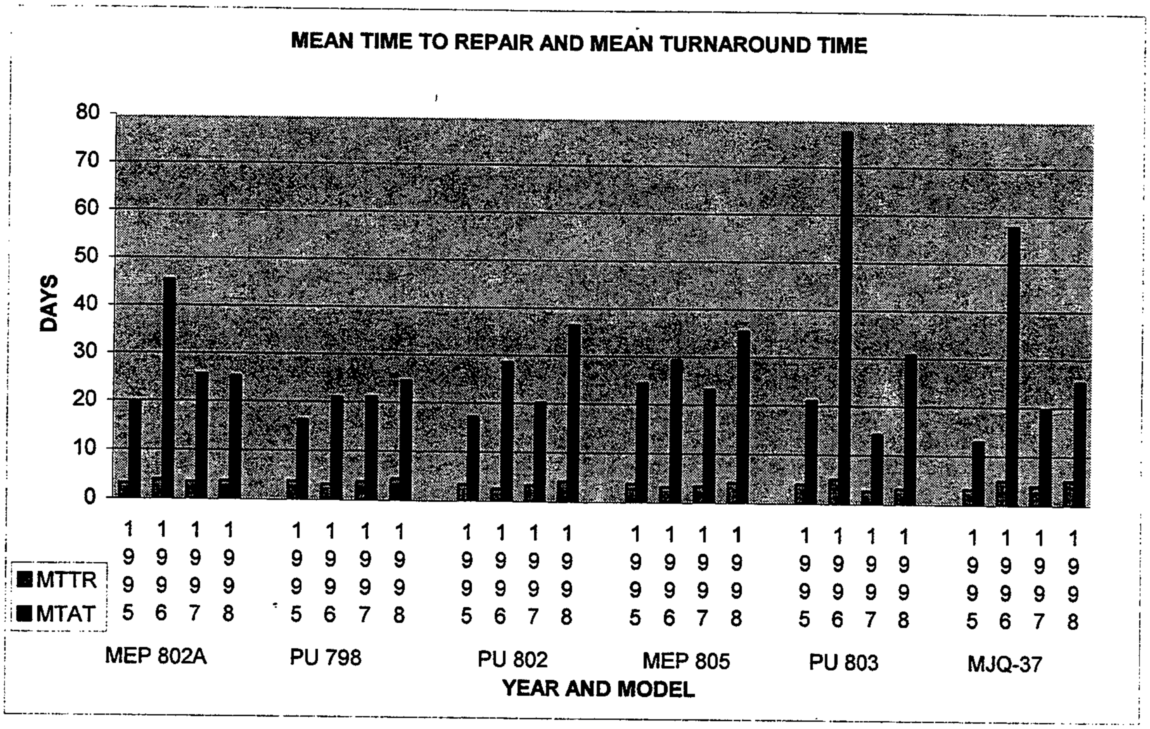


Figure 20. Mean Time to Repair and Mean Turnaround Time [After Ref. 24]

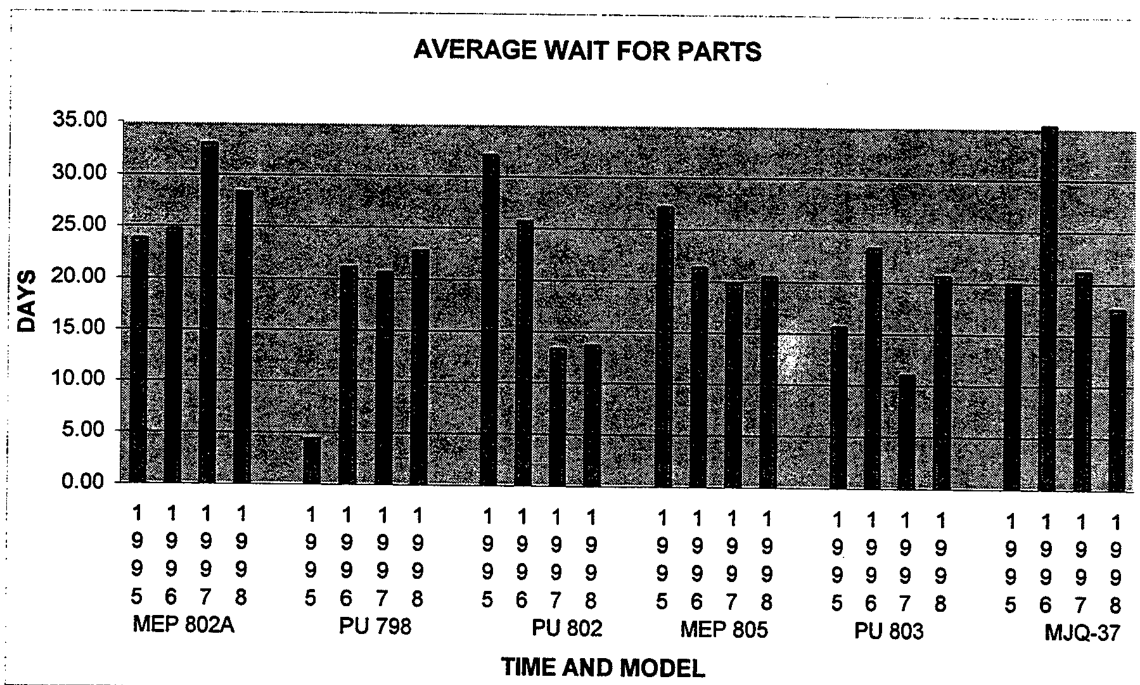


Figure 21. Average Wait For Parts [After Ref. 24]

In fact, when considering failure-rate trends on a relative basis using the bathtub curve shown in the illustration below, one would expect the generators to be in a constant failure rate region after being fielded for two years. [Ref. 25] In fact, most of the debugging should have been taken care of during the first two years, which is part of the infant mortality period. The trends shown in Figures 11-17 and Figures 20 and 21 are very consistent. Although not exactly the same, the indications are the same. The figures support the argument that the problem is not really reliability and failure rates, but, in fact, the supply system not reacting to the needs of the mechanics.

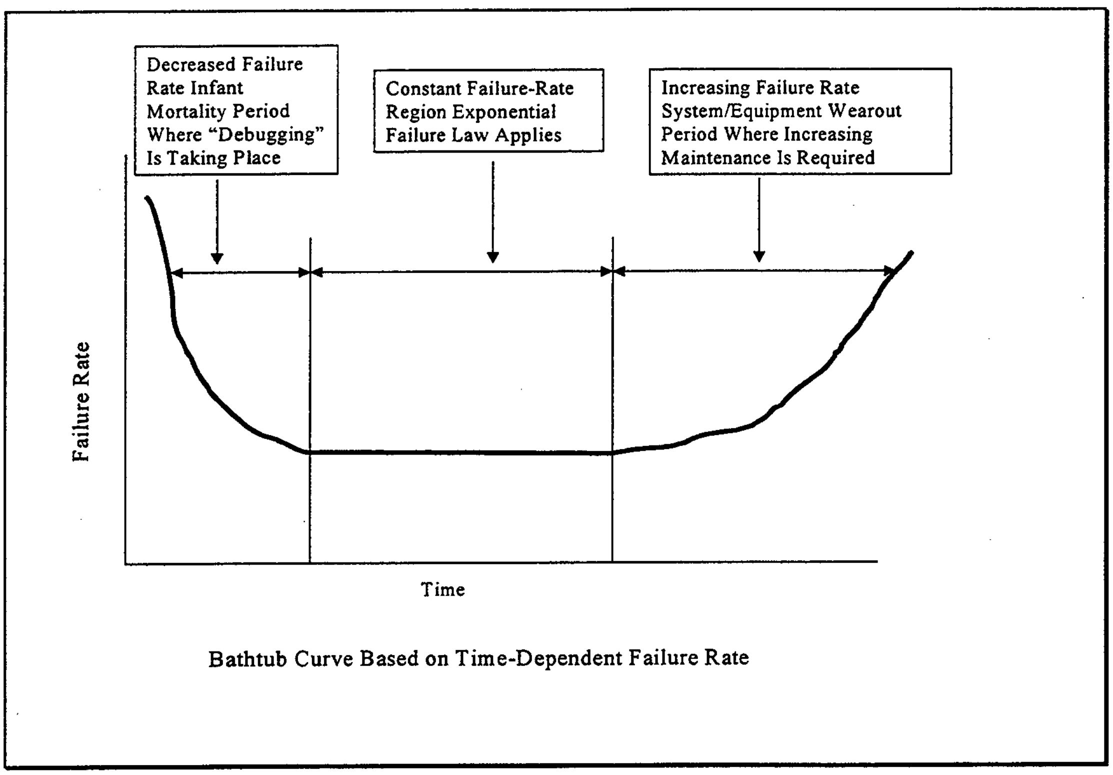


Figure 22. Bathtub Curve [From Ref. 25]

E. EFFECTIVENESS OF THE SPARE PARTS PUSH PACKAGE

1. Original Fielding Package

As stated in Chapter 2 the original ASL package consisted of 224 lines of parts for the 101st Airborne Division, for a total amount of 384 parts stocked. The original package was based on the SEASAME model's recommendations. To actually see how effective this package was, the Tactical Quiet Generator Item Manager at DLA ran the National Stock Numbers (NSN) through their computer to see current demands for these lines. The Class IX Accountable Officer at Fort Campbell ran the same lines to show the division's demands for those same lines. Both computer files only went back two years (1998 and 1999). In the case of DLA, only 121 of the 224 lines had more than 10 demands. This meant that the old package was less than 54% effective, DoD-wide. Some of these parts could be common to other items driving up the demands, but provides a way to check the ASL. Ft. Campbell showed that 45 lines were demand supported. This shows an effective rate of 20%. In an interview with CW5 (Ret.) Art Lacky, who was a supply tech for the Army and spent numerous years at Ft. Campbell, he said it was his experience to turn in over 70% of an original push package as excess within two years of fielding. These numbers clearly paint that picture. Appendix D shows all the information from DLA, Ft. Campbell, and the original ASL package.

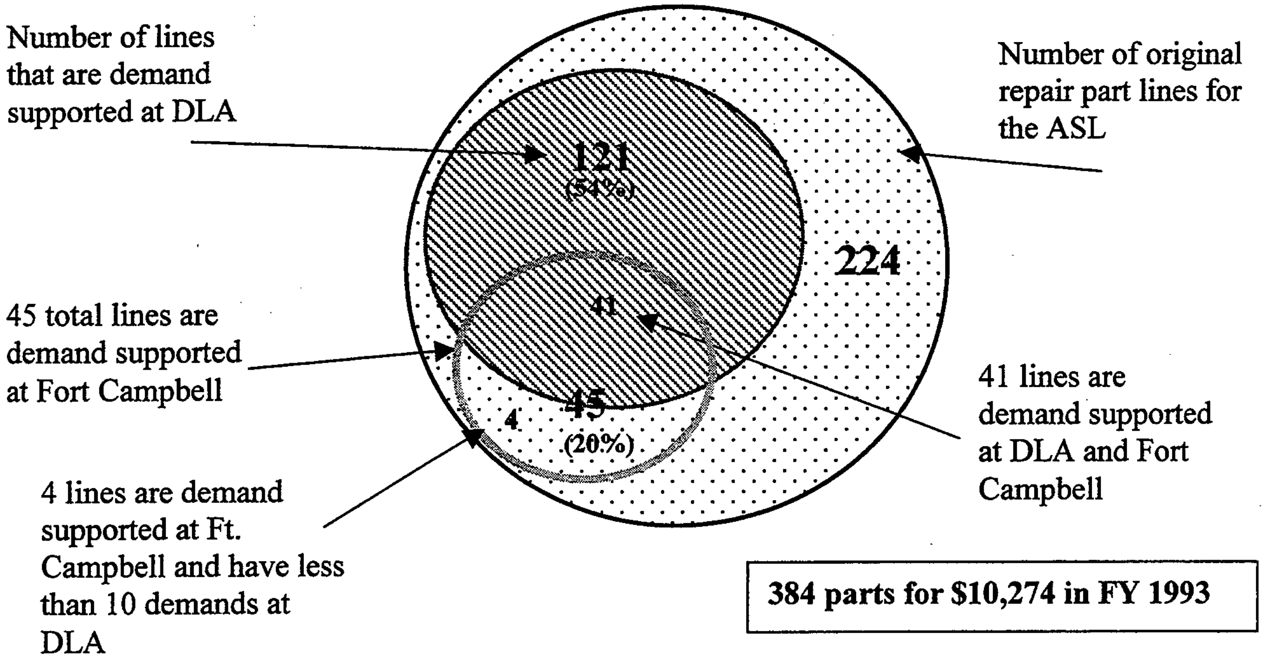


Figure 22. Initial Fielding Package [After Refs. 26, 17, 28]

2. New Fielding Package

As stated in Chapter 2, the new fielding package was based on actual field experience and usage data from Ft. Bragg over eighteen months and came up with a list of 49 lines of parts. The PM used Ft. Bragg's demand experience after receiving a lot of criticism that their fielding package had been ineffective. The PM is currently using this revised package in its fieldings overseas. Appendix E shows the new fielding package, which has been tailored around the number and type of generators fielded to Ft. Campbell. The new package has 49 lines of parts. Sized for Ft. Campbell's requirements, this would mean 515 total parts at a cost of $18,480.64 in 1999 dollars. There are 30 lines on the revised list that were on the old list; 19 lines are new. Of these 30 lines, 19 lines were demand supported. This would give it a 63% (19/30) effective rating of the 30 original lines. The other 19 new lines were not run by Ft. Campbell or

DLA to see their effectiveness. Given this incomplete picture, the bottom line is that the new package is better, but not perfect. If the 63% is any indicator, there are still excess parts being turned in, but 63% is still better than 20% effectiveness.

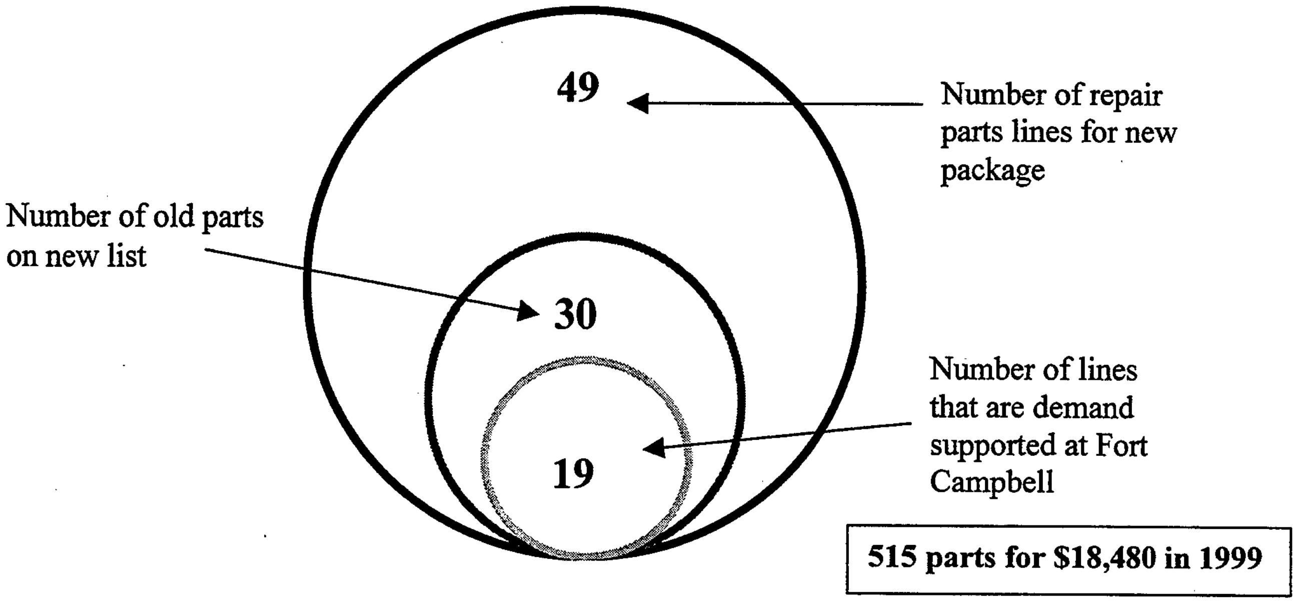


Figure 23. New Fielding Package [After Refs. 26, 17, 28]

F. DLA AND AGGREVATED SUPPLY PROBLEMS

Prior to the onset of fielding, DLA was given the National Stock Numbers for all the parts in the TQGs. They were also given failure rates. Unfortunately, DLA is only funded to stock about 85% and the Army National Inventory Control Point (NICP) is funded to stock about 80% of their current needs. DLA is funded to buy, stock, and sell only consumable items, which are items used to repair the more complex assemblies and systems. There is an enormous amount of money involved in managing parts and the overhead incurred to store and ship them. Due to budget constraints, DLA will only buy parts for actual demands and will not buy parts to support newly fielded items until real demands materialize. Furthermore, there is a high degree of variability in the demand patterns of the more than three and one half million spare and repair parts managed by DLA. [Ref. 29] Because of unpredicted failure of weapon systems and unexpected changes to operating tempo (OPTEMPO), Service demand does not always occur as predicted by their models. "Unforecasted demands result in short term parts shortages and backorders." [Ref. 29] Given the range and age of the DoD's many weapon systems and equipment, it is difficult to forecast perfectly the parts that will be required, some of which take a long time to place on contract and manufacture. In general, DLA stocks are demand-based, and without sufficient demands, DLA cannot enter into contracts established with suppliers. DLA also has to put the contract out for bid, allowing competition. This means the company that is actually making the parts for production might not actually make them for the supply system. The parts made by other companies normally meet the same specifications, but there are usually longer lead times due to required set up times. Additionally, "many of the repair parts that DLA manages are not used in commercial industry, but are instead unique to the Military Services." [Ref. 29] Many high-tech parts, such as those used in turbine engines, require vendors to acquire special materials and conduct special production runs, adding months to the lead-time for parts acquisition.

About two years ago, DLA underwent a fundamental change and began to manage parts under weapon system alignment. This allowed DLA to forecast parts requirements and work lead-time issues between customers and suppliers. This strategy allowed them to develop a comprehensive plan to apply funds and achieve the maximum benefit on a weapon systems basis. DLA was able to determine, through analysis of weapon system availability data, the need for additional investment in spare parts. They then began the process of contracting for the needed parts. Although the support for parts is good in the aggregate, they have found individual items with less than satisfactory support. Through teaming, the Services and DLA can address variability in demand, provide more on-time deliveries, and quicker response on repair parts requested by the Services. [Ref. 29]

Another problem is units using alternate sources of supply (such as credit cards) and failing to enter the demands into the supply system, thereby not building up DLA's demand history. Currently, the PM-MEP has bridged the gap by allowing units to purchase parts directly from the contractor by credit card, but only for items that will not adversely impact production within the next 60 days. This solution was not available during the first years of the fielding because the PM had not worked out this arrangement with the contractor. [Ref. 30]

G. CHAPTER SUMMARY

There are many issues surrounding the support of new systems. This chapter covered five diverse topics, but all are necessary in order to really understand the TQG support. This chapter depicted the symptoms of a problem in regards to support. First, it covered equipment utilization rates and the operating load utilization and their impact on readiness. Although any lessons on utilization rates and operating load utilization might only pertain to generators, the more general lesson is that not all flaws are found in testing; therefore, the Project Manager must quickly react to the "unpleasant surprises" that occur during fielding. Second, this chapter discussed readiness issues and how problems in reporting shroud the situation and possibly hide emerging trends. Third, it addressed maintenance issues and challenges faced with repairing the equipment. Fourth, the chapter analyzed the old and current ASL fielding packages as to their effectiveness. Finally, it described DLA's organization and practices and how DLA has improved the supply system response to maintenance needs. At best, fielding a new system is complex and there are many opportunities to make mistakes. However, there are some alternative approaches to fielding a system that might provide more responsive support to the user.

The next chapter will examine potential solutions to more smoothly transition from initial fielding to continuous support. Each option has certain benefits and deciding what has the best overall value for the Government and the user is the challenge.

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IV. ANALYSIS OF LOGISITICS SUPPORT

A. INTRODUCTION

There are many factors that should be considered when making decisions for supporting a new system. Taking the time to plan upfront will mitigate some of the problems that field customers might otherwise needlessly endure. The challenge may be more difficult when the system is a Non-Developmental Item or uses an integration of commercial components in a military design (which will be defined as Technology Integration from this point forward.) In these cases, the acquisition timelines and logistics planning are compressed and there may be insufficient time to put the necessary support structure in place. The following discussion will describe some of the support challenges incurred with Technology Integration/NDI. This will be followed by examining the pros and cons of three alternative means of support that can be used in order to bridge the gap between initial fielding and a mature, responsive supply system. Warranties, contractor logistics support, and prime vendor support are the areas investigated. The chapter will conclude with some explanation of how these alternatives might have been used to bridge the support gap for the Tactical Quiet Generator (TQG).

B. SUPPORT CHALLENGES

The relatively short lead times required for fielding Non-Developmental items and Technology Integration items mean that getting the necessary support in place requires non-traditional thinking about support. Although there is relatively little opportunity to lessen the burden of logistics support by influencing the design of these items, the acquiring agency can, by using supportability as one of the selection criteria, influence the selection process. PMs need to recognize the inherent supportability risk of a Non Developmental item or Technology Integration. A significant part of the market investigation is to ensure that the system can be made compatible with military operations and its support infrastructure. Given these inherent program risks in the areas of life-cycle cost and supportability, an acquisition decision must not be made until tradeoff factors are identified, analyzed, and compared with other alternatives. [Ref. 31]

1. Configuration Management And Control

Configuration management and control must be carefully evaluated when considering Technology Integration and NDI alternatives. The ability of the user to adjust to possible configuration changes beyond his or her control, or even configuration visibility, is a major consideration. Over time, other users, commercial or military, will drive changes to the item that can affect the user's ability to support the item. One aspect of configuration management is modifications. Minimizing modifications to a Technology Integration or NDI item preserves the option of using the existing support system. As an item is modified, existing support deteriorates quickly and support becomes more difficult. Another aspect of configuration management is upgrades. Competitive pressure and evolving technology result in frequent product changes and improvements. Therefore, support plans should allow for frequent product upgrades or change-outs. [Ref. 31]

2. Logistics Support Planning

Technology Integration/NDI supportability is an issue that must be addressed up front before the item is fielded. When selecting a Technology Integration or NDI item, one cannot ignore any element of logistics support. The support elements must be thoroughly assessed during the market investigation because logistics support remains a critical factor. The major steps required to ensure that adequate logistics planning has taken place are described below. [Ref. 31]

LOGISTICS PLANNING STEPS

Step 1. Review operational requirements.
Step 2. Identify and obtain support data.
Step 3. Analyze support data.
Step 4. Make operational assessment decision.
Step 5. Provide for interim support, and develop interim support plan.
Step 6. Develop and assess final support plan. [Ref. 31]

3. Logistics Support Elements

The unique support considerations of Technology Integration items and NDI must be evaluated within the context of the logistics support elements. There are many opportunities and challenges associated with maintenance and supply planning. When developing a maintenance plan, manufacturers of commercial items may be willing and able to support their products with preventive maintenance, repair parts, and technical personnel through the item's expected service life. If organic support is unavoidable, the initial maintenance concept must identify criteria and subsequent maintenance concepts and formulate transition plans when required. Supportability analyses form the basis of good maintenance planning. When determining supply support one needs to capitalize on the availability of item history and previous user experience in determining supply support. Manufacturer data and other historical usage data may significantly aid in the accurate prediction of initial provisioning requirements for repair parts and related support equipment and help estimate follow-on provisioning needs. However, military-unique modifications to a Technology Integration item or NDI or military usage factors may invalidate manufacturer data and other historical data. Usage factors include service life, environment, and other factors that may differ between the intended military application and the original design application. Acquisition managers should also take into consideration the possible obsolescence or discontinuance of production of the replacement parts needed to sustain or repair fielded hardware. Alternative supply methods should be investigated and employed where cost-effective. [Ref. 31]

It is quite clear that there are some serious challenges to be faced when using Technology Integration/NDI, such as little chance to influence the design, configuration management issues if the design must be changed, as well as maintenance and supply planning problems. In the case of the TQG, it seems the PM-MEP understood that the Program Office could not influence the design due to its NDI approaches. The PM-MEP was in fact, quite aware of configuration management issues, but tried to upgrade the technology where it made sense to keep pace with new emerging applications. The PM-MEP's technology assessment was based on current ongoing investigations and lessons learned by the MEP staff. This assessment evaluated engines, alternators, control systems, and structural technologies in terms of potential to be integrated in the near, mid and long term. PM-MEP engineers continue to monitor the progress of all emerging technology innovations and identify cost-effective opportunities as the technology becomes commercially marketable [Ref. 2:p. 75].

The support challenges began with the PM-MEP's logistics support plan. It is apparent that the PM-MEP's logistic support plan was to have the ASL push package support the system in the field and wait for the supply system to mature. They did not have an interim support plan in place during the period when the supply system was maturing. From the data in Chapter 3, it clearly shows that supply support planning was inadequate. The following section will describe various methods that could have been used as an interim support plan.

C. WARRANTIES

Warranties were examined as a means to cover the gap between initial fielding and a mature supply system. Decisions in regards to warranties made during each acquisition phase can affect the remaining system life cycle. The program manager should understand the long-range impacts of early warranty decisions. A warranty is not undertaken without risk to both the Government and the contractors. Risks may be mitigated through appropriate activities during the acquisition phases and through tailored terms and conditions. Well-planned and integrated warranties need not cause serious disruptions of system deployment or support. Table 1 lists the possible risks associated with warranty procurements. [Ref. 32:p. 3-18]

WARRANTY RISKS	
FACTOR	**RISK**
Characteristic Addressed Under Warranty	The "wrong" characteristic may be selected, thereby focusing effort incorrectly
Price	It is difficult to estimate expected field performance which is a basic measure for realistic pricing
Operational Factors	Field stresses may be difficult to estimate because of many unforeseen circumstances
Self-Sufficiency	Contractor repair, if part warranty, can reduce military self-sufficiency for wartime critical items
Equipment Design	Contractor may design equipment more suitable for meeting the warranty commitment than for meeting the military maintenance environment
Transition	If required, transition from contractor maintenance to military maintenance can introduce serious administrative and logistics problems
Administrative Complexity	Procurement and logistics procedures may have to be developed to implement the warranty effectively

Table 1. Warranty Risks [From Ref. 32:p.3-18]

Warranties are tools. Their optimal use is determined by their contribution to production of higher quality weapon systems within appropriate life-cycle costs. The cost-effectiveness of a potential warranty must be a major determinant of whether to use a warranty or not. A life-cycle-cost (LCC) basis may be used, comparing LCC with and without a warranty. Warranty duration should be 10%-25% of the expected life and generally not less than one calendar year of operation. For any given procurement, there may be several warranty variants, each with multiple decision variables to consider. A complete warranty cost-benefit analysis should consider a number of competing alternatives. [Ref. 32:p. 2-10] Table 2 depicts a general approach to warranty cost-benefit analysis.

WARRANTY COST CONSIDERATIONS	
Reliability	MTBF Reliability Growth
Maintainability	MTTR Special Skills No evidence of failures
Readiness	Availability Consignment of spares
Logistics Flow	Pipeline and storage times Turnaround times Spare quantities
Initial Acquisition Cost	Unit cost Test Equipment cost Training cost Data cost
Support Cost	Support per operating hour Spares cost Maintenance labor cost Warranty administration cost Shipping cost Facility cost
Contract Adjustment	Warranty duration Turnaround time
Transition Cost	Facility cost Retraining cost Test equipment cost Inventory cost

Table 2. Warranty Cost Considerations [From Ref. 32:p. 7-10]

Tailoring of the warranty terms and conditions to match the system, procurement, and operational conditions is necessary to develop a cost-effective approach. The terms of any warranty should be developed based on the objectives and circumstances of the particular acquisition, considering the planned operational, maintenance, and supply concepts. In determining whether a warranty is appropriate for a specific acquisition, the acquisition team should consider the following factors: cost, administration and enforcement, operational limitations, terms and conditions, and remedies. During initial fielding, the supply system normally is not fully in place and is unable to cover unforeseen design or manufacturing defects. There might be problems with the system that only normal operating use will uncover; testing never finds all the problems associated with a new system. Tailoring a warranty to be sufficiently robust will assist the PM in responding to these unexpected problems during fielding. There are numerous different warranty arrangements and the selection depends on cost, benefit, and operational environment. [Ref. 32:p. 2-10]

There are three uses of warranties -- assurance validation, incentivization, and insurance. Assurance validation, in the strictest sense, ends at the acceptance of the system with respect to patent defects and after a reasonable period with respect to latent defects. Incentivization occurs when guarantee provisions define penalties for failure to achieve target parameters and/or rewards for "overachievement" of such targets. Insurance is used against the risks of repair or replacement costs. [Ref. 32:p. 3-1]

An assurance warranty is used when the primary intent is to assure that minimum design, quality, and performance levels are achieved. The Government is not seeking anything more than the contract specifies, and the warranty concept and terms and conditions do not provide any incentives for the contractor to do otherwise. A latent-defects provision in a warranty has the potential to alleviate uncertainties regarding latent defects by making the conditions clear under which a warranty claim can be made, regardless of the condition of the product at time of acceptance. An incentive warranty is used to provide incentives for the contractor to exceed minimum design, quality, or performance levels. Distinctions between assurance and incentive warranties are not always clear. Table list various procurement and deployment factors and their relationship to these two warranty types. [Ref. 32:p. 3-4]

ASSURANCE VS. INCENTIVE		
FACTOR	**ASSURANCE**	**INCENTIVE**
Intent	Meet minimum performance levels	Exceed minimum performance levels
Price	May be minimal	May be significant
Duration	Limited- usually 2 yrs or less	May be extensive- usually 3 yrs or more
Administration	Generally moderate	May be complex
Technology	1) Well within state of the art Or 2) So severely pushed that a limited warranty is realistic	Pushes state of the art. Employed to protect against failures and allows opportunity for growth
Contractor	Limited opportunity to control and improve performance	Significant opportunity to control and improve performance
Competition	May sustain competitive climate	May reduce competitive climate

Table 3. Assurance Vs. Incentive [From Ref. 32:p. 3-5]

Four of the more commonly used incentive warranties are Reliability Improvement Warranty (RIW), Mean Time Between Failures Guarantee (MTBFG), Availability Guarantee (AG), and Logistics Support Cost Guarantee (LSCG). Summaries of these four forms and Spare Parts-Level Warranty are discussed in Table 4 below. Spare Parts-Level Warranty (SPLW) is a unique adaptation of an availability guarantee wherein the availability is managed by providing consignment repair parts to meet the Mean Time Between Removal, Repair, or Replacement rate. This warranty is not a commonly known or used warranty, but is a type of warranty that could have been used in the case of the TQG.

SUMMARY OF FIVE INCENTIVE WARRANTIES				
TYPE	**OBJECTIVE**	**APPROACH**	**REMEDY**	**CONDITIONS**
RIW	Achieve acceptable reliability. Motivate contractor to improve.	Under fixed price, contractor performs depot maintenance at least 2 yrs.	Contractor repairs all failures. Has option to implement no-cost engineering change proposals.	Depot repairable units. Tolerable to reduce military self-sufficiency.
MTBFG	Achieve required field MTBF.	Contractor guarantees field MTBF. Measurements are made and compared.	If guaranteed value is not achieved, contractor must implement solution.	MTBF is appropriate parameter. MTBF is measurable.
AG	Achieve required operational availability.	System availability is measured in the field or through special tests and compared to guaranteed values.	If guaranteed value is not achieved, contractor must implement solution.	Availability is appropriate parameter. Availability is acceptably measured.
LSCG	Control LSC.	Contractor "bids" model-generated target LSC. Same model is used to obtain measured field parameters. Values are compared.	Contract price adjustment. Correction of deficiency may be required.	Appropriate LSC model exists. Generally, special test program required to obtain measured values.
Spare Parts-Level	Maintain the original system with a lowered Mean Time Between Removal, Repair, or Replacement (MTBR).	Contractor guarantees that if the system or item exceeds a specified percentage envelope from a guaranteed MTBR, the contractor will provide consignment spares.	Spare system or items or major components will be provided as consignment spares. Adjustments will be made for exceeding a specified percentage envelope.	FFP contracts for equipment or items, which are prime mission essential or operational safety essential. Designed for service organic maintenance.

Table 4. Summary Of Five Incentive Warranties [After Ref. 32:p. 3-8]

The objective of RIW is to achieve acceptable reliability while providing the motivation and mechanism for reliability improvement. This is accomplished through a fixed price contract for the contractor to perform repair for all covered failures during the warranty period. The price paid for the warranty is based on reasonable costs to repair covered failure rates when the field failure rate is consistent with that specified or "expected." It is in the interest of the contractor to produce equipment with an MTBF greater than the original MTBF if the incremental development or production costs to achieve the target MTBF are less than the reduction in future warranty repair costs. The contractor, who also repairs all failures, has the opportunity to devote resources to detect systemic failures as early as possible. If a fix can be developed and implemented in time to reduce the number of future failures economically, the contractor will be inclined to do so. [Ref. 32:p. 3-7]

An MTBFG provides a direct means for controlling the operational reliability of fielded systems. This is accomplished by specifying in the contract the MTBF to be achieved in the field, a means for measuring the operational MTBF, and actions to be taken if the measured MTBF is less than the guaranteed value. The MTBFG is best applied if the weapon system is under contractor maintenance so that the problems can be identified and remedied expeditiously. The MTBFG, in conjunction with an RIW, can provide a method for assuring satisfactory or improved reliability performance. [Ref. 32:p. 3-9]

An AG is similar in concept to an MTBFG in that it focuses on a measurable population characteristic rather than on individual systems failures. In this case, the characteristic is operational availability, which measures the system readiness rate. [Ref. 32:p. 3-11]

The LSCG is used when the main focus for control is logistics support cost (LSC). A target logistics support cost (TLSC) is established in the contract, reflecting the costs to support the guaranteed equipment (i.e. acquisition costs, reliability and maintainability, and support factors). Appropriate statistics on fielded equipment are collected, usually through a special test, and the measured logistics support cost (MLSC) is calculated. The MLSC is then compared to the TLSC; if the MSLC is greater, a warranty breach has occurred and specified remedies must be invoked. If the MLSC is less than the TLSC, a positive incentive such as an award fee may be applied. [Ref. 32:p. 3-12]

Another type of warranty is Spare Parts-Level Warranty. The objective of this warranty is to maintain the system capability with a lowered Mean Time Between Removal, Repair, or Replacement (MTBR). In this case the contractor guarantees that if the system or item exceeds a specified percentage envelope for the guaranteed MTBR, spare system or items or major components will be provided as consignment spares. If multiple tests are made over time, appropriate adjustments will be made for exceeding the specified percentage envelope. [Ref. 32:p. H-9]

As shown above, warranties can be crafted to do or cover support requirements. There are some excellent reasons to have extensive warranties as well as some very good grounds not to use warranties. A detailed cost benefit analysis needs to be conducted to ensure the Government is receiving good value for what it is actually paying. In the case of the TQG, as stated in Chapter 2, the PM-MEP used the warranty only for quality assurance. The existing warranty covered an important aspect, but provided minimal coverage. If the main objective of the warranty is to reduce the reliance on the supply system, warranties should be crafted to improve reliability.

Increased reliability decreases the need for spare parts, thereby; there is less need for the supply system to be responsive. If reliability cannot be influenced, as is often the case in Technology Integration/NDI systems, then the solution may be to craft a warranty that includes aspects of LSCG and Spare Parts-Level warranties. The trends revealed in

Chapter 3 clearly depict the need for some system to bridge the supply gap. A warranty with some features of LSCG and Spare Parts-Level would have helped Fort Campbell minimize the downtime that they experienced.

Additionally, the current warranty was meant for a unit that rarely goes to the field and, then, only for short periods of time. This was not the case for units at Fort Campbell, which spent at least 30 days in the field at a given time and went to the field more frequently. In such cases, first fielded units constantly train in the field for a long time are at risk of degraded readiness. Such units do not have the luxury of time to wait for the supply system to fill the requisitions or the contractor to fix the design flaws. To cover both problems, a time-phased warranty which had assurance, LSCG, and Spare Part-Level features in it would have worked well, using extensive coverage on early-fielded units and gradually decreasing the scope of the warranty as the fielding progressed and the supply system matured.

D. CONTRACTOR LOGISTICS SUPPORT

In conjunction with warranties, Contractor Logistics Support (CLS) was reviewed as a means to supplement the supply system during initial fielding. The logistics strategy must be compatible with the program acquisition strategy. Unfortunately, logistics concerns are often deferred for later resolution. Understandably, the Project Manager with a funding shortfall is more likely to cut the long-term logistics requirements from the contract than items with immediate impact. [Ref. 33] This gap seems to be a problem for systems that are developed using commercial and NDI items. When using commercial or NDI items, it is normally not possible to influence the design to minimize support requirements.

Since NDI systems are fielded relatively quickly, establishing the support system in time to meet the need can be a challenge. Logistics planning time is compressed. Decisions affecting spares must be made very early in the life cycle of a system. The DoD Logistics Strategic Plan states that in five years CLS will be applied essentially to all new weapon systems and major equipment except where military requirements or "best value analysis" dictate that organic support is more appropriate. [Ref. 34] CLS should be considered as a support alternative and utilized when determined to be effective in terms of reducing total ownership cost and improving readiness.

Conducting a support analysis must show that CLS is the optimum among feasible alternatives, will provide the required support in peacetime and wartime, is the most cost effective, and is in the government's best interest. A wide selection of contract types is available, and provides flexibility in acquiring the needed logistics resources. These contracts vary according to the degree and timing of responsibility and risks assumed by the contractor for cost and performance and the amount and nature of profit incentive. Logistics incentives mechanisms in contracts should be designed to address one or more of the following conditions:

> Designs that tend to reduce logistics costs during the operational phase of the life cycle (increased use of standard components, reduced trouble-shooting time, etc.); Logistics system accelerated delivery (all elements) commensurate with accelerated program delivery; and/or R&M [reliability and maintainability] thresholds exceeded. (Incentives are established for significant goals that will yield increased combat effectiveness or decreased ownership costs.) [Ref. 33]

Logistics managers must also ensure that follow-on repair parts are obtained in a cost-effective manner. Relying on the original prime contractor for follow-on support material entails risks in the areas of cost and availability of needed repair parts--especially during the post production support period. [Ref. 33] The major risk area in logistics contracting, in terms of impact and the probability of its occurrence, is the failure to contract for data, materials, and services. Impacts may include degraded support and readiness, cost growth, and loss of the taxpayers' good will and confidence. [Ref. 33]

The use of commercial support also has the best potential for allowing item evolution without affecting the ability to support fielded items. There are four benefits of Contractor Logistics Support. First, it can reduce the annual appropriated spare parts requirements, assuming the CLS contract results in a reduction in pipeline spares. Secondly, it can reduce the DoD infrastructure as the contractor assumes management and warehousing costs. Third, it can lead to long-term increase in component reliability at a limited cost to the Government assuming the CLS contract incentives provide profit motive for reliability growth. Finally, it can assist in the maintenance of the defense industrial base in times of tight budgets. Life Cycle Contractor Support considerations must be based on readiness and availability requirements, life cycle costs, support risks, design maturity, planned useful life, materiel system complexity, available manpower and personnel, and other acquisition and support issues. Depending on the type and length of support desired, one constraint is the Federal Acquisition Regulations and another is the Congressional budget process's restriction on contract length. Currently, contracts are limited to one year with four successive one-year options. This can pose problems with meeting the requirement for full and open competition, if the service life of a piece of equipment is 30 years and the Government desires CLS for a system's entire life. [Ref. 33]

Interim Supply Support is the recommended approach for supporting initial operation of newly fielded weapon systems. Interim Contractor Support (ICS) is a pre-planned, temporary support alternative for the initial period of operational support to a system or piece of equipment for which eventual organic support is planned; ICS cannot exceed three years. [Ref. 35] The Interim Supply Support Process is the recommended approach for supporting initial operation of newly fielded weapon systems. No spare parts unique to that weapon system are acquired or managed by the Government until the design is stable and organic capability is established. This allows the program to stabilize and actual usage data to accumulate for development of spare requirements. As items are identified as candidates for transition to a Government inventory control point for management, they will be catalogued. A transition package of items is procured to support until replenishment buys begin. [Ref. 35]

In the case of the TQG, it seems that Interim Contractor Support would have been the best way to ensure the supply support plan covered the transition from initial fielding to sustainment. As stated earlier, it seems that there was a supply problem with the TQG, not a maintenance problem. Having a contractor support the system until the design stabilized and the organic capability was established would have helped this predicament. Allowing the contractor to collect the usage data so that an accurate support package could be developed with true data on spares requirements would have been invaluable. This would have allowed the risk of stocking what was not needed to be shifted to the contractor, not the Government. The contractor would have been more responsive to stocking the right parts since they would have been motivated by profit. Additionally, the contractor would have provided a faster turnaround time on spares, since they would not have been not be held to the same constraints that the Government experienced in contracting for spares.

E. DLA AND PRIME VENDOR SUPPORT

The final area of investigation was the use of Prime Vendors for support of the supply system. Prime Vendor is an adaptation of industry's best practice of buying and distributing consumable products. [Ref. 36:p. 2] Prime Vendor support holds potential for significant savings to reinvest in modernization. It is an innovative way to reduce overall operation and support costs, improve availability of spare parts, and maintain weapon system readiness rates. The initiative allows the prime contractor to assume complete responsibility for its overall performance in the field. It eliminates the need for Government personnel and facilities to manage and store spare parts. [Ref. 37:p. 4] The Virtual Prime Vendor Program (VPV) is more commonly known as integrated supply chain management. A single vendor under a long-term contract anticipates the customer's support needs for a weapon system or commodity area and has supplies immediately available on demand. The VPV is responsible for providing total logistical support across traditional commodity or product lines by using state-of-the-art commercial business solutions. VPV functions can include forecasting requirements, purchasing, inventory control, engineering support, technical services, storage, and distribution functions. The VPV draws on a virtual inventory of its own stock, other vendor's inventories, DLA corporate level contracts, DLA prime vendors, and depot stock. The VPV integrates the supply chain, providing tailored logistics support to a specific major customer and or weapon system. The VPV also provides for national defense readiness and emergencies. Some of the benefits of using a VPV include reduced inventory, both wholesale and retail, faster delivery, direct visibility, access to commercial assets, reduced customer downtime for items awaiting out-of-stock parts, and value-added services, such as no hassle warranty on returns and technical support. VPV operates a process-wide paperless system that eliminates inventory redundancies, simplifies procedures, provides on-demand supply support, and provides a reduced total cost method of operation. [Ref. 36:p. 2-3]

The Army is pursuing their own program called Prime Vendor Support (PVS). PVS is an innovative way to reduce overall Operations and Support (O&S) costs, improve availability of parts, and maintain weapon system readiness rates. The initiative would allow the prime contractor of an Army weapon system to assume complete responsibility for its overall performance in the field. This program would transfer responsibility for complete wholesale support to a single accountable corporate entity, which would eliminate the need for Government personnel and facilities to manage and store parts. [Ref. 37:p. 4]

In evaluating whether to use the prime vendor approach, there are six criteria that must be considered:

- First, we must ensure that any new approach results in no degradation of readiness.
- Second, that it works in both peace and war.
- Third, that it meets applicable statutory requirements.
- Fourth, that it truly provides a significant cost savings.
- Fifth, that it guarantees a competitive industrial base and vendor base will remain for the future.
- Sixth, and perhaps the most important that any new approach is politically sustainable. [Ref. 37:p. 5]

Mechanics of a Prime Vendor Program -- The activity that awards the requirements contract for specified supplies to a prime vendor makes its selection on a best value basis. The activity running the program also establishes Distribution and Pricing Agreements (DAPA) with various manufacturers/ suppliers on a best value basis. Under a DAPA, the prime vendor agrees with the suppliers to distribute their products to customers in accordance with prices set forth in the agreement. DAPA is a non-contractual agreement. An Indefinite Delivery Type Contract may be used to establish the same terms and conditions. The prime vendor enters agreements with DAPA holders in order to develop an inventory of supplies. The prime vendor then owns and manages the inventory. The activity running the program establishes a contractual relationship between the prime vendor and future customers. [Ref. 37]

The Prime Vendor program is very similar to Contractor Logistics Support. The difference is that Prime Vendor is a long-term supply solution, initiated by DLA, CLS is a supply and maintenance solution initiated by the PM. This is a very powerful solution to the problem of supply support for the TQG. If a company had been responsible for the management of all parts for a single weapons system with access to Depot and DLA stocks, it could have been very effective. A Prime Vendor would not have had to deal with as many bureaucratic layers. The success of this initiative would have rested on a close partnership between the PM's office and the contractor. Additionally, the contract would have needed to have been crafted so that the contractor would receive an award for increased responsiveness as well as increased reliability of parts. Without the additional incentive, the support would have stayed the same as the existing system.

F. MOTIVATION

The recurring dilemma appears to be ensuring that the incentives for everyone from the project manager to the item manager are in line with the overall objective -- reduce life cycle cost, increase readiness and responsiveness. Until the incentives are changed, participants may not focus on readiness goals. The project manager traditionally concentrates on cost, schedule and performance. This is not to say that the PM-MEP did not care about the above issues; rather there is immense pressure from the field units as well as Congress to get an item fielded as cheaply and quickly as possible. Item managers may look at best value contracts that do not properly support the customer. Contractors try to fulfill what is in their contract, whether or not it satisfies the needs of the customer in the field.

Fort Campbell would have experienced much better support if there had been appropriate incentivization of the PM, the item manager, and the contractor. Changing the Acquisition Program Baseline to include logistic support goals and capabilities as well as field requirements, changes the elements the PM is graded on and, therefore, transforms the PM's priorities. Better item manager and contractor support would have occurred if the PM's priorities had been reestablished. Awards and incentives would have motivated both suppliers and contractors. The PM would have made sure the contracts reflected logistics support issues to include supply support and an interim support package so that Fort Campbell would not have faced the numerous support challenges.

G. MULTIPLE YEAR CONTRACTING

Another problem to be addressed is the length of multiple year contracts and their impact on programs and contractors. PM-MEP addressed this issue in the Master Plan as follows:

> Unlike the Major Defense Acquisition Programs, which often have long-term relationships with a single major defense contractor, the Tactical Electric Power program has traditionally been supported by multiple small businesses (or small large businesses). We [PM-MEP] presently have OPA contracts with four different contractors, and RDT&E contracts with three others. Because our "prime" contractors are frequently changing, it has been difficult (if not impossible) for us to establish long-term contractor logistics support, configuration management or drawing support relationships with our contractors. We have concluded that the best way to encourage a stable production base, improve contractor logistics support, and transfer more configuration management responsibilities to industry, is to increase the length of our contracts. Based on the pace of generator technology improvements and our ability to project our requirements, we concluded that ten-year contracts were optimal.
>
> By extending future re-buy contracts to ten years, we expect to foster more beneficial contractor relationships to better serve our Soldier, Sailor, Airman and Marine users. We also should achieve cost reductions through lower hardware costs, and through elimination of the additional solicitation processes-- including preparation of drawings/solicitations, elimination of source selection board costs and limitation of the number of First Article Tests (FAT) due to fewer procurements. PM-MEP is therefore planning to extend all future routine procurement contracts for generators from the current five, to ten-year requirements-type contracts. [Ref. 2]

Longer contracts allow for better partnering with industry. Contractors can then develop relationships with suppliers that work with incentives to improve the reliability and design of the product. Additionally, longer contracts allow for a better use of incentive warranties. Extending contracts also is less disruptive the logistics support system since there are less contractors to work with. Furthermore, lengthening the life of the contract eliminates redundancies and businesses do not have to repeat the learning curve upon award of a contract.

H. CHAPTER SUMMARY

Unfortunately, for Fort Campbell, the PM-MEP did not take sufficient action to alleviate the supply and readiness problems that plagued the 101st Airborne Division. Fort Campbell needed a system that bridged the gap between initial fielding and a mature supply system to ensure operational readiness. This did not happen. The 101st Airborne Division needed an initial fielding package that was tailored to the real problems with the TQGs. Fort Campbell also needed a more responsive supply system and warranty to satisfy its requests for spare parts. Furthermore, it needed a responsive mechanism that would react when readiness was being degraded by the supply system's inability to react. It is obvious the support systems failed to adequately deal with the TQG.

Having a better warranty, Contractor Logistics Support and Virtual Prime Vendor support could have alleviated these problems. It would have taken a combination of all these mechanisms to achieve success. The Project Manager needed to continue to stress the importance of logistic planning throughout the system's life cycle. Using a time phased warranty that incorporated aspects of assurance, LSCG, and Spare Parts-Level would have seen a return on the money invested. Interim Contractor Support would have covered risk, while maintaining readiness. Together these mechanisms would have allowed for adequate support coverage, while minimizing investment in repair parts as the design stabilized. Using Prime Vendor support after Contractor Logistics Support would have ensured uninterrupted coverage of the supply system. The use of incentives with Prime Vendors would have increased their responsiveness to long-term reliability and readiness of the TQG.

Proper incentivization of the PM, the item manager, and the contractor would have made the difference at Fort Campbell. Changing the Acquisition Program Baseline to include logistic support goals and capabilities based on field requirements would have refocused the PM's priorities. Realigning the PM's priorities would then have been reflected in better item manager and contractor provided support. The PM would have had a vested interest in making sure the contracts reflected logistics support issues to include supply support and an interim support package so that Fort Campbell could have overcome the numerous support challenges.

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V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The general lesson learned is that the Acquisition Program Baseline needs to be changed to reflect logistics support elements to ensure Project Mangers focus on continuous support of a newly fielded system. When using commercial items, non-developmental items, and technology insertion, the acquisition timeline is compressed and logistic support of these items suffers since there is less time to test and plan for spare parts. This has a tremendous effect of the field user. There may be at least a two-year gap (or more) between when an item is initially fielded and when the existing supply system becomes able to successfully react. When a chosen logistics strategy fails, it affects the operational availability of deploying field units in times of conflict and it may take years to get the unit well again. More assets are needed during the initial planning stages of these items to identify and produce the support structures needed for the life of the system. A combination of well written and executed warranties, contractor logistics support, and prime vendor support will allow for a successful fielding by ensuring the gap has been bridged between initial fielding and long term sustainment.

B. RECOMMENDATIONS

Users need to develop a better way of communicating their requirements needed in the field to the developers. Additionally, developers need to ensure they are thinking from the perspective of the user when they design systems. Systems engineers need to ensure they use integrated product teams when developing new systems and that someone represents the users and field logisticians on the team. Over the past five years, acquisition reform has better tied the user to the development process, but the perspective of the user and support logistician must be continually emphasized during system development.

The Acquisition Program Baseline needs to be changed to reflect logistics support planning elements. The PM's priorities need to be changed to ensure he or she is looking at the key logistical planning steps and the supportability of the system. Logistics support goals need to include operational availability, mean turnaround time, mean time to repair, and mean time between failure rates and the metrics to evaluate them.

Interim support planning should include warranties, contractor logistic support and prime vendor support. Warranties and CLS are solutions to be initiated by the PM and Prime Vendor is a solution to be initiated by DLA. The contracts need to be written to reflect the support really needed with awards and incentives for increased reliability and improvement. It will take a combination of all of these mechanisms to achieve success and bridge the gap between a newly fielded item and a mature supply system.

C. AREAS FOR FURTHER RESEARCH

There are many opportunities and different avenues to approach life cycle logistics support issues. Some possible areas for further research include:

A study of contractual arrangements to cover warranties, contractor logistics support, and prime vendor to include actual contract wording to cover interim logistics support.

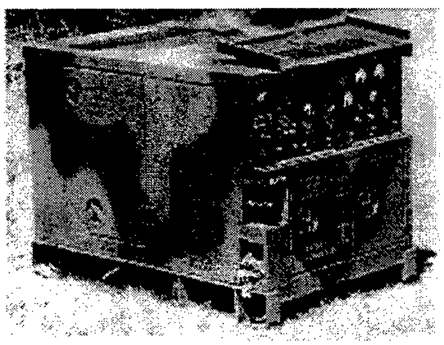
A study of the decision-making process needed to ensure the correct metrics are used in the Acquisition Program Baseline to guarantee proper attention and compliance to logistic support elements.

APPENDIX A. FAMILY OF TACTICAL QUIET GENERATORS

The following is pictures and information on each member of the family of Tactical Quiet Generators from 5kW to 60kW to include the Power Plants, which are just two generators mounted on a trailer.

5KW TQG GENERATOR

"THE WORKHORSE OF THE FLEET"

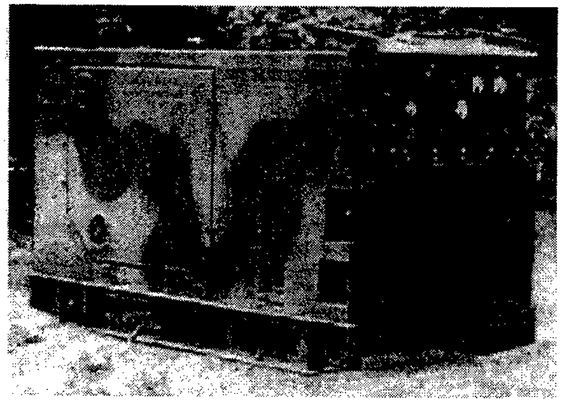


Typical Applications

Weapon Systems
Missile Systems
Causeway Systems
C4I Systems

Nomenclature	60 Hz TQG	400 Hz TQG
MEP Model Number	802A	812A
NSN	6115-01-274-7387	6115-01-274-7391
LIN	G11966	G12102
ZLIN	Z31532	Z47570
SSN	M535	M518
Wet Weight	888 lb.	911 lb.
Length	50.4 in.	50.4 in.
Width	31.8 in.	31.8 in.
Height	36.2 in.	36.2 in.
Cubic Feet	34	34
Noise at 7 meters	70 dBA	70 dBA
Voltage Connection	120 V, single phase, 2 wire; 120/240V, single phase, 3 wire; 120/208V, three phase, 4 wire	120 V, single phase, 2 wire; 120/240V, single phase, 3 wire; 120/208V, three phase, 4 wire
Replaced Items	J47068, J35813	J46252

10KW TQG GENERATOR



Typical Applications

Weapon Systems
Missile Systems
Laundry Units
C4I Systems
Refrigeration Systems

Nomenclature	60 Hz TQG	400 Hz TQG
MEP Model Number	803A	813A
NSN	6115-01-275-5061	6115-01-274-7392
LIN	G74711	G74779
ZLIN	Z47289	Z47366
SSN	M52900	M56500
Wet Weight	1182 lb.	1220 lb.
Length	61.7 in.	61.7 in.
Width	31.8 in.	31.8 in.
Height	36.2 in.	36.2 in.
Cubic Feet	41	41
Noise at 7 meters	70 dBA	70 dBA
Voltage Connection	120 V, single phase, 2 wire; 120/240V, single phase, 3 wire; 120/208V, three phase, 4 wire	120 V, single phase, 2 wire; 120/240V, single phase, 3 wire; 120/208V, three phase, 4 wire
Replaced Items	J49398, J35825	

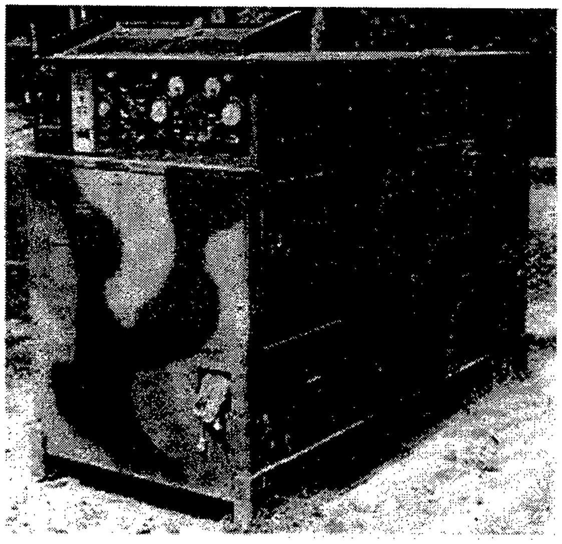
15KW TQG GENERATOR

Typical Applications

Weapon Systems
Missile Systems
Well Kit, Printing Plant
Topographic Support Systems
C4I Systems
Hospital Maintenance

Nomenclature	60 Hz TQG	400 Hz TQG
MEP Model Number	804A	814A
NSN	6115-01-274-7388	6115-01-274-7393
LIN	G12170	G12238
ZLIN	Z71049	Z71117
SSN	M549	M52600
Wet Weight	2124 lb.	2238 lb.
Length	69.3 in.	69.3 in.
Width	35.3 in.	35.3 in.
Height	54.1 in.	54.1 in.
Cubic Feet	77	77
Noise at 7 meters	70 dBA	70 dBA
Voltage Connection	120/208V, three phase, 4 wire; 240/416V, three phase, 4 wire	120/208V, three phase, 4 wire; 240/416V, three phase, 4 wire
Replaced Items	J35385, J35369	J36006

30KW TQG GENERATOR

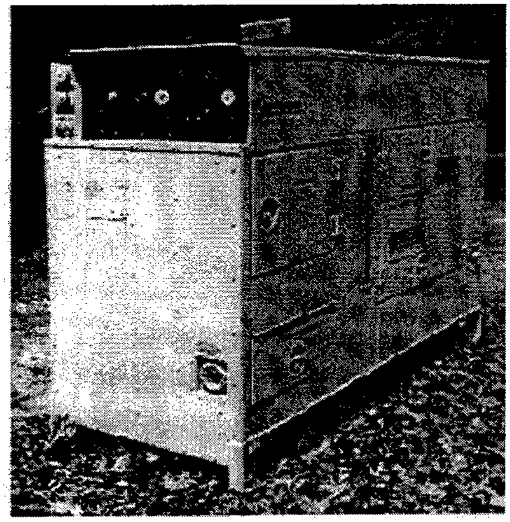


Nomenclature	60 Hz TQG	400 Hz TQG
MEP Model Number	805A	815A
NSN	6115-01-274-7389	6115-01-274-7394
LIN	G74575	G74643
ZLIN	Z06675	Z06743
SSN	M532	M50100
Wet Weight	3006 lb.	3015 lb.
Length	79.3 in.	79.3 in.
Width	35.3 in.	35.3 in.
Height	54.1 in.	54.1 in.
Cubic Feet	88	88
Noise at 7 meters	70 dBA	70 dBA
Voltage Connection	120/208V, three phase, 4 wire; 240/416V, three phase, 4 wire	120/208V, three phase, 4 wire; 240/416V, three phase, 4 wire
Replaced Items	J36109, J36304	J36725

Typical Applications

Weapon Systems
Missile Systems
Bakery Plant
ADP Support Systems
Water Purification
C4I Systems
Aviation Shop Sets

60KW TQG GENERATOR



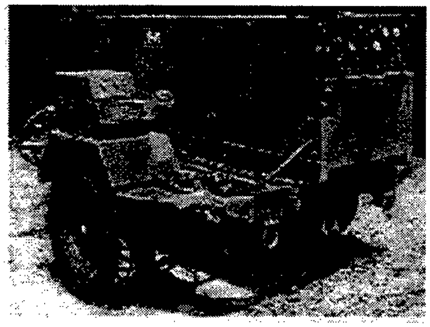
Typical Applications

Weapon Systems
Missile Systems
Earth Satellite Terminals
Field Hospitals/Schools
Aviation Ground Support

Nomenclature	60 Hz TQG	400 Hz TQG
MEP Model Number	806A	816A
NSN	6115-01-274-7390	6115-01-274-7395
LIN	G12034	G18052
ZLIN	Z31600	Z31668
SSN	M53400	M53100
Wet Weight	4063 lb.	4153 lb.
Length	86.3 in.	86.3 in.
Width	35.3 in.	35.3 in.
Height	58.2 in.	58.2 in.
Cubic Feet	103	103
Noise at 7 meters	70 dBA	70 dBA
Voltage Connection	120/208V, three phase, 4 wire; 240/416V, three phase, 4 wire	120/208V, three phase, 4 wire; 240/416V, three phase, 4 wire
Replaced Items	J38301, J38369	J38506

Power Units and Power Plants

Power Unit Description



Power units consist of a single generator (5 to 60kW) mounted on a trailer.

Generator Power Units

SIZE/ FREQUENCY	5KW/ 60 HZ	10KW/ 400 HZ	10KW/ 60 HZ	15KW/ 400 HZ	15KW/ 50-60 HZ	15KW/ 50-60 HZ	30KW/ 400 HZ	30KW/ 50-60 HZ	60KW/ 400 HZ	60KW/ 50-60 HZ
MEP Model Number	PU-797	PU-799	PU-798	PU-800	PU-801	PU-802	PU-804	PU-803	PU806	PU805
NSN	6115-01-332-0741	6115-01-313-4283	6115-01-319-9032	6115-01-317-2137	6115-01-319-9033	6115-01-3317-2138	6115-01-317-2135	6115-01-317-2136	6115-01-317-2133	6115-01-317-2134
LIN	G42238	G53403	G42170	G78203	G78374	Z00844	G35919	G35851	G17460	G78306
ZLIN	Z29764	Z44714	Z29764	Z67139	Z67071	Z00844	Z00776	Z00708	Z44748	Z29832
Weight	2320 lb.	2469 lb.	2457 lb.	4855 lb.	3180 lb.	4920 lb.	5730 lb.	5700 lb.	6813 lb.	6720 lb.
Cubic Feet	410	410	410	770	520	770	770	770	770	770
Prime Mover	Trk, Cgo 1-1/4 ton (e.g. HMMWV)	Trk, Cgo 1-1/4 ton (e.g. HMMWV)	Trk, Cgo 1-1/4 ton (e.g. HMMWV)z	Trk, Cgo 2-1/2 ton (e.g.M35A2)	Trk, Cgo 1-1/4 ton (e.g. HMMWV)	Trk, Cgo 2 1/2 ton (e.g. M35A2)	Trk, Cgo 2-1/2 ton (e.g. M35A2)	Trk, Cgo 2-1/2 ton (e.g. M35A2)	Trk, Cgo 2 1/2 ton (e.g. M35A2)	Trk, Cgo2-1/2 ton (e.g. M35A2)
Trailer	HMT or M116A3	HMT or M116A3	HMT or M116A3	M200A1	HMT or M116A3	M200A1	M200A1	M200A1	M200A1	M200A1
Replaced Items	G37273 J47343	J41819 J50195 J41836 J41436 J50205	J49809 G40744 J50083 J41786 J49946	G36074	G62574	J35492	G53871	J36383 G62642	J35680 J35414	J35629 J35595 J35663

Power Plant Description

Power plants consist of two generators per system, generally on a single trailer, but in a few cases two trailers that are connectable.

Generator Power Plants

SIZE/ FREQUENCY	3KW/ 400 HZ	3KW/ 60 HZ	5KW/ 60 HZ	5KW/ 60 HZ	10KW/ 60 HZ	15KW/ 400 HZ	15KW/ 50-60 HZ	30KW/ 400 HZ	30KW/ 50-60 HZ	60KW/ 50-60 HZ
MEP Model Number	MJQ-43	MJQ-42	MJQ-35	MJQ-36	MJQ-37	MJQ-38	PU-802	MJQ-39	MJQ-40	MJQ-41
NSN	6115-01-322-8582	6115-01-322-8583	6115-01-313-4216	6115-01-313-42157	6115-01-299-6035	6115-01-317-4214	6115-01-317-2138	6115-01-299-6034	6115-01-299-6033	6115-01-303-7896
LIN	TBD	TBD	P28083	P28151	P42262	P42330	G53778	P42614	P42126	P42194
ZLIN	Z13713	Z13645	Z75459	Z75459	Z50264	Z50263	Z00844	Z50263	Z50259	Z50259
Weight	TBD	TBD	3087 lb.	3785 lb.	4334 lb.	4350 lb.	9756 lb. (2 VEH)	9756 lb. (2PU)	11400 lb. (2PU)	15440 lb. (2PU)
Cubic Feet	TBD	TBD	420	600	600	600	1540	1540	1540	1540
Prime Mover	Trk, Cgo, 3/4 ton	Trk, Cgo, 3/4 ton	Trk, Cgo 1 1/4 ton (e.g., HMMWV)	Trk, Cgo 2-1/2 ton (e.g.M35A2)	Trk, Cgo, 2 1/2 ton, (e.g. M35A2)	Trk, Cgo 2 1/2 ton (e.g. M35A2)	Trk, Cgo 2-1/2 ton (e.g. M35A2)	Trk, Cgo 2-1/2 ton (e.g. M35A2)	Trk, Cgo 2 1/2 ton (e.g. M35A2)	Trk, Cgo2-1/2 ton (e.g. M35A2)
Trailer	HMT or M116A3	HMT or M116A3	HMT or M116A3	M103A3	M103A3	M103A1	M200A1	M200A1	M200A1	M200A1
Replaced Items	G78135 J46384	G78238 J46252	J47617 G41670	P41832 J47480 J46396	P28015 J42100 J50185	P42364 J50151	J35492	P28075	P27819	P27823 P27799

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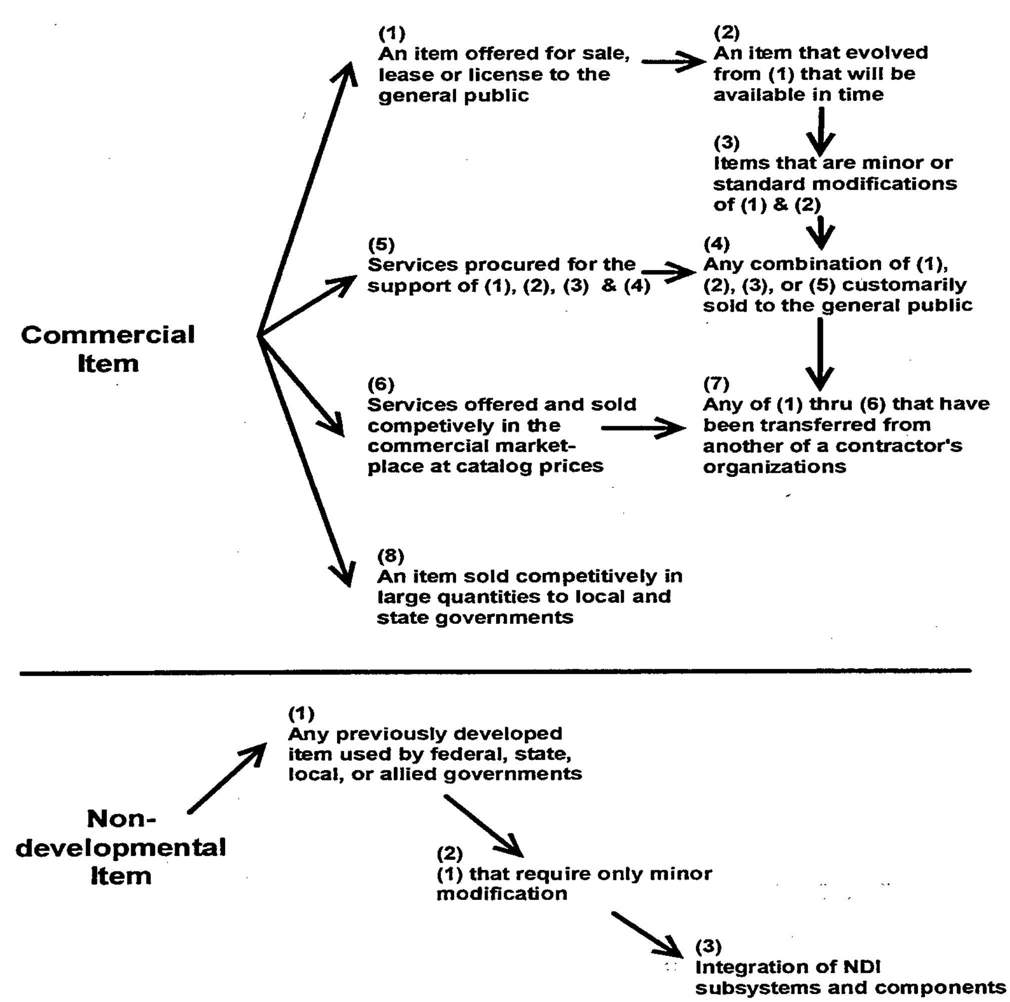
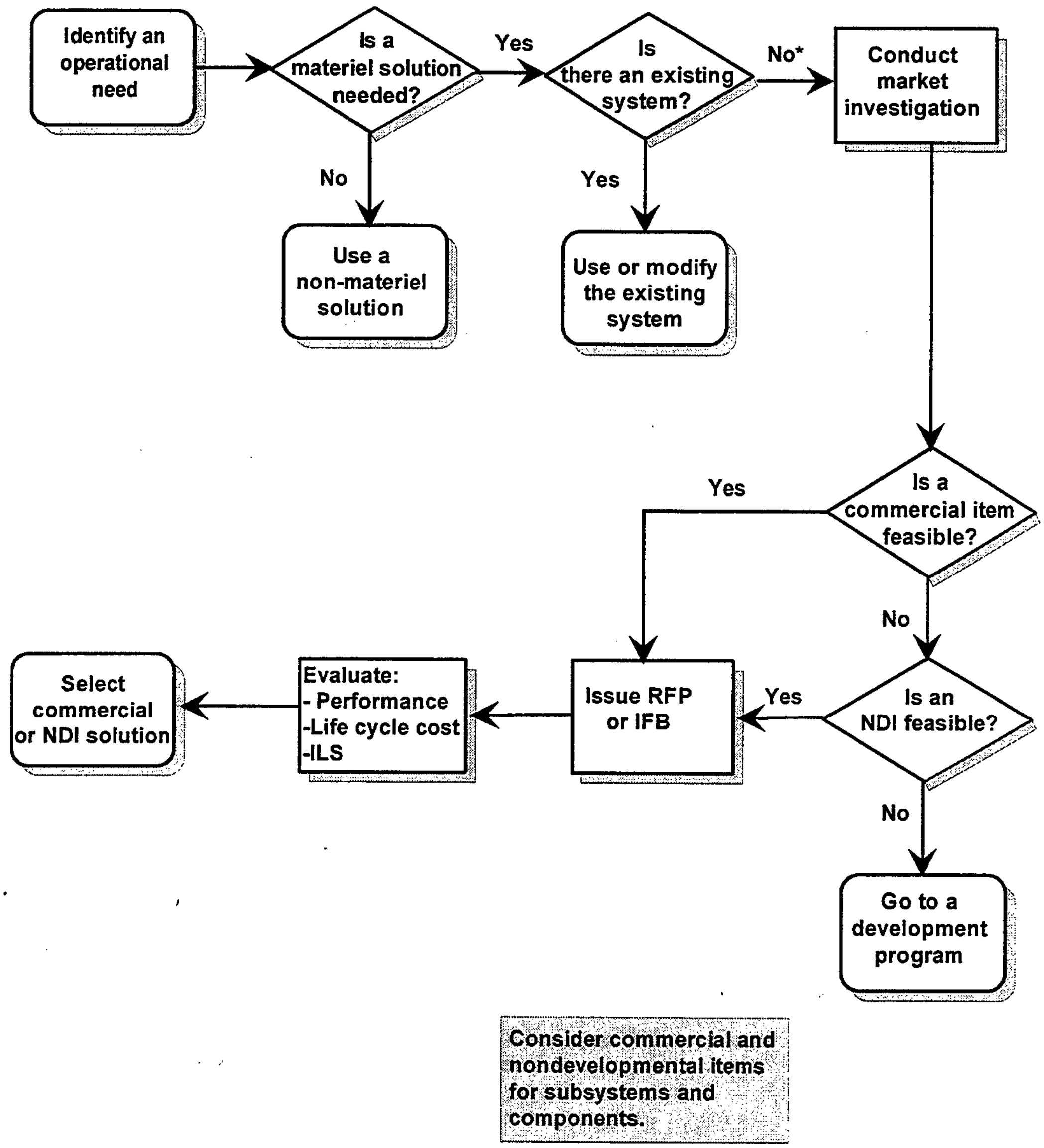
APPENDIX B. AQUISTION OF COMMERICIAL OFF THE SHELF VS. NON-DEVELOPMENTAL ITEMS

The following is the Federal Acquisition Regulation's definition of a Commercial Item or more commonly known as Commercial Off The Shelf (COTS) and Non Developmental Items. It is followed by the decision process a Project Manger must go through and tradeoffs between cost and time.

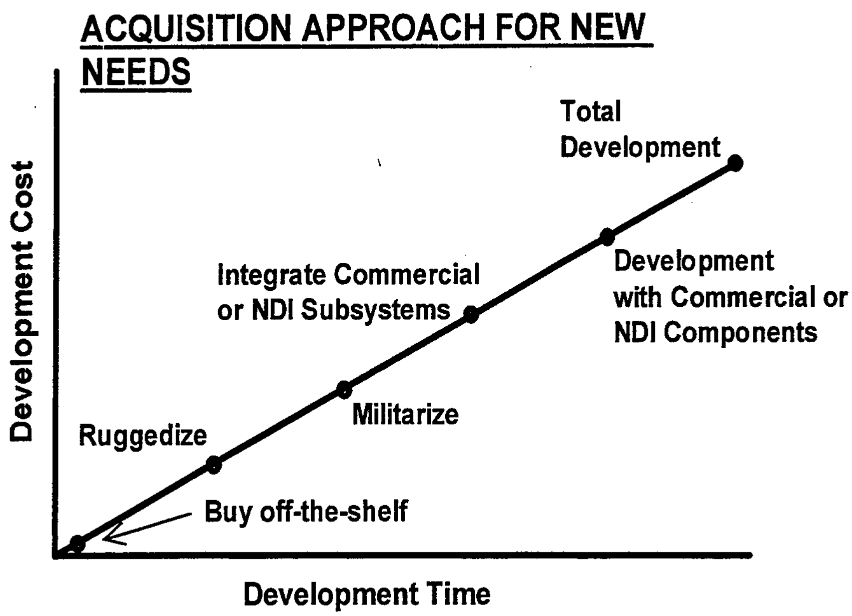
FAR DEFINITION SUMMARIZED



The Commercial/NDI Decision Process



* In preparation for the market investigation establish objectives and thresholds for cost, schedule, and performance based on the users' operational and readiness requirements.


ACQUISITION APPROACH FOR NEW NEEDS
Development Cost
Total Development
Development with Commercial or NDI Components
Integrate Commercial or NDI Subsystems
Militarize
Ruggedize
Buy off-the-shelf
Development Time

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APPENDIX C. ACRONYMS

AG	Availability Guarantee
AMC	Army Materiel Command
APU	Auxiliary Power Unit
AR	Acquisition Reform
ASIOE	Associated Support Items of Equipment
ASL	Authorized Stockage List
CAIV	Cost As an Independent Variable
CLS	Contractor Logistics Support
CONUS	Continental United States
COTS	Commercial Off the Shelf
CRP	Central Receiving Point
DAAS	Defense Automatic Addressing System
DATA	Decisions and Advanced Technology Associates
DISCOM	Division Support Command
DLA	Defense Logistics Agency
DLR	Depot Level Repairable
DoD	Department of Defense
DOL	Director of Logistics
DS	Direct Support
DT	Developmental Testing
FAT	First Article Test
FFP	Firm Fixed Price
FMC	Fully Mission Capable
FORSCOM	Forces Command
FP	Force Package
FUE	First Unit Equipped
GS	General Support
HAEMP	High Altitude Electromagnetic Pulse
ICT	Integrated Concept Team
ILS	Integrated Logistics Support
IPT	Integrated Production Team
IR	Infrared
ISC	Interim Logistics Support
LCC	Life Cycle Costs
LIF	Logistics Intelligence File
LOGSA	Logistics Support Activity
LSCG	Logistics Support Cost Guarantee
MACOM	Major Command
MASH	Mobile Army Surgical Hospital
MEPGS	Mobile Electric Power Generating Sources
MFP	Materiel Fielding Plan
MIL STD	Military Standard

MLSC	Measured Logistics Support Cost
MRO	Material Release Order
MSB	Main Support Battalion
MTAT	Mean Turn Around Time
MTBF	Mean Time Between Failures
MTBFG	Mean Time Between Failures Guarantee
MTBR	Mean Time Between Removal, Repair, or Replacement
MTBUE	Mean Time Between Unscheduled Events
MTTR	Mean Time To Repair
NDI	Non-Developmental Items
NET	New Equipment Training
NICP	National Inventory Control Point
NMCM	Non Mission Capable Maintenance
NMCS	Non Mission Capable Supply
NSN	National Stock Number
O&S	Order and Ship
OCONUS	Overseas, outside the Continental United States
OPTEMPO	Operational Tempo
OR	Operational Readiness
ORD	Operations Requirement Document
OST	Order Ship Time
OT	Operational Testing
PLL	Prescribed Load List
PM	Project Manager
PMCS	Preventive Maintenance Checks and Services
PM-MEP	Project Manager- Mobile Electric and Power
PU	Power Unit
PVS	Prime Vendor Support
R&D	Research and Development
RDD	Required Delivery Date
RIDB	Readiness Integrated Data Base
RIW	Reliability Improvement Warranty
SAMS	Standard Army Maintenance System
SARSS	Standard Army Retail Supply System
SSA	Supply Support Activity
SSR	Supply Support Requests
STTE	Special Tools and Test Equipment
TI	Technology Insertion
TLSC	Target Logistics Support Cost
TMDE	Test Measurement and Diagnostic Equipment
TPF	Total Package Fielding
TQG	Tactical Quiet Generator
ULLS	Unit Level Logistics System
VPV	Virtual Prime Vendor
WOLF	Work Order Logistics File

APPENDIX D. ORIGINAL FIELDING PACKAGE, DLA DEMAND HISTORY AND FT. CAMPBELL DEMAND HISTORY

The following table lists the original fielding package for Fort Campbell by National Stock Number (NSN), item name, price, unit of issue (UI), quantity needed for each type of generator, and total quantity per line item, and total price per line item. Then it lists the Defense Logistics Agency's (DLA) item manager's demand history for 1998 and 1999 with the total demand in lines and total demand in quantity. It is followed by whether it is demand supported by Fort Campbell (FTCKY) and if it is contained on the new fielding package.

	Original Fielding Package												DLA Demand History					
	NSN	NOUN	PRICE	UI	5 KW	10 KW	15 KW	30 KW	60 KW	TOTAL		TOTAL $ AMT	1998 TOT DMD LINES	1998 TOT DMD QTY	1999 TOT DMD LINES	1999 TOT DMD QTY	FTCKY Demand History Info	NEW FIELDING PACKAGE
6625	00-003-0975	WATTMETER	12.84	EA	0	0	1	1	1	3	$	38.52	203	440	194	346		Y
6625	00-004-8066	METER,ELECTRICAL FR	15.29	EA	0	0	1	1	1	3	$	45.87	223	481	198	344	Y	Y
2940	00-007-4791	FILTER ELEMENT,FLUI	2.90	EA	0	0	0	1	2	3	$	8.70	932	8,997	938	8,848	Y	Y
4730	00-024-3971	CLAMP,HOSE	0.20	EA	0	0	1	1	0	2	$	0.40	506	28,452	557	28,348		
4730	00-041-2526	ELBOW,PIPE TO HOSE	0.57	EA	0	0	1	0	0	1	$	0.57	131	1,073	83	605		
4730	00-063-7919	CLAMP,HOSE	0.11	EA	0	0	1	2	1	4	$	0.44	51	843	43	1,590	Y	
6625	00-081-5840	AMMETER	47.93	EA	0	0	0	1	0	1	$	47.93	82	145	83	200		Y
2910	00-099-5467	FILTER	2.89		2	1	0	0	0	3	$	8.67	405	3,127	439	3,151	Y	Y
3110	00-100-2357	BEARING,BALL,ANNULA	15.20	EA	0	0	0	1	1	2	$	30.40	4	7	2	3		
3110	00-100-2364	BEARINGXBALLXANNULA	9.71	EA	0	0	0	1	1	2	$	19.42	5	10	8	16		
4730	00-125-7916	ELBOW,PIPE TO TUBE	4.85	EA	1	1	0	0	0	2	$	9.70	12	33	5	28		
2910	00-141-9758	CAP,FUEL TANK	11.14	EA	1	1	1	1	1	5	$	55.70	359	749	437	684		
3110	00-144-8499	BEARINGXBALLXANNULA	1.98	EA	0	0	1	0	0	1	$	1.98	42	108	44	227		
3110	00-155-6298	BEARINGXBALLXANNULA	28.51	EA	0	0	1	1	1	3	$	85.53	49	232	51	148		
4730	00-177-6166	TEE,PIPE	1.91	EA	0	0	1	0	0	1	$	1.91	57	601	69	342		
4730	00-187-4202	PLUG,PIPE	0.16	EA	1	1	0	0	0	2	$	0.32	136	4,317	217	5,546	Y	
4730	00-200-0531	ADAPTER,STRAIGHT,PI	0.17	EA	0	0	1	0	0	1	$	0.17	55	2,145	51	2,388		
4730	00-202-6491	BUSHING,PIPE	0.28	EA	1	1	0	0	0	2	$	0.56	437	10,044	461	10,500	Y	
4730	00-209-1570	LOCKNUT,PIPE	0.75	EA	0	0	1	0	0	1	$	0.75	9	392	6	27		
4730	00-289-5484	ADAPTER,STRAIGHT,PI	0.55	EA	0	0	0	1	0	1	$	0.55	250	2,922	241	2,259		
4730	00-489-2492	ELBOW,PIPE TO TUBE	1.65	EA	0	0	1	0	1	2	$	3.30	12	81	15	167		
4730	00-574-8807	COUPLING,PIPE	5.64	EA	1	1	0	0	0	2	$	11.28	19	146	11	85		
6210	00-583-9349	LIGHT,INDICATOR	5.59	EA	1	1	0	0	0	2	$	11.18	259	1,137	268	1,342	Y	Y
4720	00-595-1088	HOSE,RUBBER	1.92	FT	0	0	0	1	0	1	$	1.92	573	40,723	403	31,038		
4820	00-595-3191	COCK,SHUTOFF,SCREW	7.10	EA	1	1	0	0	0	2	$	14.20	123	335	109	444		
4730	00-618-8497	ADAPTER,STRAIGHT,PI	0.79	EA	1	1	0	0	0	2	$	1.58	149	874	140	828		
4730	00-620-6904	ADAPTER,STRAIGHT,PI	1.01	EA	0	0	1	1	0	2	$	2.02	79	2,199	80	2,820		
4730	00-647-3207	ELBOW,PIPE TO TUBE	1.53	EA	1	1	1	0	0	3	$	4.59	145	1,156	155	1,161		
4730	00-752-9138	STRAINER ELEMENT,SE	16.48	EA	1	1	0	0	0	2	$	32.96	404	608	430	920		
4730	00-765-9103	NIPPLE,PIPE	0.24	EA	0	0	1	0	0	1	$	0.24	11	301	7	175		
4820	00-785-8153	COCK,SHUTOFF,SCREW	3.93	EA	0	0	0	1	1	2	$	7.86	220	960	211	969		
4720	00-804-9249	TUBING,NONMETALLIC	0.05	FT	0	0	0	2	0	2	$	0.10	44	9,287	58	9,684		
4730	00-812-1333	CAP,TUBE	2.11	EA	1	1	0	0	0	2	$	4.22	243	1,433	258	1,239		
4730	00-812-7999	ELBOW,PIPE TO TUBE	1.71	EA	0	0	1	0	0	1	$	1.71	145	1,296	125	882		
4730	00-833-7983	PLUG,PIPE	0.92	EA	1	1	0	0	0	2	$	1.84	3	3	7	29		
4730	00-842-2200	ADAPTER,STRAIGHT,TU	2.10	EA	1	1	0	1	1	4	$	8.40	534	22,240	395	15,843	Y	

	Original Fielding Package											DLA Demand History					
	NSN	NOUN	PRICE	UI	5 KW	10 KW	15 KW	30 KW	60 KW	TOTAL	TOTAL $ AMT	1998 TOT DMD LINES	1998 TOT DMD QTY	1999 TOT DMD LINES	1999 TOT DMD QTY	FTCKY Demand History Info	NEW FIELDING PACKAGE
4730	00-842-2201	ADAPTER,STRAIGHT,TU	2.65	EA	0	0	1	1	1	3	$ 7.95	427	5,469	375	4,916		
4730	00-852-6951	SLEEVE,COMPRESSION,	0.11	EA	0	0	0	2	1	3	$ 0.33	3	13	3	5		
6625	00-869-3144	VOLTMETER	50.30	EA	0	0	1	0	1	2	$ 100.60	179	313	268	497	Y	Y
4730	00-897-5497	COUPLING,PIPE *	1.90	EA	1	0	0	0	0	1	$ 1.90	100	544	91	381	Y	
4730	00-908-3193	CLAMP,HOSE	0.29	EA	1	1	1	1	0	4	$ 1.16	1,535	123,866	1,524	96,978	Y	
4730	00-908-3194	CLAMP,HOSE	0.22	EA	1	1	1	1	0	4	$ 0.88	1,700	135,505	1,777	153,186	Y	
4730	00-908-6293	CLAMP,HOSE	0.40	EA	0	0	1	0	3	4	$ 1.60	785	25,148	815	25,202	Y	
4730	00-908-6294	CLAMP,HOSE	0.61	EA	1	1	1	1	0	4	$ 2.44	815	28,117	970	31,629		
4730	00-909-8627	CLAMP,HOSE	0.29	EA	0	0	1	0	0	1	$ 0.29	1,236	60,878	1,369	79,861	Y	
4730	00-995-1559	ADAPTER,STRAIGHT,PI	1.13	EA	0	0	1	0	0	1	$ 1.13	234	3,132	226	3,538		
4730	00-995-1568	ELBOW,PIPE TO TUBE	1.63	EA	0	0	0	1	0	1	$ 1.63	32	141	22	136		
4820	00-999-4135	VALVE,ANGLE	2.29	EA	0	0	0	1	1	2	$ 4.58	1	1	2	4		
4820	01-008-2922	VALVE,BALL	12.88	EA	0	0	1	1	0	2	$ 25.76	91	649	46	265		
3030	01-017-4340	BELT,V	5.79	EA	0	0	1	0	0	1	$ 5.79	164	624	244	759	Y	Y
4730	01-020-5607	LOCKNUT,TUBE FITTIN	0.40	EA	1	1	1	0	0	3	$ 1.20	31	211	24	166		
4730	01-043-6300	SLEEVE,FLARED,TUBE	0.30	EA	1	0	0	0	0	1	$ 0.30	49	508	40	544	Y	
4730	01-051-9840	ELBOW,PIPE TO TUBE	1.41	EA	1	1	0	0	0	2	$ 2.82	6	17	18	54	Y	
2815	01-101-2431	LOCK,VALVE SPRING R	1.92	EA	1	1	0	0	0	2	$ 3.84	6	16	1	4		
2940	01-103-3296	FILTER	24.96		0	0	1	0	0	1	$ 24.96	1	1	0	0		Y
6145	01-104-5076	CABLE,POWER,ELECTRI	0.21	FT	0	0	0	2	0	2	$ 0.42	6	1,327	10	1,127		
4720	01-116-7814	HOSE,PREFORMED	3.15	EA	0	0	0	1	0	1	$ 3.15	12	21	5	27		
2920	01-117-0825	BRACKET,ENGINE ACCE	8.13	EA	0	0	0	1	0	1	$ 8.13	0	0	1	1		
2920	01-117-0826	BRACKET	0.00		0	0	0	1	0	1	$ -	0	0	1	1		
4730	01-117-1935	ADAPTER,STRAIGHT,PI	3.30	EA	0	0	0	1	0	1	$ 3.30	1	5	0	0		
3020	01-117-8986	PULLEY,GROOVE	13.29	EA	0	0	0	1	0	1	$ 13.29	6	14	10	14		
4730	01-119-0558	ADAPTER,STRAIGHT,PI	2.43	EA	0	0	0	1	0	1	$ 2.43	4	4	3	16		
4730	01-119-6897	COUPLING,TUBE	0.54	EA	0	0	0	1	1	2	$ 1.08	7	21	4	9		
4730	01-120-3316	NUT,TUBE COUPLING	0.94	EA	0	0	0	1	0	1	$ 0.94	11	64	11	37		
4730	01-123-8618	ADAPTER,STRAIGHT,TU	2.94	EA	0	0	1	0	0	1	$ 2.94	22	71	8	91		
4730	01-126-2173	NIPPLE,TUBE	2.27	EA	0	0	1	1	1	3	$ 6.81	16	111	15	119		
6145	01-128-2979	CABLE,SPECIAL PURPO	0.34	FT	0	0	0	2	0	2	$ 0.68	7	6,390	3	1,443		
6620	01-128-3053	TRANSMITTER,PRESSUR	18.06	EA	1	1	1	0	0	3	$ 54.18	104	196	165	328	Y	Y
4730	01-134-9827	ADAPTER,STRAIGHT,PI	0.94	EA	0	0	1	1	0	2	$ 1.88	1	2	2	4		
3110	01-160-9663	BEARING,ROTOR	21.74	EA	1	1	0	0	0	2	$ 43.48	9	41	9	14	Y	
4820	01-192-7676	VALVE,VACUATOR	8.44	EA	0	0	0	1	1	2	$ 16.88	23	61	31	59		
3040	01-196-1487	BRACKET,EYE,ROTATIN	8.07	EA	0	0	0	1	0	1	$ 8.07	0	0	0	0		

		Original Fielding Package										DLA Demand History					
	NSN	NOUN	PRICE	UI	5 KW	10 KW	15 KW	30 KW	60 KW	TOTAL	TOTAL $ AMT	1998 TOT DMD LINES	1998 TOT DMD QTY	1999 TOT DMD LINES	1999 TOT DMD QTY	FTCKY Demand History Info	NEW FIELDING PACKAGE
4730	01-199-1439	ADAPTER,STRAIGHT,PI	4.89	EA	0	0	0	1	1	2	$ 9.78	0	0	1	20		
4730	01-200-0798	ELBOW,PIPE TO TUBE	7.12	EA	0	0	0	1	1	2	$ 14.24	0	0	1	1		
4820	01-206-1286	COCK,DRAIN	3.58	EA	0	0	1	0	0	1	$ 3.58	1	2	4	9		
6140	01-210-1964	BATTERY,STORAGE	57.22	EA	0	0	1	0	0	1	$ 57.22	0	0	0	0		
6145	01-213-5495	CABLE,POWER,ELECTRI	0.37	FT	0	0	0	2	0	2	$ 0.74	22	6,046	14	1,404		
3110	01-214-8361	BALL,BEARING	19.15	EA	1	1	0	0	0	2	$ 38.30	9	14	11	21		
6620	01-220-7105	THERMOSTAT	21.11	EA	0	0	1	0	0	1	$ 21.11	56	152	60	104	Y	Y
4710	01-221-5770	TUBE ASSEMBLY,METAL	13.30	EA	0	0	1	0	0	1	$ 13.30	1	1	5	7	Y	
4730	01-221-7154	CONNECTOR,MULTIPLE,	9.89	EA	0	0	1	0	0	1	$ 9.89	1	1	2	4		
2805	01-221-7364	DEFLECTOR,DIRT AND	2.45	EA	0	0	2	0	0	2	$ 4.90	15	59	14	180		
2815	01-221-7484	PUSH ROD,ENGINE POP	3.30	EA	0	0	1	0	0	1	$ 3.30	3	15	3	14		
2815	01-221-7485	LOCK,VALVE SPRING R	0.32	EA	0	0	1	0	0	1	$ 0.32	1	2	3	23		
4730	01-221-8816	FITTING	1.01	EA	0	0	1	0	0	1	$ 1.01	0	0	0	0		
2815	01-221-8925	ROCKER ARM,ENGINE P	10.27	EA	0	0	1	0	0	1	$ 10.27	3	4	2	5		
2815	01-221-8926	ROCKER ARM,ENGINE P	9.04	EA	0	0	1	0	0	1	$ 9.04	3	3	3	8		
4730	01-222-0235	TEE,PIPE TO TUBE	8.61	EA	1	1	0	0	0	2	$ 17.22	8	14	6	53		
2815	01-222-0793	INSERT,ENGINE VALVE	7.50	EA	0	0	1	0	0	1	$ 7.50	1	1	1	1		
2815	01-222-1001	GUIDE,ENGINE POPPET	1.34	EA	0	0	1	0	0	1	$ 1.34	3	4	2	16		
2815	01-222-5491	ROCKER ARM,ENGINE P	10.17	EA	0	0	1	0	0	1	$ 10.17	4	7	3	8		
4730	01-222-7562	BOLT,FLUID PASSAGE	1.30	EA	0	0	1	0	0	1	$ 1.30	6	24	7	34		
2520	01-223-8780	SHIFTER FORK	6.02	EA	1	1	0	0	0	2	$ 12.04	7	9	0	0		
2920	01-224-6246	PARTS KIT,STARTER D	5.09	EA	1	1	0	0	0	2	$ 10.18	12	14	18	35		Y
2920	01-224-6247	PARTS KIT,STARTER D	5.09	EA	1	1	0	0	0	2	$ 10.18	10	12	14	31		Y
2920	01-224-8389	PARTS KIT,STARTER D	37.79	EA	1	0	0	0	0	1	$ 37.79	0	0	0	0		
3020	01-225-6988	GEAR,SPUR	19.77	EA	1	1	0	0	0	2	$ 39.54	1	1	1	1		
3030	01-231-7066	BELT,V	9.41	EA	0	0	0	2	0	2	$ 18.82	63	123	52	108		Y
4730	01-236-1186	TEE,PIPE	3.70	EA	0	0	1	0	0	1	$ 3.70	0	0	3	19		
4710	01-248-8113	TUBE ASSEMBLY,METAL	22.08	EA	0	0	1	0	0	1	$ 22.08	1	1	1	3		
4710	01-249-2118	TUBE ASSEMBLY,METAL	22.08	EA	0	0	1	0	0	1	$ 22.08	0	0	1	3		
4710	01-249-2119	TUBE ASSEMBLY,METAL	22.08	EA	0	0	1	0	0	1	$ 22.08	0	0	1	3		
4710	01-249-3576	TUBE ASSEMBLY,METAL	25.60	EA	0	0	1	0	0	1	$ 25.60	0	0	1	3		
3120	01-250-2116	BEARING,SLEEVE	4.76	EA	0	0	1	0	0	1	$ 4.76	1	2	2	3		
3110	01-252-0446	BEARING,BALL,ANNULA	34.94	EA	0	0	1	0	0	1	$ 34.94	0	0	0	0		
2590	01-260-0382	CAP,FILLER OPENING	5.71	EA	0	0	1	0	0	1	$ 5.71	8	9	6	9		
4730	01-262-2585	BOLT,FLUID PASSAGE	1.20	EA	0	0	1	0	0	1	$ 1.20	0	0	3	8		
2990	01-262-2653	BRACKET,ENGINE ACCE	3.60	EA	0	0	1	0	0	1	$ 3.60	0	0	1	1		

	Original Fielding Package											DLA Demand History					
	NSN	NOUN	PRICE	UI	5 KW	10 KW	15 KW	30 KW	60 KW	TOTAL	TOTAL $ AMT	1998 TOT DMD LINES	1998 TOT DMD QTY	1999 TOT DMD LINES	1999 TOT DMD QTY	FTCKY Demand History Info	NEW FIELDING PACKAGE
4720	01-262-6271	HOSE,PREFORMED	6.41	EA	0	0	1	0	0	1	$ 6.41	4	4	3	8		
2520	01-263-3149	FILLER NECK	10.66	EA	0	0	1	0	0	1	$ 10.66	3	4	1	1		
2990	01-263-3171	BRACKET,ENGINE ACCE	9.29	EA	0	0	1	0	0	1	$ 9.29	0	0	0	0		
4730	01-264-3345	BOLT,FLUID PASSAGE	3.26	EA	0	0	1	0	0	1	$ 3.26	0	0	1	4		
4730	01-264-3880	CLAMP,HOSE	1.79	EA	0	0	1	0	0	1	$ 1.79	0	0	0	0		
4820	01-264-5571	VALVE,CHECK	1.52	EA	0	0	1	0	0	1	$ 1.52	0	0	3	6		
4730	01-264-9459	ADAPTER,STRAIGHT,TU	3.31	EA	0	0	1	0	0	1	$ 3.31	0	0	1	2		
4730	01-264-9460	ADAPTER,STRAIGHT,TU	1.30	EA	0	0	1	0	0	1	$ 1.30	0	0	0	0		
4730	01-268-2448	ADAPTER,CHECK VALVE	5.41	EA	0	0	1	0	0	1	$ 5.41	0	0	0	0		
4730	01-269-2313	PLUG,PIPE	1.65	EA	0	0	1	0	0	1	$ 1.65	0	0	0	0		
4720	01-269-8761	HOSE,NONMETALLIC	2.35	EA	0	0	0	1	1	2	$ 4.70	0	0	4	5		
4730	01-280-4081	BOLT,FLUID PASSAGE	3.98	EA	0	0	1	0	0	1	$ 3.98	5	25	5	12		
4820	01-299-1607	VALVE, BALL	0.00		1	1	0	0	0	2	$ -	1,066	3,183	1,116	3,191		
2815	01-303-2505	COVER,TAPPET	27.39	EA	0	0	1	0	0	1	$ 27.39	0	0	0	0		
4730	01-324-2117	ELBOW,TUBE TO BOSS	4.96	EA	0	0	0	1	0	1	$ 4.96	2	4	3	9		
3120	01-330-8382	BEARING,SLEEVE	5.49	EA	0	0	0	1	1	2	$ 10.98	4	8	5	11		
2920	01-331-3567	GENERATOR,ENGINE AC	153.01	EA	0	0	0	2	1	3	$ 459.03	98	109	105	134	Y	
4820	01-333-0164	SEAT,VALVE	7.83	EA	0	0	0	1	1	2	$ 15.66	1	1	1	3		
2815	01-333-0256	PUSH ROD,ENGINE POP	3.55	EA	0	0	0	1	1	2	$ 7.10	4	25	4	15		
2815	01-333-0730	INSERT,ENGINE VALVE	11.33	EA	0	0	0	1	1	2	$ 22.66	1	6	1	6		
2805	01-333-0751	ROTOR,ENGINE POPPET	9.92	EA	0	0	0	2	1	3	$ 29.76	4	84	3	18		
2815	01-333-1457	VALVE,POPPET,ENGINE	13.32	EA	0	0	0	1	1	2	$ 26.64	10	45	5	8		
4730	01-333-1948	ELBOW,PIPE	16.74	EA	0	0	0	1	1	2	$ 33.48	7	11	5	9		
2910	01-333-2238	VALVE,FUEL SYSTEM	5.80	EA	0	0	0	1	1	2	$ 11.60	2	2	1	7		
2910	01-333-2309	NOZZLE,FUEL INJECTI	67.03	EA	0	0	0	1	1	2	$ 134.06	15	66	29	103		Y
2815	01-335-3545	LOCK,VALVE SPRING R	0.11	EA	0	0	0	2	2	4	$ 0.44	22	101	4	45		
2815	01-335-4414	VALVE,POPPET,ENGINE	11.70	EA	0	0	0	1	0	1	$ 11.70	9	67	3	8		
2920	01-335-5893	REGULATOR,ENGINE GE	20.89	EA	0	0	0	1	1	2	$ 41.78	6	7	5	6	Y	
4730	01-336-6962	PLUG,PIPE	0.21	EA	0	0	0	2	0	2	$ 0.42	0	0	0	0		
2910	01-337-7377	PUMP,FUEL,METERING	45.75	EA	0	0	0	1	0	1	$ 45.75	0	0	0	0	Y	
4730	01-337-7632	BUSHING,PIPE	2.57	EA	0	0	0	1	1	2	$ 5.14	9	30	11	27		
6685	01-348-4793	THERMOSTAT,FLOW CON	10.12	EA	0	0	0	2	0	2	$ 20.24	60	67	35	43		Y
2910	01-355-6028	INJ ASSY	128.55		2	1	0	0	0	3	$ 385.65	56	144	64	163		Y
3030	01-357-4157	BELT,V	7.41	EA	0	0	3	0	0	3	$ 22.23	0	0	3	3		
2815	01-357-5704	ROCKER ARM,ENGINE P	24.75	EA	0	1	0	0	0	1	$ 24.75	4	8	6	18		
4730	01-357-8705	UNION,PIPE TO HOSE	16.86	EA	1	1	0	0	0	2	$ 33.72	1	4	0	0		

		Original Fielding Package										DLA Demand History					
	NSN	NOUN	PRICE	UI	5 KW	10 KW	15 KW	30 KW	60 KW	TOTAL	TOTAL $ AMT	1998 TOT DMD LINES	1998 TOT DMD QTY	1999 TOT DMD LINES	1999 TOT DMD QTY	FTCKY Demand History Info	NEW FIELDING PACKAGE
4730	01-357-8706	TEE,HOSE	2.53	EA	1	1	0	0	0	2	$ 5.06	14	39	14	60	Y	
4730	01-358-6994	CLAMP,HOSE	0.33	EA	1	1	0	0	0	2	$ 0.66	17	425	30	775	Y	
2920	01-359-1077	PARTS KIT,ELECTRICA	0.25	KT	0	0	0	1	0	1	$ 0.25	1	1	0	0		
2815	01-359-4955	OIL PUMP ASSEMBLY,E	145.97	EA	1	1	0	0	0	2	$ 291.94	1	2	1	1		
2910	01-359-4971	FILTER	11.16	EA	0	0	0	3	3	6	$ 66.96	325	2,287	512	3,906	Y	Y
2930	01-359-4992	WATER PUMP	188.41	EA	1	1	0	0	0	2	$ 376.82	18	28	31	38		Y
2910	01-359-6543	PUMP,FUEL,METERING	773.48	EA	0	0	0	1	0	1	$ 773.48	62	75	47	116	Y	
3120	01-359-7002	BUSHING,SLEEVE	23.92	EA	0	1	0	0	0	1	$ 23.92	0	0	0	0		
4520	01-359-8114	HEATING ELEMENT,ELE	193.30	EA	1	1	0	0	0	2	$ 386.60	11	19	15	24		
2815	01-359-8471	GUIDE,VALVE STEM	5.61	EA	1	1	0	0	0	2	$ 11.22	1	2	1	1		
2815	01-359-8473	TAPPET,ENGINE POPPE	18.21	EA	1	1	0	0	0	2	$ 36.42	0	0	1	1		
2815	01-360-3221	VALVE,POPPET,ENGINE	14.12	EA	1	1	0	0	0	2	$ 28.24	6	11	3	4		
2920	01-360-3314	GLOW PLUG	22.58	EA	0	0	1	0	0	1	$ 22.58	11	56	9	59		
2910	01-360-6368	FILTER ELEMENT,FLUI	16.28	EA	0	0	2	0	0	2	$ 32.56	169	1,282	170	801	Y	Y
2915	01-360-6943	PUMP,FUEL,METERING	107.23	EA	1	1	0	0	0	2	$ 214.46	170	472	202	649		
4730	01-360-9198	ELBOW,PIPE TO TUBE	1.59	EA	0	0	0	1	1	2	$ 3.18	2	2	7	9		
6685	01-360-9653	THERMOSTAT,FLOW CON	64.30	EA	1	1	0	0	0	2	$ 128.60	21	27	34	61	Y	Y
3110	01-361-0251	BALL,BEARING	0.20	EA	0	0	0	2	1	3	$ 0.60	5	5	2	2		
2815	01-361-0770	PUSH ROD,ENGINE POP	8.13	EA	1	1	0	0	0	2	$ 16.26	13	50	11	57		
3110	01-361-2801	RETAINER,BALL BEAR *	0.89	EA	0	0	0	1	1	2	$ 1.78	1	1	0	0		
2940	01-361-5161	FILTER ELEMENT,FLUI	8.18	EA	2	1	0	0	0	3	$ 24.54	348	2,715	473	3,887		Y
2815	01-361-7711	VALVE,POPPET,ENGINE	11.80	EA	1	1	0	0	0	2	$ 23.60	5	10	2	2		
3120	01-361-7891	BUSHING,SLEEVE	6.71	EA	0	1	0	0	0	1	$ 6.71	0	0	0	0		
4820	01-361-8099	VALVE,SAFETY RELIEF	61.04	EA	1	1	0	0	0	2	$ 122.08	0	0	0	0		
4720	01-362-1702	HOSE ASSEMBLY,NONME	16.48	EA	0	0	0	1	0	1	$ 16.48	2	2	2	2		
2815	01-362-1753	INSERT,ENGINE VALVE	9.61	EA	0	0	1	0	0	1	$ 9.61	0	0	0	0		
4710	01-362-1981	TUBE AND FITTINGS,M	19.18	EA	0	0	0	1	0	1	$ 19.18	1	1	3	3		
4730	01-362-5574	NIPPLE,PIPE	2.65	EA	0	0	1	0	0	1	$ 2.65	0	0	0	0		
4730	01-362-5575	NIPPLE,PIPE	15.82	EA	0	0	1	0	0	1	$ 15.82	0	0	1	3		
2815	01-362-5668	VALVE,POPPET,ENGINE	35.28	EA	0	0	1	0	0	1	$ 35.28	0	0	2	10		
6110	01-363-0493	REGULATOR,VOLTAGE	225.00	EA	0	0	1	0	0	1	$ 225.00	39	53	39	47		
4710	01-363-2490	PIPE ASSEMBLY,METAL	11.53	EA	0	0	1	0	0	1	$ 11.53	0	0	5	7	Y	
2930	01-363-3096	PUMP,COOLING SYSTEM	151.57	EA	0	0	1	0	0	1	$ 151.57	7	12	23	37		
2815	01-363-5159	VALVE,POPPET,ENGINE	25.27	EA	0	0	1	0	0	1	$ 25.27	0	0	2	10		
4730	01-363-5161	CLAMP,HOSE	0.78	EA	0	0	1	0	0	1	$ 0.78	3	10	4	35		
2920	01-363-5181	END BELL,ELECTRICAL	3.66	EA	0	0	1	0	0	1	$ 3.66	0	0	1	1		

	Original Fielding Package											DLA Demand History					
	NSN	NOUN	PRICE	UI	5 KW	10 KW	15 KW	30 KW	60 KW	TOTAL	TOTAL $ AMT	1998 TOT DMD LINES	1998 TOT DMD QTY	1999 TOT DMD LINES	1999 TOT DMD QTY	FTCKY Demand History Info	NEW FIELDING PACKAGE
4730	01-366-0163	CLAMP,HOSE	0.37	EA	0	0	1	1	0	2	$ 0.74	4	14	4	20		
2990	01-366-0735	SWITCH,ENGINE TEMPE	74.14	EA	0	1	0	0	0	1	$ 74.14	34	44	44	61	Y	
2990	01-366-7020	MUFFLER,EXHAUST	188.47	EA	0	1	0	0	0	1	$ 188.47	17	18	17	20	Y	Y
4730	01-366-7151	ADAPTER,STRAIGHT,PI	4.75	EA	0	0	1	0	0	1	$ 4.75	0	0	1	1		
4720	01-366-7172	HOSE ASSEMBLY,NONME	34.19	EA	0	0	1	0	0	1	$ 34.19	0	0	11	16		
2910	01-366-7293	PUMP,FUEL,ELECTRICA	109.50	EA	1	1	0	2	1	5	$ 547.50	368	688	407	1,006	Y	Y
2910	01-366-8983	SWITCH,LIQUID LEVEL	34.43	EA	0	0	0	1	0	1	$ 34.43	38	49	32	38		
2910	01-366-8985	SWITCH,LIQUID LEVEL	42.20	EA	1	0	0	0	0	1	$ 42.20	54	80	98	148	Y	
4730	01-366-9017	COUPLING,PIPE	6.60	EA	0	0	1	0	0	1	$ 6.60	0	0	1	3		
4720	01-367-0007	HOSE ASSEMBLY,NONME	17.13	EA	1	0	0	0	0	1	$ 17.13	9	10	12	15	Y	
4820	01-367-1836	VALVE,CHECK	17.97	EA	0	0	1	1	1	3	$ 53.91	2	2	18	37		
2910	01-367-2057	NOZZLE,FUEL INJECTI	38.84	EA	0	0	0	1	0	1	$ 38.84	1	1	2	4		
6695	01-367-9723	TRANSDUCER,MOTIONAL	63.66	EA	0	0	0	1	0	1	$ 63.66	45	91	87	133		
4720	01-368-5430	HOSE,PREFORMED	14.41	EA	0	0	1	0	0	1	$ 14.41	26	55	24	29		
6695	01-368-7113	TRANSDUCER,MOTIONAL	35.08	EA	1	1	0	0	0	2	$ 70.16	17	32	39	55	Y	Y
6620	01-369-0432	INDICATOR,PRESSURE	19.28	EA	0	0	0	1	0	1	$ 19.28	4	6	9	16		
3020	01-369-4953	GEAR,SPUR	78.26	EA	1	1	0	0	0	2	$ 156.52	3	3	2	2		
4720	01-369-9366	HOSE,PREFORMED	21.22	EA	0	0	0	1	0	1	$ 21.22	1	2	0	0		
2815	01-370-0208	OIL PUMP ASSEMBLY,E	87.06	EA	0	0	1	0	0	1	$ 87.06	1	4	2	4		
2910	01-370-1541	SWITCH,LIQUID LEVEL	36.29	EA	1	0	0	0	0	1	$ 36.29	68	74	64	108		
2990	01-370-1546	MUFFLER,EXHAUST	183.07	EA	1	0	0	0	0	1	$ 183.07	37	41	46	46	Y	Y
4730	01-370-5426	CLAMP,HOSE	9.87	EA	1	1	0	1	0	3	$ 29.61	14	86	25	252	Y	
6110	01-372-2597	COVER,DISTRIBUTION	8.98	EA	0	0	1	1	1	3	$ 26.94	3	3	3	3		
4720	01-373-0526	HOSE,AIR DUCT	11.76	EA	0	0	0	1	1	2	$ 23.52	85	108	64	94		
2990	01-373-1344	MUFFLER,EXHAUST	604.96	EA	0	0	0	2	0	2	$ 1,209.92	1	2	2	2		
4720	01-373-1405	HOSE,PREFORMED	4.11	EA	0	0	0	1	0	1	$ 4.11	59	69	29	37	Y	
5120	01-373-8976	WRENCH,BOX	13.00	EA	1	1	1	0	0	3	$ 39.00						
4720	01-374-0783	HOSE,PREFORMED	4.12	EA	0	0	1	0	0	1	$ 4.12	18	44	25	33		
6110	01-374-0836	REGULATOR	225.00	EA	0	0	0	1	0	1	$ 225.00	89	100	27	33	Y	Y
6140	01-374-2243	BATTERY STORAGE	97.02	EA	0	1	0	0	0	1	$ 97.02	4,017	28,956	4,145	29,571	Y	
2990	01-374-8591	PIPE,EXHAUST	179.60	EA	0	0	0	1	0	1	$ 179.60	0	0	0	0		
2990	01-374-9149	CONNECTOR,EXHAUST P	8.00	EA	0	0	1	0	0	1	$ 8.00	1	1	3	9		
4720	01-375-1391	HOSE ASSEMBLY,NONME	15.00	EA	0	0	1	0	0	1	$ 15.00	1	2	5	8		
4720	01-375-1392	HOSE ASSEMBLY,NONME	15.25	EA	0	0	0	1	0	1	$ 15.25	1	1	1	1		
4720	01-375-1930	HOSE,PREFORMED	13.27	EA	0	0	0	1	0	1	$ 13.27	1	2	4	10		
5120	01-375-4373	WRENCH,BOX	15.50	EA	0	0	0	1	0	1	$ 15.50						

		Original Fielding Package										DLA Demand History					
	NSN	NOUN	PRICE	UI	5 KW	10 KW	15 KW	30 KW	60 KW	TOTAL	TOTAL $ AMT	1998 TOT DMD LINES	1998 TOT DMD QTY	1999 TOT DMD LINES	1999 TOT DMD QTY	FTCKY Demand History Info	NEW FIELDING PACKAGE
3030	01-375-8087	BELT,V	11.61	EA	2	1	0	0	0	3	$ 34.83	117	263	166	402	Y	Y
4730	01-376-4256	ADAPTER,STRAIGHT,TU	24.30	EA	0	0	1	0	0	1	$ 24.30	0	0	0	0		
2940	01-376-5666	FILTER,FLUID	64.77	EA	2	1	3	0	0	6	$ 388.62	738	4,059	1,026	5,207	Y	Y
4730	01-378-5224	CLAMP,HOSE	0.07	EA	0	0	0	1	2	3	$ 0.21	8	28	17	109		
2910	01-378-6025	PUMP,FUEL,ELECTRICA	101.06	EA	1	0	0	0	0	1	$ 101.06	530	973	671	1,490	Y	Y
6110	01-379-7187	VOLTAGE REGULATOR	250.00	EA	0	0	0	1	0	1	$ 250.00	14	24	18	25		
2990	01-B79-5658	HANGER, ENGINE	0.00		0	0	0	1	0	1	$ -						
4710	01-B80-0294	TUBE ASSY	0.00		0	1	0	0	0	1	$ -						
		GRAND TOTAL			**65**	**59**	**102**	**107**	**51**	**384**	**$ 10,274.36**						

APPENDIX E. NEW FIELDING PACKAGE TAILORED TO FT. CAMPBELL'S FIELDING

The following table lists the new fielding package adjusted for the number and type of generators fielded at Fort Campbell by whether it is a new addition since the old fielding package, the National Stock Number (NSN), item name, quantity needed for each type of generator, total quantity for that line, price, and total price per line item.

NEW	NSN	NOUN	5kw	10kw	15kw	30kw	60kw	TOTAL QTY	PRICE	TOTAL PRICE
	2910000995467	FILTER, ELE	25	20				45	2.89	130.05
	2910013332309	NOZZLE, FUE				1	3	4	5.80	23.20
	2910013556028	INJECTOR, AS	8	8				16	128.55	2056.80
	2910013594971	FILTER, ELE				8	8	16	12.76	204.16
	2910013606368	FILTER ELE			9			9	14.28	128.52
	2910013667293	PUMP, FUEL	5	3	1	2	2	13	53.38	693.94
	2910013786025	PUMP, FUEL	5	3				8	66.82	534.56
	2920012246246	PARTS KIT	4	4				8	5.70	45.60
	2920012246247	PARTS KIT	4	4				8	7.65	61.20
	2930013594992	WATER PUMP	4	3				7	262.00	1834.00
Y	2930013681071	RADIATOR			2			2	297.00	594.00
	2940000074791	FILTER ELE				8	8	16	2.61	41.76
Y	2940009347989	FILTER, AIR	10	8				18	5.71	102.78
	2940011033268	FILTER, AIR			3			3	24.96	74.88
	2940013615161	FILTER ELE	25	20				45	2.07	93.15
Y	2940013656535	FILTER, AUX	25	20	9	8	8	70	2.98	208.60
	2940013765666	FILTER, FLU	25	20	9			54	28.58	1543.32
	2990013667020	MUFFLER, EX		0				0	186.47	0.00
	2990013701546	MUFFLER, EX	1					1	152.42	152.42
	3030010174340	BELT, V			3			3	7.83	23.49
	3030012317066	BELT, V				2	2	4	9.15	36.60
	3030013758087	BELT, V	7	5				12	12.00	144.00
Y	4130013781130	FILTER ELE				3	3	6	28.60	171.60
Y	5905006435626	RESISTOR VAR	2	1				3	2.40	7.20
Y	5925000893031	CKT BREAK	5	4	1	2	2	14	19.81	277.34
Y	5930013779113	SWITCH, TEMP			1			1	70.37	70.37
Y	5930013786882	SWITCH TEMP	4	3				7	17.90	125.30
Y	5945004583351	RELAY	4	5	2	2	2	15	17.90	268.50
Y	5945013662725	RELAY			1	2	1	4	93.98	375.92
Y	5945013787172	SOLENOID	6	4				10	60.34	603.40
Y	5961001547046	DIODE				1	1	2	256.85	513.70
Y	5961010679493	DIODE				1	1	2	5.82	11.64
Y	6110013630492	REGULATOR	4	3				7	412.06	2884.42
	6110013740836	REGULATOR				1	1	2	8.98	17.96
Y	6115013682911	ALTERNATOR	2	1				3	184.21	552.63
	6210005839349	LIGHT, INDI	5	4				9	8.13	73.17
	6620011283053	TRANSMITTER	4	3	1			8	18.06	144.48
	6620012207105	THERMOSTAT			1			1	15.11	15.11
	6625000030975	WATTMETER			1	1	1	3	159.64	478.92
	6625000048066	METER, ELEC			1	1	1	3	13.12	39.36
	6625000815840	AMMETER				1	1	2	15.63	31.26
	6625008693144	VOLTMETER			1			1	15.63	15.63
Y	6625010386826	VOLTMETER	4	3				7	56.15	393.05
Y	6625010386829	AMMETER, AC	4	3				7	58.49	409.43
Y	6625010386869	METER, FREQ	4	3				7	44.01	308.07
	6685013484793	THERMOSTAT		3		1	1	5	224.85	1124.25
	6685013609653	THERMOSTAT	4	3				7	63.42	443.94
Y	6685013696549	INDICATOR	4	3	1	1	1	10	15.14	151.40
	6695013687113	TRANSDUCER	4	3				7	35.08	245.56
		Total	208	167	47	46	47	515		**18480.64**
		QUANTITIES ON HAND AT FT. CAMPBELL	**226**	**120**	**37**	**40**	**33**			

APPENDIX F. FORSCOM EQUIPMENT HISTORICAL AVAILABILITY

The following table lists the equipment historical availability trends for Forces Command (FORSCOM) from 1995 to 1998 on the following model generators – PU 797, PU 798, PU 802, PU 803, MEP 802, MEP 803, and MEP 805.

MODEL	NMCS	NMCM	FMC	QOH	DATE
PU 797	0.00	0.00	0.00	0	1 QTR 96
	0.00	0.00	0.00	0	2 QTR 96
	1.00	1.40	97.60	16	3 QTR 96
	1.40	0.10	98.50	41	4 QTR 96
	6.80	2.60	90.60	57	1 QTR 97
	3.50	3.00	93.50	80	2 QTR 97
	1.90	0.70	97.40	90	3 QTR 97
	2.50	1.10	96.40	121	4 QTR 97
	0.00	0.00	0.00	0	1 QTR 98
	0.00	0.00	0.00	0	2 QTR 98
	0.00	0.00	100.00	3	3 QTR 98
	2.80	1.40	95.80	148	4 QTR 98

MODEL	NMCS	NMCM	FMC	QOH	DATE
PU 798	0.4	0.2	99.40	40	4 QTR 95
	1.60	0.50	97.90	41	1 QTR 96
	3.10	0.00	96.90	61	2 QTR 96
	0.80	0.00	99.20	59	3 QTR 96
	0.30	0.10	99.60	103	4 QTR 96
	1.60	0.40	98.00	144	1 QTR 97
	1.90	0.70	97.40	170	2 QTR 97
	2.10	0.50	97.40	218	3 QTR 97
	1.40	0.30	98.30	200	4 QTR 97
	0.70	0.40	98.90	575	1 QTR 98
	0.80	0.60	98.60	525	2 QTR 98
	1.40	0.90	97.70	303	3 QTR 98
	2.60	1.00	96.20	265	4 QTR 98

MODEL	NMCS	NMCM	FMC	QOH	DATE
PU 802	1.80	0.00	98.20	37	4 QTR 95
	3.50	0.10	96.40	91	1 QTR 96
	2.60	0.90	96.50	89	2 QTR 96
	2.00	1.90	96.10	126	3 QTR 96
	2.20	1.70	96.10	154	4 QTR 96
	2.10	0.50	97.40	145	1 QTR 97
	4.40	0.90	94.70	166	2 QTR 97
	1.70	0.50	97.80	255	3 QTR 97
	1.20	0.60	98.20	173	4 QTR 97
	2.00	2.50	95.50	216	1 QTR 98
	2.80	2.20	95.00	204	2 QTR 98
	5.30	1.60	93.10	190	3 QTR 98
	3.70	3.10	93.20	198	4 QTR 98

MODEL	NMCS	NMCM	FMC	QOH	DATE
PU 803	1.90	0.00	98.10	40	4 QTR 95
	0.20	0.60	99.20	68	1 QTR 96
	2.00	0.30	97.70	69	2 QTR 96
	1.00	0.50	98.50	80	3 QTR 96
	1.20	0.20	98.60	104	4 QTR 96
	1.00	0.10	98.90	101	1 QTR 97
	2.50	0.10	97.40	141	2 QTR 97
	2.40	0.40	97.20	210	3 QTR 97
	2.00	0.70	97.30	130	4 QTR 97
	1.20	1.00	97.80	128	1 QTR 98
	2.30	1.50	96.20	130	2 QTR 98
	2.80	2.40	94.80	133	3 QTR 98
	2.40	3.00	94.60	146	4 QTR 98

MODEL	NMCS	NMCM	FMC	QOH	DATE
MEP 802	1.40	0.20	98.40	300	1 QTR 96
	2.00	0.40	97.60	398	2 QTR 96
	1.80	0.60	97.60	505	3 QTR 96
	1.90	0.50	97.60	644	4 QTR 96
	2.90	0.80	96.30	685	1 QTR 97
	3.20	0.70	96.10	737	2 QTR 97
	2.20	0.90	96.90	1125	3 QTR 97
	2.00	0.70	97.30	744	4 QTR 97
	1.70	1.40	96.90	1004	1 QTR 98
	2.40	2.00	95.60	1057	2 QTR 98
	2.00	1.60	96.40	1089	3 QTR 98
	2.50	1.70	95.80	1137	4 QTR 98

MODEL	NMCS	NMCM	FMC	QOH	DATE
MEP 803					4 QTR 95
	0.00	0.00	100.00	40	1 QTR 96
	0.20	0.60	99.20	83	2 QTR 96
	2.30	0.00	97.70	141	3 QTR 96
	1.20	0.20	98.60	186	4 QTR 96
	1.30	0.50	98.20	217	1 QTR 97
	2.30	0.50	97.20	261	2 QTR 97
	1.70	0.50	97.80	414	3 QTR 97
	1.70	0.30	98.00	324	4 QTR 97
	0.00	0.00	100.00	13	1 QTR 98
	0.00	0.00	100.00	18	2 QTR 98
	2.00	0.60	97.40	504	3 QTR 98
	2.10	1.30	96.60	541	4 QTR 98

MODEL	NMCS	NMCM	FMC	QOH	DATE
MEP 805	9.80	10.20	80.00	5	4 QTR 95
	9.40	3.70	86.90	14	1 QTR 96
	3.30	1.10	95.60	23	2 QTR 96
	6.80	0.00	93.20	39	3 QTR 96
	3.80	0.10	96.10	42	4 QTR 96
	0.10	0.00	99.90	39	1 QTR 97
	1.00	1.40	97.60	35	2 QTR 97
	3.80	0.00	96.20	86	3 QTR 97
	0.70	1.90	97.40	43	4 QTR 97
	3.10	1.80	95.10	97	1 QTR 98
	2.20	0.30	97.50	76	2 QTR 98
	2.60	0.40	97.00	77	3 QTR 98
	1.80	0.70	97.50	96	4 QTR 98

APPENDIX G. WOLF COMPUTER DATA

	YEAR	EI NSN	TOTAL WON CT	TOTAL DOWNTIME	MTTR	MTAT	MTAT-MTTR	PARTS DOWN WON CT	PARTS DOWNTIME	AVG WAIT FOR PARTS	TOTAL PART COST
MEP 802A	199	6115012747387	551	10910	3.1	19.8	16.7	33	785	23.79	$ 11,688.00
5KW	199	6115012747387	311	14143	3.9	45.4	41.5	72	1779	24.71	$ 45,576.00
1509	199	6115012747387	327	8375	3.5	25.6	22.1	68	2240	32.94	$ 55,306.00
	199	6115012747387	257	6525	3.7	25.3	21.6	82	2322	28.32	$ 119,089.00
PU 798	199	6115013199032	183	2998	3.7	16.3	12.6	6	26	4.33	$ 2,120.00
10 KW	199	6115013199032	72	1518	3.2	21	17.8	16	337	21.06	$ 2,990.00
432	199	6115013199032	128	2712	3.8	21.1	17.3	26	537	20.65	$ 13,824.00
	199	6115013199032	76	1864	4.4	24.5	20.1	28	637	22.75	$ 49,920.00
PU 802	199	6115013172138	109	1868	3.4	17.1	13.7	1	32	32.00	$ 95.00
15KW	199	6115013172138	50	1432	2.5	28.6	26.1	9	231	25.67	$ 1,055.00
307	199	6115013172138	69	1398	3.3	20.2	16.9	15	200	13.33	$ 1,118.00
	199	6115013172138	59	2150	4.1	36.4	32.3	27	369	13.67	$ 15,256.00
MEP 805	199	6115012747389	49	1196	3.8	24.4	20.6	7	190	27.14	$ 3,416.00
30KW	199	6115012747389	50	1469	3.2	29.3	26.1	13	277	21.31	$ 2,634.00
212	199	6115012747389	44	1021	3.4	23.2	19.8	15	297	19.80	$ 3,641.00
	199	6115012747389	35	1240	4.1	35.4	31.3	19	389	20.47	$ 7,940.00
PU 803	199	6115013172136	59	1241	4	21	17	3	47	15.67	$ 501.00
10KW	199	6115013172136	32	2477	5	77.4	72.4	6	140	23.33	$ 4,409.00
210	199	6115013172136	31	441	2.7	14.2	11.5	4	44	11.00	$ 827.00
	199	6115013172136	37	1141	3.2	30.8	27.6	20	413	20.65	$ 17,146.00
MJQ-37	199	6115012996035	91	1184	3.2	13	9.8	4	80	20.00	$ 555.00
10KW	199	6115012996035	35	2021	5	57.7	52.7	8	281	35.13	$ 1,245.00
241	199	6115012996035	62	1222	3.9	19.7	15.8	7	148	21.14	$ 4,513.00
	199	6115012996035	37	939	5	25.3	20.3	14	246	17.57	$ 10,658.00

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