



C-Bag Consolidation: An Inventory and Safety Stock Analysis

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**C-BAG CONSOLIDATION: AN INVENTORY AND SAFETY STOCK
ANALYSIS**

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ANALYSIS**

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Abstract

The Air Force finds itself at the end of over two decades of warfare with a shrinking budget and is searching for ways to save money. An area worth exploring is the consolidation of standard Chemical bags (C-1 bags) to one location to save the Air Force money. Currently, there are 215 stateside locations that are storing and maintaining C-1 bags. Consolidation of these assets to one location will provide the Air Force pooling effects which could result in C-1 bag inventory reduction. This research will also explore C-1 bag safety stocks. If C-1 bag consolidation is undertaken, can the Air Force reduce the level of safety stock currently being maintained in order to save additional money.

This paper will investigate current C-1 bag inventory calculations and will compare it to the current National Security Strategy. The paper will determine how much C-1 inventory is required to meet these stated goals and will then compare this number to the current inventory to determine if the Air Force has too much or too little inventory. Based upon the two most demanding planning scenarios, it would appear that the Air Force has \$249 million dollars in excess C-1 bag items being stored in the lower forty eight states. Consolidating these items in one location would allow the Air Force to rid itself of \$249 million dollars in inventory. Additionally, reducing safety stock from 10 percent down to 5 percent could save the Air Force an additional \$13 million dollars. Inventory and safety stock are two items to consider when discussing consolidation. Other factors such as infrastructure, manpower requirements and just in time transportation delivery should be analyzed before a final decision is made.

Dedicated to my loving wife and my five children. Thank you for your love and support during this challenging endeavor and I am glad you were there to provide balance.

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INTRODUCTION

Background

The Air Force is winding down from over two decades of warfare and is faced with a shrinking military budget. The current aircraft fleet is getting old and has flown more hours than originally planned when they were first purchased. The Air Force desperately wants to recapitalize the fleet, but it will take Billions of dollars to do so. In addition to these challenges, Congress passed legislation which enacted a budget sequestration on the entire Department of Defense. This sequestration stripped \$37 and \$52 billion dollars from the Department of Defense budget for 2013 and 2014 respectively, forcing all branches of the military to find ways to save money. (Pellerin, 2013) The Air Force was forced to park of sixteen flying squadron's aircrafts as the money used for aircraft training was cut by \$208 million dollars. (Martinez, 2013) The Air Force went so far as to furlough civilians for six days and to introduce force management programs with a goal of reducing the active duty Air Force manning down to 309,000 Airmen, a cut of 18,600 individuals. (Losey, 2014) The scope of the budget cuts have led the Air Force to look for innovative ways to save money. Vice Chief of Staff for the Air Force, Gen Larry Spencer, has even enacted an "Every Dollar Counts" campaign, whereby government employees can submit their money saving ideas directly to his staff for consideration. Gen Spencer stated "[w]hether it's \$500, \$1 million or \$30 million, we want to hear it because those dollars add up. We're taking every angle we can to manage our money and 'buy' as much mission as we can." (Network, 2013)

The Air Force is searching for ways to save money and all areas are open for investigation. One area worth exploring is the consolidation of standard Chemical bags

(C-1 bags) to one location to save the Air Force money. Currently, there are 215 stateside locations that are storing and maintaining C-1 bags. Consolidation of these assets into one location will provide the Air Force pooling effects that could result in the reduction of overall C-1 bag inventories. This research will also explore C-1 bag safety stock policies to determine if any additional savings can be gained by reducing the number of C-1 bags being stored by the Air Force.

The research will begin with a description of what comprises a C-1 bag and the policies and practices which guide the storage of C-1 bags. The paper will also look at other areas where consolidation has been used by the military and the benefits gained by consolidation. Air Force C-1 bag planning factors will be discussed next, as the planning factors are what drive the number of C-1 bags to be maintained and purchased. A discussion on whether the current planning factors are sufficient will then be investigated. Finally, the results will be analyzed and a recommendation provided on whether C-1 bag consolidation and safety stock reduction would save the Air Force money.

Problem Statement

Will consolidating Air Force C-1 bags to one location reduce the inventory, allow for safety stock reduction and save the Air Force money? Currently, there are 215 stateside Active Duty, Guard and Reserve bases storing and maintaining C-1 assets in support of deployment taskings assigned to them in support of a Combatant Commander's (COCOM) Operations Plan (OPLAN). That means there are 215 bases required to inventory, maintain, and issue C-1 bags. C-1 bags are stocked with shelf life items, defined by AFI 23-110 *Material Management* as “an item of supply possessing

deteriorative or unstable characteristics to the degree that a storage time period shall be assigned to ensure that it shall perform satisfactorily in service”. Shelf-life items come with an expiration date, which has to be managed. As the expiration date approaches, an extension can be requested and granted if the item is still in serviceable condition. If the item is no longer usable, the item will then need to be discarded and a replacement item purchased. The maintenance of shelf-life items drive a manpower requirement at each storage location as these assets must be managed and replaced for the C-1 bag to remain operationally current.

C-1 bags are issued to individuals deploying overseas into a medium or high threat environment, where there is a risk of encountering chemical, biological or nuclear agents. This was not always the case. The threat of an attack from the Soviet Union during the Cold War was a real concern. The storage of Chemical Weapon Defense Equipment (CWDE) at each location ensured Airmen would be protected in case of an attack. The Airmen would then be able to respond by generating aircraft to counter the attack. In this post-Cold War environment, the need for storing C-1 bags stateside has gone away except for a few career fields that could be called upon to respond to a natural disaster or a rogue attack. A rethinking of where C-1 bags are stored and how many are stored is in order.

The Air Force has already proven that C-1 bag consolidation can work. A transportation cost saving initiative developed during Operation IRAQI FREEDOM and Operation ENDURING FREEDOM was to preposition C-1 bags at three locations around the Central Command Area of Responsibility. C-1 bags were stationed at Ali Al Salem Air Base in Kuwait, Manas Air Base in Kyrgyzstan, and at Al Udeid Air Base,

Qatar. These locations were designated Expeditionary Theater Distribution Centers (ETDC). C-1 bags were maintained at these locations and the bags were provided to all individuals deploying into Iraq and Afghanistan. The individuals were issued bags at these centers on their deployment into the theater, prior to entering a combat zone. Once an individual's combat tour was complete, they processed back through an ETDC so the C-1 bags could be turned in, serviced, and then reissued to another individual deploying into the theater. This saved the Air Force \$17 million dollars the first year in transportation costs as the C-1 bags did not have to be transported from and to the individual's home base with either military or commercial airlift. The consolidation of C-1 bags in theater saved millions of dollars in transportation costs and gained the Air Force efficiencies in how the equipment was inventoried and maintained. (Butterfield, 2007) The ETDC concept garnered positive results for the Air Force and this concept is worth investigating as a stateside consolidation initiative to save the Air Force money in the long term.

“[C]onsolidation of inventory creates pooling effects, improves standardization, and can increase control and visibility of key stocks.” (Skipper, Bell, Cunningham and Mattioda, 2010). In order to gain the efficiencies described above, the Air Force has executed consolidation in many wide ranging areas. In 2007, the Air Force consolidated many base-level financial functions at Ellsworth Air Force Base, setting up the Air Force Financial Services Center. This center consolidated back-office financial functions such as processing travel vouchers and military pay documents from 93 individual bases into one location. The Air Force maintained financial customer service sections at each location so the changes were transparent to most Airmen. The consolidation of these

functions into one location is slated to save the Air Force \$200 million dollars over the first ten years. (Dean, 2007) The Army has taken a large step by centralizing its installation and mission support when it established the Installation Management Command (IMCOM) in 2001. IMCOM is comprised of a centralized command structure and vertical integration and it is responsible for all aspects of installation management for 187 Army installations. (Burbach, 2010) IMCOM has developed common level of support, streamlined processes/created efficiencies, upgraded facilities, and improved overall service to its customers. (Groat, 2012) The Air Force is proposing to move its installation support in the same direction as the Army. Currently installation and mission support is planned and executed at each base or MAJCOM. The proposal wants to establish an Air Force Installation and Mission Support Center, which would remove support agencies off of local bases or MAJCOMs. The results of this action would shuffle day-to-day base management issues such as construction and equipment procurement away from the Wing Commander to the Support Center. This move was driven by the directive to reduce headquarter staffs by 20 percent by 2019. While the proposed benefits have not been fully explained, the Air Force is hoping to have the same level of success the Army has found with the establishment of IMCOM. (Ybarra, 2014) C-1 bag consolidation fits in with the Air Force's movement to consolidate installation and mission support functions. C-1 bag consolidation should achieve pooling efficiencies, improve standardization and reduce inventory. This consolidation effort is in the same vein that the Air Force is seeking with other consolidation initiatives.

Hypothesis & Research Questions

The hypothesis for this research is consolidation of C-1 bags at one location will save the Air Force money by changing C-1 bag planning factors and by reducing safety stock. A thorough analysis of the data will either support this hypothesis, meaning consolidation will reap the Air Force savings in inventory costs or the hypothesis will be rejected if the data shows these savings cannot be achieved. Research questions to be investigated will include:

- What is the current national security strategy?
- What are the two most taxing scenarios for the Air Force to meet the national security strategy?
- How many C-1 bag equipment items are currently being maintained stateside by the Air Force?
- What is the right number of C-1 bags to be maintained by the Air Force?
- What is the inventory cost of the current and the proposed inventories?
- What is the current safety stock level?
- Can consolidation achieve savings in safety stock levels?

Methodology

This paper will take a quantitative and analytical look at CWDE planning factors. Time Phased Force Deployment Data (TPFDD) data from OPLANS and CWDE data obtained from the Mobility Inventory Control and Accountability System (MICAS) will be analyzed. TPFDDs will be reviewed to determine which two TPFDDs best support the current National Security Strategy. The summary of these TPFDDs will be compared to the current inventory in MICAS. The current inventory and the cost associated with this equipment will be compared to the cost of the proposed inventory. Additionally,

safety stock levels will be investigated to determine if additional cost savings can be achieved by reducing the amount of safety stock on hand.

Assumptions and Limitations

Research into C-1 bags consolidation is an imprecise science and in order to make the research viable, some assumptions had to be made by the author. Understanding these assumptions will provide the reader a lens upon which to view the research and the findings. Operational Plans (OPLANs) and TPFDDs are in a constant state of review and update. The author assumed the TPFDDs analyzed for this research were current and accurate at the time the data was analyzed for this paper. TPFDDs analyzed are only the primary forces needed to fight the OPLAN. TPFDDs for the follow-on forces have not been established, so an assumption was made that rotational or follow-on forces for OPLAN TPFDDs will mirror the distribution of CONUS and OCONUS location taskings seen in the initial deployment.

In relation to C-1 bags, the items are tracked and recorded in MICAS. This system is also constantly updated with changes. The author assumed the data analyzed in MICAS was accurate at the time it was analyzed for this paper. Also, the C-1 bag analysis for this research was for items in support of OPLANs only. Some Air Force career fields use chemical defense gear for local accident response or for natural disasters. These uses are not addressed in this paper. The author assumed that all C-1 bag items tracked in MICAS were in support of contingency operations and not for local uses. C-1 assets from the Guard and Reserve were investigated as part of this research

and it is assumed that if consolidation is enacted, these C-1 bags can be consolidated with Active Duty C-1 assets.

Additionally, limitations were placed on the research to ensure the data was manageable and it helped scope the project. This framework provided the boundaries of what the research paper could accomplish. In relation to the C-1 bag, the data was limited to the standard C-1 bag items found in AFI 23-226. Any specialized chemical gear needed for specific career fields (i.e. pilots, firefighters) was excluded from this research. Any items found in both the A-bag and C-bag (helmet, web belt, canteen, etc.) were also excluded. The protective mask (MCU-2A/P) is part of the standard issue C-1 bag but was excluded from this research. The protective mask must be fit tested to each individual and based upon the personal fit of this equipment it cannot be centrally stored. The costs of C-1 bag items have gone up over time. The analysis used current prices to determine overall cost of the inventory. Additionally, this is the current replacement cost for items currently found in the C-1 bag.

Another limiting factor used was based on the location and type of units in the Air Force. OCONUS locations were excluded from this C-1 bag data analysis. The premise of this research is cost savings can be achieved if C-1 bag items are consolidated in one stateside location. Overseas locations are closer to high threat areas and are expected to fight from or near their location. These locations will require quick access to chemical bags. Therefore, bags stored at overseas locations were excluded from the analysis. Special Operations units C-1 bags were also excluded from this analysis. Special Operations forces and their support agencies are the military's emergency response force. Often times, they will deploy in 24 hours or less from tasking notification. These units

will require quick access to their C-1 bags, and therefore, their data was excluded from this research.

TPFDD limitations were also enacted. Special Operations UTCs were removed from all OPLAN TPFDDs. The requirement to deploy Special Operations forces quickly does not allow for C-1 bag consolidation stateside. Since overseas C-1 bags were excluded based upon the units already being forward deployed, the author excluded all UTCs that originated from an OCONUS location. The author also excluded UTCs from OPLAN TPFDDs that had a CONUS destination. If a UTC was tasked to remain stateside to perform its wartime task, then the individual would not need a C-1 bag to perform their wartime duty.

To understand C-1 bag consolidation, it is best to look at previous research done on the topic to get some insight and to determine where this research fits in.

LITERATURE REVIEW

Consolidation of MOBAGS: The Quest for Efficiency in Logistics Operations was a recent research project that looked at the potential cost savings of C-1 bag consolidation from a transportation perspective. (Carter, 2010) The results from the study showed that consolidation in relation to transportation costs was not recommended. It cost the United States Air Force less to ship C-1 bags from a member's home station using commercial airlines, than it was to ship the bags from a consolidated stateside location. Transportation is one aspect of consolidation that needs to be considered when determining whether or not to consolidate items. This GRP will complement the research previously conducted and will address the consolidation question from a supply standpoint. This research will investigate whether the Air Force can reduce the number of bags currently being stored if the bags are consolidated in one location. Additionally, will the consolidation of C-1 bags in one location allow for a reduction in safety stock as well and save the Air Force money. Before answering these questions, a brief overview of the C-1 bag is in order.

Joint Pub 1-02 defines individual protective equipment as "in a nuclear, biological and chemical warfare the personal clothing and equipment required to protect an individual from biological and chemical hazards and some nuclear effects." Per AFI 23-226 this individual protective equipment set consists of one operational groundcrew ensemble, a winterization kit (if required), M8 detector paper booklet, M9 detector paper roll, M258A1 or M291 decontamination kit, M295 decontamination kit, a web belt, canteen, M1 canteen cap and helmet. The operational groundcrew ensemble can be

further broken down and it consists of a protective mask, two filter sets/canisters, chemical protective overgarment, two pair of footwear covers or one Green/Black Vinyl Overshoe, two pair of glove sets and two protective hoods. The Air Force breaks down the individual protective equipment into two separate bags, the A-1 ditty bag and the C-1 bag. The helmet, web belt, canteen and M1 canteen cap are found in the A-1 ditty bag as they have a use in both standard combat as well as a chemical, biological, nuclear environment. Excluding the items in the A-1 ditty bag, all other items are found in the C-1 bag. For the purpose of this research, only the C-1 bag will be examined for consolidation. Additionally, the protective mask (MCU-2A/P) will be excluded from the research as each mask has to be individually fitted. All other equipment in the C-1 bag is not individually sized and would be eligible to be centrally stored. A snapshot of the items being investigated for consolidation and the number of items issued per C-1 bag is depicted below in Table 1.

Table 1. C-1 Bag Assets

C-1 Bag Assets	Basis of Issue
M8 Detector Paper	1
M9 Detector Tape	1
M 295 Decon Kit	1
M61 Canister	2
JSLIST Coat	2
JSLIST Trousers	2
AFS Over Boots	2
JBU2GU Gloves	2
A3 Bag	1

The C-1 bag assets are consolidated at the local base level in the Logistics Readiness Squadron (LRS). This squadron is responsible for the maintenance, upkeep

and issuance of these assets when an individual is tasked to deploy. Local storage requirements are driven by Air Force Instruction 23-101 “Air Force Materiel Management”. One of the responsibilities of the LRS is to know how much equipment it should be maintaining. Annually the LRS will review the mobility position requirements for the entire Air Force base based upon the most demanding OPLAN the base is tasked to support. This allows the base to be ready to respond if they are called upon to execute their OPLAN. The LRS ensures 100 percent of the individuals tasked to a high or medium threat environment have a C-1 bag stored and maintained locally. (United States Air Force, 2013) Once the annual baseline is established, the LRS will report quarterly on its inventory levels.

The Mobility Inventory Control Accountability System (MICAS) is the system used to track and provide accountability of on-hand mobility bags and individual protective equipment (IPE). This system tracks items found in the C-1 bag and provides visibility of inventory and facilitates equipment receipt. Each quarter, every unit with C-1 assets is required to submit an inventory report to higher headquarters for visibility. The major commands (MAJCOM) consolidate all the individual base reports and send this information to the MICAS program office where the data is consolidated into AF totals. This AF data is then submitted to HQ USAF and inputted into the Joint Acquisition Chemical Biological Radiological Nuclear Knowledge System (JACKS). The quarterly report is also used by the AF Civil Engineering Support Agency (AFCESA) to forecast and budget for stock needed to bring “on-hand” stock of Chemical Biological Radiological Nuclear (CBRN) equipment to authorized levels. The quarterly

inputs are also used by JACKS to report the AF's stock level to Congress. (Styslinger, 2012)

Current Process

There are inefficiencies with the current process. Each storage location is basing its C-1 bag requirements based upon its most demanding OPLAN tasking. Once this process is repeated across the Air Force, there will be a wide disparity in the number of OPLANs being supported, as each base has optimized itself at the sake of a sub-optimized Air Force. In order for the Air Force to be a superefficient organization, the entire supply chain needs to be optimized, not the individual units. Issues with this set up, as described by Michael Hammer is separate processes in separate areas working to optimize their unit at the detriment to the entire supply chain. These inefficiencies mean processes are not being coordinated, more individuals are needed to track and maintain the program and “inconsistencies, errors, and misunderstandings routinely arise, leading to even more wasted work.” (Hammer, 2001) The Air Force needs to take an enterprise look at what the Air Force is tasked to support and ensure it is able to meet the requirement.

Air Force Logistics Management Agency did a study in 2011 that highlighted many issues surrounding the decentralized planning and execution of C-1 assets. The study found three major findings. Many units were submitting incomplete data quarterly. Some items were reported on while others were not. An example would be a unit providing an update on JLIST Trousers but not submitting an inventory on M-9 Tape. The second major issue identified was units were not submitting reports at all. Over a

one year time, 43.8% of the units failed to submit a quarterly report as required. The third issue was units labeling themselves differently from one quarter to the next, causing MICAS not to link the data. For example a unit may be labeled 78 LRS one quarter and 78th Logistics Readiness Squadron the next.

The results showed the Air Force was unable to provide an accurate snapshot of what inventory it actually had available. This inaccurate data makes it hard for AFCESA to know what to order to get the units up to their authorized level, but it also makes it hard for the Air Force to report its CWDE concerns to Congress. MAJCOMs, as the reviewer and consolidating agency for CWDE, has also failed by not ensuring all units are reporting their entire inventory and the units are reporting them quarterly. Finally, the quarterly report requires 215 units to be standardized across the board in how they inventory their items and report what they have in stock. (Styslinger, 2012)

An issue identified in the report is Logistics Readiness Squadrons are not manned to handle the current reporting requirements. One A4 study estimated a shortage of 300 personnel needed to complete the tasks levied on the LRS' to maintain and inventory C-1 bag assets. This would be a 60% increase over the 500 individuals that are currently assigned to do these tasks currently. (United States Air Force, 2012). The Navy did a business case analysis of the Air Force's C-1 bag inventory process and found that only 37% of the assigned tasks were being completed. (United States Air Force, 2012). Local commanders are juggling their manning and placing individuals in their highest priority area. Decentralization means there are 215 bases placing different priorities on the maintenance and inventorying of C-1 assets. Unless the Air Force makes C-1 assets a

priority, the level of attention will remain the same and the AFLMA findings will continue into the future.

Case for Consolidation

“[C]onsolidation of inventory creates pooling effects, improves standardization, and can increase control and visibility of key stocks.” (Skipper, Bell, Cunningham III, & Mattioda, 2010). Many of the issues described above could be solved through consolidation. Instead of having 215 individual locations responsible for the inventory and maintenance of C-1 assets, the Air Force could have one location whose sole purpose is to manage C-bags. Standardization would be vastly improved, as supply lot numbers will all be maintained at one organization. As equipment expires, the consolidated activity will be able to purge the equipment instead of trying to track the equipment down through multiple locations to ensure it is properly disposed. Better inventory management will make it easier to report to higher headquarters on what assets are currently in the Air Force inventory and will provide a clear picture to Congress. Put succinctly “consolidation of demand can reduce the total expected holding and penalty cost in an inventory system” (Eppen, 1979)

Consolidation also plays a key role in reducing safety stock. “The greater the number of stocking locations, the greater the safety stock required to maintain a given customer service level as measured by inventory availability. Conversely, aggregate safety stock is reduced whenever inventories are centralized into fewer stocking locations.” (Zinn, Levy, & Bowersox, 1989). Each storage location is required to carry an additional 10 percent inventory above authorizations to prevent stock-outs. Pooling

all the assets together at one location will allow the Air Force to reduce its safety stock levels. Due to the large size of the inventory held at a consolidated location, it will be easier to meet the demands of the customer without fear of a stockout.

Centralization is not without costs though. “Greater centralization decreases cycle and safety stocks but increases transportation costs.” (Das & Tyagi, 1997) There is a trade-off in the efficiencies gained in decreased cycle and safety stock garnered by centralization and the increased transportation cost. Economy of scales in facility operations and storage is also a benefit to be gained from centralization. Transportation cost, as a separate entity is only one factor to consider when determining centralization. The goal is to find the right optimal degree of centralization that allows the Air Force to be responsive to its customers while maximizing centralization efficiencies. (Das, 1997)

C-1 bag consolidation would help to eliminate inefficiencies found in the current stocking process. Instead of each individual location having its optimal number of C-1 bag, the Air Force can plan to meet their largest requirements based on approved National Strategies, which would streamline the entire system. The two overarching policies that should guide Air Force stocking policy are the National Security Strategy and Defense Strategic Guidance. The most recent Defense Strategic Guidance, “Sustaining U.S. Global Leadership: Priorities for 21st Century Defense” released in January 2012 states , “Even when U.S. forces are committed to a large-scale operation in one region, they will be capable of denying the objectives of – or imposing unacceptable costs on – an opportunistic aggressor in a second region.” In essence, the military should be able to fight and win one conflict while engaging (holding) objectives in another region at the same time. In order to determine how much CWDE it will need for this

posture, the Air Force should plan for the worst case scenario it could face. In essence, the Air Force should have enough C-1 bags to support the two most demanding Air Force OPLAN scenarios from two separate Combatant Commander's Area of Responsibility. Stocking C-bags to this scenario would ensure the entire Air Force enterprise has enough chemical equipment to meet its wartime requirements. Knowing what this Air Force requirement will be determined next.

METHODOLOGY

Determining the right number of C-1 bags to maintain in the inventory needs to be the starting point for the Air Force. It all starts with knowing what is required of the Air Force, can the Air Force currently meet that requirement, and if so, how best to store and inventory the stock. Consolidating C-1 bags at one stateside location could provide the Air Force savings in inventory and standardization of the entire process. Consolidation strategy, if done incorrectly, could introduce higher levels of risk to the Air Force, risk that will have to be managed. The ramifications of sending Airmen into harm's way without the proper chemical protection gear, due to a lack of inventory would be disastrous. The method best suited to determine these requirements is a case study, which is "a type of qualitative research in which in-depth data are gathered relative to a single individual, program, or event, for the purpose of learning more about an unknown or poorly understood situation." (Ormrod, 2010) This research will involve a lot of data collection, comparison and extrapolation, so it will digress from the qualitative research and is more of an embedded case study. "[a]n embedded case study allows for a multiplicity of methods that may be applied within the subunits. Thus, hypotheses may be formulated, quantitative data sampled, or statistical analyses applied." (Tietje, 2002)

The focus of this research is to cost compare the current Air Force C-1 bag inventory to a proposed consolidated inventory based upon National Security Directives and safety stock reductions. The methods used to gather and analyze the data is not overly complex, however, understanding how much inventory the Air Force currently

stores and the cost of that inventory can be of great assistance to decision makers as the Department of Defense continues to search for ways to save money.

The C-1 bag is addressed in this research because it does not have an in-garrison use at the bases where it is currently being stored. Each base has training gear, which is chemical gear that has either expired or was damaged and cannot be used in a deployed environment. The training gear is used during training and exercises to provide realistic training for military members. This provides the military member with a level of familiarity with the equipment if it has to be used while deployed. The C-1 bag will only be issued if the member is tasked to deploy. The C-1 bag will be taken with the member to their deployed location and will be used only if under attack. The C-1 bag is a perfect candidate for consolidation, as it does not matter where the bag is stored and maintained as long as the member has the bag prior to their deployment.

Data to determine the right number of C-1 bags was gathered from multiple sources. Quantitative analysis of the two most demanding Air Force scenario Time-Phased Force Deployment Data (TPFDD) were examined. TPFDDs were looked up in Joint Operation Planning and Execution System (JOPES) and Deliberate and Crisis Action Planning and Execution System (DCAPES). Each TPFDD was analyzed to determine the total number of Airmen tasked to support each OPLAN. Once each OPLAN was reviewed, the two scenarios with the highest number of Airmen tasked from separate Combatant Commander's Area of Responsibility (AOR) were selected. The TPFDDs were then limited to stateside only Airmen, in order to properly scope stateside C-1 bag consolidation. The time responsiveness of the Airmen stationed outside the

continental United States prohibits consolidation stateside. An example of a TPFDD can be seen in Appendix A.

The next data gathered was stateside C-1 bag inventories. MICAS data was obtained in November 2013 from Lt Col David Gehrich, commander of the 435th Supply Chain Operations Squadron. His organization stores excess Chemical Warfare Equipment for the Air Force and his squadron has visibility in MICAS over the Air Force chemical warfare equipment inventory. The MICAS data was analyzed to determine the current number of C-1 bag items being stored at stateside locations.

A cost comparison of individual equipment items, both currently in the inventory and the proposed inventory was then compared using data found in MICAS. MICAS maintains a listing of current C-1 bag item replacement costs. The cost of each item was factored against the current and proposed inventories to provide a total cost of the inventory to the Air Force.

C-1 bag stocking policies allow for safety level quantity (or safety stock) to be held at each location. Safety stock is a “quantity of an item, in addition to the normal level of supply, required to be on hand to permit continuing operation with a specific level of confidence if resupply is interrupted or demand varies in an unpredictable manner.” (Patton, 1986) The Air Force requires each base maintain a 10% backup stock of C-bag requirements. (United States Air Force, 2013) To ensure a fair comparison between the current and proposed inventory, safety stock levels of 10 percent were also added to the proposed inventory

ANALYSIS AND RESULTS

The data for the cost of C-bag items was obtained from Mr. Kevin Pelkey, who works at Headquarters Air Mobility Command, Scott AFB, Illinois. Mr. Pelkey obtained the individual cost per item out of MICAS and the number of items to be issued per C-1 bag. Multiplying the cost per unit by the total basis of issue provides a total price of the items per each C-1 bag. The complete cost of issuing a C-1 bag is the summation of the total price column and the number is totaled at the bottom of the page. The data is shown in Table 2 below.

Table 2. C-1 Bag Cost

Nomenclature	Basis of Issue	Cost per Unit	Total Price
Detection Paper M8	1	\$1.06	\$1.06
Detection Paper M9	1	\$6.24	\$6.24
M295 Decon Kit	1	\$19.15	\$19.15
M61 Canister	2	\$51.21	\$102.42
JLIST Coat	2	\$249.12	\$498.24
JLIST Trousers	2	\$229.96	\$459.92
Boots	2	\$49.25	\$98.50
JBU2GU Gloves	2	\$30.96	\$61.92
A3 Bag	1	\$30.11	\$30.11
		Total Cost	\$1,277.56

As shown in Table 2, the total cost of a C-1 bag is \$1,277.56. This is the cost to outfit every Airman tasked to deploy with the basic C-1 bag. Specialized gear required for specific career fields are not included. With the cost of the C-1 bag now determined, the next step is to determine how much inventory the Air Force currently owns stateside.

MICAS is the system of record for inventorying all mobility gear for the Air Force. C-1 bags items are stored and updated in this system and a summary from MICAS was obtained of all mobility items stored at CONUS locations. The data was

sorted for only those items found in the C-1 bag. All training C-1 items were removed, as these items are not used in an operational environment. Special Operations locations were also removed from the data, as their mission requires a quick response to contingencies, and centrally storing C-1 items could be detrimental to the timeliness of their mission. Obtaining this data provided a full picture of the current stateside Air Force inventory. Table 3 is a summary of the current inventory levels of C-1 bag items and the total cost of these inventories. At the bottom is a complete cost to the Air Force of this inventory.

Table 3. Current Inventory

Nomenclature	Cost per Unit	Current Inventory	Total Cost
Detection Paper M8	\$1.06	625072	\$662,576.32
Detection Paper M9	\$6.24	207517	\$1,294,906.08
M295 Decon Kit	\$19.15	490992	\$9,402,496.80
M61 Canister	\$51.21	1368501	\$70,080,936.21
JLIST Coat	\$249.12	799910	\$199,273,579.20
JLIST Trousers	\$229.96	805971	\$185,341,091.16
Boots	\$49.25	614658	\$30,271,906.50
JBU2GU Gloves	\$30.96	977085	\$30,250,551.60
A3 Bag	\$30.11	147932	\$4,454,232.52
		Current Cost	\$531,032,276.39

The total cost of the current inventory is in excess of \$531 million dollars. This cost is based upon the current price to replace these items in the inventory. Now that the

current inventory has been identified, the question to be answered is whether or not this is the right amount of inventory needed to meet the National Security Strategy. All the OPLANs were reviewed and two OPLANs identified as being the most taxing to the Air Force. The two plans were selected from different AORs. After analyzing the most taxing scenarios, the TPFDDs were reduced to only CONUS originating UTCs with associated personnel with OCONUS destinations. The results are seen in Table 4. In the interest of keeping the research unclassified, the plans are labelled generically and are therefore not tied to any specific plan.

Table 4. OPLAN Summary

	Initial Plan	Rotation	Total
Plan A	63490	63490	126980
Plan B	37543	37543	75086
		Total	202066

In any major contingency, the Air Force should be prepared to send follow-on replacement forces to switch out with the initial force if the execution of the plan extends beyond six months. While this portion of the TPFDD is not currently built, it is imperative the rotational forces are taken into consideration for the establishment of a C-1 bag inventory levels. Rotational forces will spend three to five days doing changeover with the initial forces, so it is imperative that both individuals have their own C-1 bag during this time. This will ensure each individual has their own gear, fitted to them if there is a chemical attack during this changeover period. As seen in Table 4, the rotation force is a complete mirror of the initial plan force, as the location of these rotational

forces is currently unknown. For any future rotations of forces, those Airmen will be able to receive the gear originally deployed with the initial forces. There will be time for the C-1 equipment to be reconstituted, repaired and replaced and then redistributed to the second rotational forces.

A total of 202,066 Total Force CONUS Airmen will be needed to meet the National Security Strategy goal. This information can now be used to extrapolate how many C-1 items the Air Force should store in order to have enough equipment to meet these objectives. Table 5 provides the number needed of each item and the associated cost to the Air Force of this equipment.

Table 5. Proposed Inventory

Nomenclature	Basis of Issue	Cost per Unit	Proposed Inventory	Total Cost
Detection Paper M8	1	\$1.06	202066	\$214,189.96
Detection Paper M9	1	\$6.24	202066	\$1,260,891.84
M295 Decon Kit	1	\$19.15	202066	\$3,869,563.90
M61 Cannister	2	\$51.21	404132	\$20,695,599.72
JLIST Coat	2	\$249.12	404132	\$100,677,363.84
JLIST Trousers	2	\$229.96	404132	\$92,934,194.72
Boots	2	\$49.25	404132	\$19,903,501.00
JBU2GU Gloves	2	\$30.96	404132	\$12,511,926.72
A3 Bag	1	\$30.11	202066	\$6,084,207.26
			Proposed Cost	\$258,151,438.96

The proposed inventory is what is required to meet the OPLAN TPFDDDS without any safety stock. The Air Force directs each base to hold an additional 10% of all C-1

bag items as safety stock. On some items, such as the coat and trousers, this is especially important as it would be difficult to determine everyone's sizes ahead of time to ensure the proper numbers were in the inventory. Keeping in line with current Air Force policies, table 6 shows the proposed inventory with a 10% safety stock for all items and the associated cost.

Table 6. Proposed Inventory with 10% Safety Stock

Nomenclature	Basis of Issue	Inventory w/10% Safety Stock	Total Cost
Detection Paper M8	1	222273	\$235,608.96
Detection Paper M9	1	222273	\$1,386,981.02
M295 Decon Kit	1	222273	\$4,256,520.29
M61 Canister	2	444545	\$22,765,159.69
JLIST Coat	2	444545	\$110,745,100.22
JLIST Trousers	2	444545	\$102,227,614.19
Boots	2	444545	\$21,893,851.10
JBU2GU Gloves	2	444545	\$13,763,119.39
A3 Bag	1	222273	\$6,692,627.99
		Proposed Cost	\$283,966,582.86

It is now important to compare the current CONUS inventory to the proposed inventory based upon the number of Airmen needed to meet the current National Security Strategy. This will help identify if there an excess or shortage of equipment and the cost associated with this surplus or deficit. The comparison will be between the current

inventory and proposed inventory with safety stock to ensure like data is compared. The results are seen in Table 7.

Table 7. Inventory Cost Difference

Nomenclature	Cost per Unit	Current Inventory	Current Inventory Cost	Proposed Inventory	Proposed Inventory Costs	Proposed Inventory Cost Difference
Detection Paper M8	\$1.06	625072	\$662,576.32	222273	\$235,608.96	\$426,967.36
Detection Paper M9	\$6.24	207517	\$1,294,906.08	222273	\$1,386,981.02	-\$92,074.94
M295 Decon Kit	\$19.15	490992	\$9,402,496.80	222273	\$4,256,520.29	\$5,145,976.51
M61 Canister	\$51.21	1368501	\$70,080,936.21	444545	\$22,765,159.69	\$47,315,776.52
JLIST Coat	\$249.12	799910	\$199,273,579.20	444545	\$110,745,100.22	\$88,528,478.98
JLIST Trousers	\$229.96	805971	\$185,341,091.16	444545	\$102,227,614.19	\$83,113,476.97
Boots	\$49.25	614658	\$30,271,906.50	444545	\$21,893,851.10	\$8,378,055.40
JBU2GU Gloves	\$30.96	977085	\$30,250,551.60	444545	\$13,763,119.39	\$16,487,432.21
A3 Bag	\$30.11	147932	\$4,454,232.52	222273	\$6,692,627.99	-\$2,238,395.47
Total			\$531,032,276.39		\$283,966,582.86	\$247,065,693.53

The proposed inventory cost saving was calculated by subtracting the proposed inventory cost from the current inventory cost. Of note in the calculations, currently there is a shortage of M9 detection paper and A3 bags as identified in MICAS. In order to meet the OPLAN TPFDDs, these items would need to be brought up to the proposed levels and therefore these costs are annotated as a cost expenditure for the proposed inventory. Based upon the TPFDD analysis, if the Air Force stores enough C-1 bag items to meet the current National Security Strategy with a ten percent safety stock, over \$247 million dollars could be removed from the Air Force inventory. Three items are the biggest drivers of this savings. The JSLIST coat and pants come in with over \$80 million

dollars in inventory reduction and the M61 canister saving the Air Force close to \$50 million dollars. While this money has already been spent and would not be a cost savings to the Air Force, the cost avoidance of having to maintain, repair, issue and replenish this stock could result in long term savings.

By keeping a ten percent safety stock on hand at the consolidated facility, the items with a single basis of issue would have 20,207 additional items on hand while those that have two basis of issue would keep 40,413. A ten percent safety stock is considered reasonable, when these items are dispersed to individual bases as their level of inventory is relatively low. However, in a consolidated environment, a ten percent safety stock drives high numbers. As shown in the Zinn article on centralization's effect on safety stock, the amount of safety stock needed to meet customer needs can be greatly reduced based upon the efficiencies gained. If the Air Force consolidates C-bags into a central facility, then the amount of safety stock can be reduced. The amount of reduction will be based upon the level of risk the Air Force is willing to accept by having less inventory at its disposal if there was a series of contingencies that exceeded the national security strategy. All safety stock cannot be eliminated without assuming a substantial risk, so Table 8 shows the saving that could be achieved if the 10 percent safety stock was reduced to different levels to a minimum of 5 percent.

Table 8. Safety Stock Levels

Safety Stock Level	Single Issue Items	Double Issue Items	Single Issue Safety Stock Remaining	Double Issue Safety Stock Remaining	Proposed Cost	Cost Savings
10 percent	222273	444545	20207	40413	\$283,966,582.86	\$247,065,693.53
9 percent	220252	440504	18186	36372	\$281,385,068.47	\$249,647,207.92
7 percent	216211	432421	14145	28289	\$276,222,039.69	\$254,810,236.70
5 percent	212169	424339	10103	20207	\$271,059,010.91	\$259,973,265.48

Every one percent decrease in safety stock levels reduces the amount of inventory on the single issue items by 2021 and double issue items by 4041. Reducing the safety stock down to 5 percent still leaves 10,103 single issue items and 20,207 double issue items available. As a cost figure, the Air Force could reduce its inventory by \$2,581,514.39 for each percentage reduction in safety stock. If reduced all the way down to five percent safety stock, the Air Force could achieve a \$12,907,571.95 reduction in inventory. This savings, when tied with the savings achieved from going to the proposed inventory levels, would result in a \$259,973,265.48 inventory reduction for the Air Force overall.

There may be concerns that reducing the stateside inventory to these low safety stock levels would place an unnecessary risk on the Air Force. As currently analyzed, if safety stock was lowered down to five percent, it would still allow the Air Force to send 10,000 more Airmen to a contingency from the continental United States than were originally projected and the consolidated facility could handle the surge. Additionally, overseas military locations would not consolidate their C-1 bag items stateside, so each overseas military installation would have a safety stock which the consolidated facility may be able to tap into if needed. Finally, if the demand far exceeded the 10,000

additional individuals, the consolidated facility would be able to pull from the C-1 gear set aside for the follow-on rotational forces.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions of Research

This research focused on determining the right level of C-1 bag inventory to meet current Air Force OPLAN requirements. The research showed an excess of equipment at stateside locations needed to meet these OPLAN requirements. Ridding the Air Force of this excess equipment will reduce replacement and maintenance costs. Additionally, consolidating C-1 bags at a single location could further reduce the Air Force inventory by minimizing the safety stock levels. Enacting these changes could save the Air Force in excess of \$259 million dollars in inventory costs.

There is a need for an enterprise management of C-1 bag assets. The decentralized planning and execution of CWDE assets has caused ineffective inventory management, as the Air Force cannot determine what it has available at any given time. The ineffective inventory management means there is a lack of control and accountability of C-1 bag assets. The Air Force cannot ensure Airmen will be issued serviceable chemical warfare defense equipment during wartime.

Significance of Research

The Air Force strives to be lean, agile, responsive and efficient. C-1 bag consolidation and inventory reduction would allow the Air Force to be all of these things. Keeping and maintaining excess inventory is a drain on manpower and is costing the Air Force money. Establishing a C-1 bag stocking level based upon the National Security Strategy is the right step in aligning inventory levels to policy. Establishing an annual requirement to review and validate OPLAN TPFDDs that meet the National Security

Strategy will ensure the Air Force is responsive to the needs of the nation, while being agile in its stocking levels.

The research aimed to answer the question on will consolidating Air Force C-1 bags to one location reduce the inventory, allow for safety stock reduction and save the Air Force money? If the Air Force moves away from a decentralized C-1 bag planning, inventory and execution and moves to an enterprise wide control of stateside assets, the answer is very much an affirmative. From an inventory perspective, the Air Force could shed in excess of \$247 million dollars in inventory. The effects of pooling the C-1 assets will allow the Air Force to reduce its safety stock and if safety stock levels are reduced from ten percent down to five percent it would save the Air Force almost \$13 million more dollars. Monetary savings are only one of the added benefits of consolidating these assets, however, when every dollar counts, these savings should be enough to catch leadership's eyes and spur a serious discussion about C-1 bag consolidation.

Recommendations for Action

Headquarters Air Force designates an office to be responsible for CWDE accountability and ordering. Currently, each base is responsible for reviewing and updating its inventory levels. Having a single Air Force requirement based upon the National Security Strategy will ensure the proper amount of inventory is purchased and maintained. The Air Force should also appoint a lead agency to further investigate C-1 bag centralization stateside. The Air Force should also streamline the annual review process. Until consolidation is enacted, each base storing C-1 bags will still need to provide their C-1 bag inventory quarterly. Each base should report directly to the

MICAS program office. Most MAJCOMs do a cursory review of the quarterly and annual inputs, based upon their lack of expertise with each locations requirement. Cutting out the middle man, who is mostly a consolidating agency by having the inputs provided directly to the MICAS program office will cut out excess, non-value added work.

Recommendations for Future Research

This research focused on determining the right C-1 bag inventory to meet the National Security Strategy. Determining the two largest Air Force requirements to support COCOM OPLANs show the Air Force needs less stateside inventory than is currently being stored. Additionally, safety stock can be reduced based upon the efficiencies gained by pooling. This analysis is only one key piece of information needed to make an informed decision on centralization. Previous research determined centralization was not cost effective in regards to transportation costs, which is one of the trade-offs for centralizing inventory. Centralization would have to show a positive return overall in order for the idea to have merit.

Other areas for future research include a study of the manpower requirements necessary if the inventory is consolidated. Manpower savings could be achieved by centralizing C-1 bags in one location. The 215 stateside locations have Airmen and civilians assigned to maintain and issue C-1 bags. Further research could identify the proper number of individuals needed to make a consolidated location functional and determine if this would save the Air Force manpower.

Facility requirements will also need to be identified. Consolidating 215 locations into one location will require a large warehousing facility. The cost of altering a current building or constructing a new building could end up costing the Air Force more than the realized savings. The Air Force may be able to save on infrastructure costs by consolidation, once the 215 locations are vacated.

The risk involved with consolidation needs to be investigated. Placing all C-1 items in one location increases the risk of loss due to natural disaster or enemy action. Future research will have to determine if the risk can be mitigated enough to warrant the benefits gained from centralization.

If consolidation is achieved stateside, the idea of consolidating C-1 bags in overseas locations could be looked at as well. EUCOM would be a more likely candidate as the ability to ground transport equipment is feasible in this AOR as compared to PACOM.

Summary

Every dollar counts in a fiscally constrained environment. Whether retiring aircraft, separating Airmen from the Air Force or ridding the service of excess equipment, this money will be used to recapitalize the Air Force. The research has shown the Air Force has \$247 million dollars in excess C-1 bag items than is needed to meet the current National Defense strategy. This excess equipment is more manpower intensive to store, maintain and replace. There are efficiencies to be gained, by reducing the inventory to the proper level and consolidating the equipment. Additional saving can be found in reducing the C-1 bag safety stock. An additional \$12.9 million dollars in

inventory could be removed by reducing safety stock levels down to five percent.

Consolidation is not without risks. The question is, “How much risk is the Air Force willing to assume with consolidation and reduced safety stocks?” The Air Force is currently accepting risks where it has not in the past, especially in relation to aircraft retirements. C-1 bag consolidation and safety stock reduction is one area where the risk is worth the level of reward based upon the amount of money the Air Force could save.

Appendix A – Sample TPFDD

ULN	UTC	BULK S/T	OUT S/T	OVER S/T	PAX	ALD	EAD	LAD	RDD	ORIGIN	M/S 1	POE NAME	M/S 2	POD NAME	M/S 3	DESTINATION	SF
K3F01	3FQEF	57.1	9	51.8	133	0	1	6	7	Nellis Afb	XG	Nellis Afb	AK	Chitose	XX	Chitose	T
K3F03	3FQKR	70.5	6.3	90.7	89	0	2	7	8	Nellis Afb	XG	Nellis Afb	AK	Chitose	XX	Chitose	T
H3S01	3SAAZ	6.6	0	0.6	0	4	6	9	10	Eglin Af Aux Nr 3	XG	Eglin Af Aux Nr 3	AK	Clark Intl	XX	Clark Intl	
H3C01	3CB66	29.9	118.8	103.1	169	3	6	8	9	Ft Irwin	XG	Ft Irwin	AK	Clark Intl	XX	Clark Intl	A
A71Q1	QFAAG	0	0	0	1	3	5	7	7	Pope Afb	XG	Pope Afb	AK	Clark Intl	XX	Clark Intl	
A71Q3	QFEB2	5.6	0	0	13	3	5	7	7	Pope Afb	XG	Pope Afb	AK	Clark Intl	XX	Clark Intl	
A71Q4	QFEB2	5.6	0	0	13	3	5	7	7	Pope Afb	XG	Pope Afb	AK	Clark Intl	XX	Clark Intl	
A71Q5	QFEB8	0	0	4.3	0	3	5	7	7	Pope Afb	XG	Pope Afb	AK	Clark Intl	XX	Clark Intl	
A81P1	PFMA1	0	0	0	1	0	1	4	5	Macdill Afb	LG	Pope Afb	AM	Clark Intl	XX	Clark Intl	V
A81P2	PFMA3	0	0	0	1	0	1	4	5	Macdill Afb	LG	Pope Afb	AM	Clark Intl	XX	Clark Intl	V
A81P3	PFMAH	1.8	0	0	0	3	5	7	7	Macdill Afb	LG	Pope Afb	AK	Clark Intl	XX	Clark Intl	
A81P4	PFMAK	0.2	0	0	0	3	5	7	7	Macdill Afb	LG	Pope Afb	AK	Clark Intl	XX	Clark Intl	
A71U2	UFTSL	0	0	0	1	3	5	7	7	Incirlik Ab	XG	Incirlik Ab	AD	Clark Intl	XX	Clark Intl	
A71X2	XFFA2	0	0	0	1	3	5	7	7	Lajes	XG	Lajes	AD	Clark Intl	XX	Clark Intl	
AE1F1	FFGRL	1	0	0	4	3	5	7	7	Scott Afb	LG	Pope Afb	AK	Clark Intl	XX	Clark Intl	

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14. ABSTRACT This paper investigates how C-1 bag inventories are currently calculated and compares this to the National Security Strategy and how much inventory is required to meet the stated goals. The current inventory is then compared to the proposed inventory, to determine if the Air Force has too much or too little inventory to meet these requirements. Based upon the two most demanding planning scenarios, it would appear that the Air Force has \$249 million dollars in excess C-1 bag items. Consolidating these items in one location and reducing safety stock from 10 percent down to 5 percent could save the Air Force an additional \$13 million dollars. Inventory and safety stock are two important factors the Air Force should consider when investigating the feasibility of consolidating stateside C-1 bags at one location.				
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