U.S. Navy A&EFS Program Overview & Magazine Storage Requirements Calculator (MSRC)

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Abstract

An overview of the U.S. Navy Ammunition and Explosives Facility Support (A&EFS) program. This groundbreaking effort has changed how the Navy plans and has created a new way for the U.S. Department of Defense (DoD) to analyze storage capacity. It has also created an efficient new method to characterize and catalog storage magazines in the DoD magazine inventory, providing fast options for statistical analysis and reporting.

The A&EFS program will generate explosives site plans for more than 90% of Navy storage magazines. Each magazine is characterized using the Magazine Construction Assessment Report (MCAR) form. A storage capacity analysis is generated for each installation using the Magazine Storage Requirements Calculator (MSRC).

The MSRC is designed to analyze explosives storage requirements and utilization at DoD installations. The tool can optimize explosives storage magazine space based on volume and explosive weight, while adhering to explosives safety requirements.

Introduction

The U.S. Navy Ammunition and Explosives Facility Support (A&EFS) program is a groundbreaking effort that has changed how the Navy plans and has created a new way for the U.S. Department of Defense (DoD) to analyze storage capacity. It has also created an efficient new method to characterize and catalogue storage magazines in the DoD magazine inventory, providing fast options for statistical analysis and reporting.

The A&EFS program is a follow-up and expansion of the U.S. Navy Fleet Concentration Area Magazine Study (FCAMS) begun in 2014. The FCAMS project brought together many different commands throughout the Navy, including the Naval Facilities Engineering Command (NAVFAC), Naval Ordnance Safety and Security Activity (NOSSA), Naval Munitions Command (NMC), Fleet, and Naval Supply Systems (NAVSUP). The intent was to overhaul the available methods for estimating required storage space for explosives articles. A history of the FCAMS project is provided.

Upon completion in 2020, the A&EFS program will generate explosives site plans for more than 90% of Navy storage magazines. Each magazine will be characterized using the Magazine Construction Assessment Report (MCAR) form. A storage capacity analysis will be generated for each installation using the Magazine Storage Requirements Calculator (MSRC).

Background

Planning for explosives storage facilities in the Navy is governed by UFC 2-000-05N, Series 420 (Reference 1). Based on work done as part of FCAMS, a major update to this portion of the UFC was released in early 2017. Prior to this update, FCAMS identified two major issues planners experience with regard to establishing facility requirements for explosives storage (i.e., how much space is needed). The first issue was how to correctly identify existing magazine facility types, and the second issue was properly quantifying the required munitions to be stored at an installation (i.e., the load plan). The combination of these issues made the creation of repeatable Basic Facility Requirement (BFR) documents difficult and potentially inaccurate. With limitations on the available details for existing magazines and potential for inaccurate or incomplete load plans, how can planning be done? How can the Navy determine if a given load plan (large or small) can be accommodated safely and properly at a given installation (large or small)? These questions were the genesis for FCAMS in 2014.

Currently, the Navy utilizes approximately 20 different variations of arch and box storage magazines of varying age and capacity. As recently as 2017, NAVFAC's Real Property accounting system (internet Navy Facilities Asset Data Store – iNFADS) did not have the ability to provide details of the structure type or other parameters related to explosives safety criteria. Only dimensions and date of construction were available. Storage magazines are assigned a Category Code Number (CCN), however these are often assigned by facility use instead of facility type. These limitations make it difficult to quickly answer basic queries:

- How many of a specific type magazine does the Navy have available in a certain region?
- Can an Installation support storing a given amount of specific type munition?
- Can an Installation support storing items that are unique in terms of either size or security requirements?

When developing BFRs in accordance with existing UFC guidance, a NAVFAC planner would estimate or be provided with a total gross weight to be stored at the facility or location (not actually based on Net Explosive Weight (NEW)). Additional attention could be given to unique aspects, such as the container or logistical constraints (e.g., can it fit through the door), but the total gross weight has historically been the only variable stressed. Using the previous UFC guidance, these methods were not able to:

- Determine if the total quantity of explosives had been accounted for
- Fully consider the space requirements of individual container types
- Consider explosives safety storage criteria, such as mixing rules
- Consider the difference between varying explosives hazard classes

The FCAMS effort led to several "big picture" findings across the Navy. The largest of which is that munitions storage cannot be correctly and universally planned for if NEW is the only variable considered. Key properties such as packaging size, storage compatibility, and hazard division must be accounted for. Likewise, explosives storage facilities cannot be accurately defined in terms of only square footage. Explosives storage facilities vary significantly in terms

of accessibility and usability. In other words, “a pound is not a pound and a square foot is not a square foot”.

Historically, the Navy has been a low-volume, high-density organization (bombs and pallets). The modern Navy, in addition to the low-volume, high-density material, is transitioning toward a second ordnance type: high-volume, low-density ordnance (containerized missiles). These new types of items cannot be stowed in many of the existing magazine spaces throughout the Navy.

FCAMS

The FCAMS project was a NAVFAC Atlantic contract co-sponsored by NOSSA and Naval Munitions Command (NMC Atlantic and NMC CONUS West). Parsons and APT executed the contract October 2014 through March 2017. The objective of the FCAMS project was to develop the capability to assess the current available storage capacity of Navy magazine while simultaneously considering explosives limits, spatial constraints including magazine construction type, safe storage practices, and optimal storage techniques. FCAMS consisted of three phases.

- Phase I baselined six fleet concentration sites to establish the NEW limits of the storage magazines.
- Phase II developed the MSRC to provide a uniform approach for determining storage requirements and generating BFRs.
- Phase III utilized the MSRC at each of the six sites to analyze the Global Requirements Based Load Plans (GRBLP), provided by NMC, against the available magazines.

The deliverables of the FCAMS were detailed planning utilization analyses for the fleet concentration sites and the MSRC, the new standardized method of analyzing explosives storage requirements. The major accomplishments of the project were:

- Standardization of the identification and classification of magazine types.
- Creation of new streamlined magazine assessment procedures and identification methods.
- Adoption of GRBLP and its use in planning.
- Updates to the UFC.

Improved planning methods have been developed considering three key factors. The first is standardization of storage magazine types and identification. This includes accurately identifying the physical structure type of each magazine, identifying other physical properties affecting storage capability, and recording the properties using a standardized codex system. The second is the use of the GRBLP where available. The GRBLP provides Naval Ammunition Logistics Codes (NALCs), the quantity required, and considers future growth and new munition types. NALC lists should be available at smaller sites without a GRBLP. The third is the translation of munitions into eight standardized footprint types. This categorizes NALCs into generalized groups by footprint size and allows for rapid analysis of thousands of differing items.

Prior to FCAMS, the iNFADS database was not configured to show the data and variables required to define the Navy’s explosives storage capacity or magazine inventory. Magazines have historically been identified by category codes that are often associated with use (which

changes with time) instead of design type (which does not change with time). Category codes do not describe the physical structure (e.g., door width, interior columns, etc.). The FCAMS project has developed important updates to the type of information gathered and how it is gathered. These updates are detailed in the UFC.

MCAR and Magazine Codex

Asset Evaluations (AEs) are used to gather general information to populate iNFADS with basic dimensions. An MCAR has been developed to gather additional structural details relevant to explosives safety and storage capability. Updates to the process include:

- Identifying the magazine standard construction type.
- Obtaining measurements of key structural features, such as doors, columns, and headwall.
- Recording details of surrounding features, such as loading dock, barricade, and wingwalls.

The MCAR data for each installation must be approved by the local Explosive Safety Officer (ESO) prior to uploading the information to iNFADS.

NAVFAC, NOSSA, and APT developed an intelligent identification coding system referred to as a codex. Each single character in the 8-character code gives information about various features or limitations of the structure. The resulting 8-character code is not unique to a particular structure but allows for fast sorting of facilities and accurate descriptions. The characters are as follows:

- 1st and 2nd characters identify the facility type (e.g., Box D vs. Arch).
- 3rd and 4th characters identify facility sub-type or length (e.g., 5-bay Box D, or 71-84 ft Arch) or can be used to identify magazines handled as equipment (e.g., Golan 10, NABCO or CONEX-ISO Container).
- 5th character identifies the headwall type (if applicable) or structural weaknesses (e.g., 7-bar headwall or downgraded Earth Covered Magazine (ECM)).
- 6th character identifies if a front barricade is present and the configuration.
- 7th character identifies access type (e.g., confined door that allows only pallets).
- 8th character identifies the presence of an Intrusion Detection System (IDS).

Details of each magazine type as well as a complete description of the codex variables and all inputs are provided in the Magazine Design Type Identification Guide (NOSSAINT 8020.22A Guide 6) (Reference 2).

Use of the GRBLP for Load Plans

The FCAMS project brought together many different commands throughout the Navy, including NAVFAC, NOSSA, NMC, Fleet, and NAVSUP. Together, it was established that the GRBLP is the best consistent resource for establishing the munitions load plan for an installation. The GRBLP stockage objective quantities account for:

- Operational quantities

- Training rounds
- Maintenance rounds
- Security
- Other miscellaneous requirements

For installations that do not have a GRBLP, the stockage objective or load plan can be generated as list of NALCs and required quantities provided by the operators (tenant commands).

MSRC Methodology

To facilitate a fast-running MSRC, munition footprints are simplified into eight categories/footprints. NMC developed standardized quantities for each footprint that can fit in various magazine types.

As a result of the FCAMS, the process described in the updated UFC is focused on developing the BFR report. The MSRC now provides consistent results across the Navy because it takes into consideration the cause and effect of:

- How the load plan is considered.
- How munition items are categorized, grouped, and analyzed for space.

The MSRC generates a BFR that has been redesigned to utilize the new methodology, while still reporting the information it has historically.

The MSRC first analyzes the GRBLP and then presents the results of the magazine requirement to store the GRBLP. The MSRC has the capability to provide how existing and future magazines are analyzed for usable space and the load plan can be designed to account for future weapon platforms and expected increases/decreases at an installation for future years. The MSRC's BFR output will be uploaded to iNFADS in the same way it has been in the past.

The MSRC, what supports the BFR development, accomplishes this with a "Stowage Matrix," which was developed to identify the ideal number of footprints that can be stowed in each of 21 general magazine types modeled in the tool. The principles of NAVSEAINST 8024.2 (Reference 3) and NAVSEA OP 5 (Reference 4) were adhered to. NEW limits and mixing rules of HC/D materials are followed. Storage Compatibility Group (SCG) rules are followed.

The load plan and magazine list are the two main data requirements for the MSRC. The load plan includes the GRBLP or NALC list. The Magazine list includes facility types, security features, and the sited NEW.

The MSRC is the first planning tool capable of analyzing and optimizing both spatial utilization and NEW utilization while meeting all applicable requirements. This provides standardization of storage requirements Navy-wide. The UFC 2-000-05N process can also be implemented without the MSRC for small facilities or small load plans.

MSRC Capabilities and Uses

The MSRC provides a variety of benefits, including consistent, repeatable results across the Navy. It models requirements based on actual storage layouts/footprints. It takes into account design type of existing magazine assets. Space requirements are based on actual size/type of article (footprint types) instead of generalized formulas. Space requirements account for safe storage principles (e.g., stack height maximums) instead of only available area in square feet. Vastly differing magazine types are properly categorized to store acceptable items (i.e., a square foot isn't just a square foot). The MSRC also provides faster analyses and reduced human errors.

The MSRC also provides military construction (MILCON) support. Supporting new construction requires justification of the requirement for the new facility. The MSRC can be used to determine whether there is a surplus or deficit of explosives storage space. The load plan can be analyzed first against the existing magazines. If a deficit in available space is found (i.e., the load plan won't completely fit within the available magazines), the MSRC can be used to calculate the minimum number magazines (modular storage magazines (MSM) or box magazines) that would be required to support the remaining munition items. This process would use the MSRC in tandem with explosives safety siting (ESS) software to determine the allowable NEW limits for new facilities. ESS provides the allowable NEW limits based on surrounding exposures and constraints. The MSRC helps determine the upper-bound limit needed for varying magazines types (e.g., a magazine may not need an extremely large sited NEW if it will be used to store missiles).

The MSRC can also be used in recapitalization efforts. The MSRC can be used to efficiently and defensibly determine the required number of new MSMs or box magazines necessary to replace any number of legacy arch or other magazines. The MSRC is first used to determine what quantities of munitions are being stored in current legacy magazines. This list of munitions is then analyzed to determine the number of new (larger) magazines that would be required to store the same load plan. Due to the inherent limitations of legacy magazines, a single box magazine can often replace several arch magazines. One example analysis of actual data showed that 51 arch magazines (80' and 50' depths) could be replaced by seven new Box D magazines. The benefits of recapitalization are:

- Extremely reduced footprint
- Fewer facilities to maintain
- Modern structures with increased accessibility and security
- Greater storage flexibility

The ESS software would be used in conjunction to determine acceptable locations for the new magazines replacing the legacy magazines.

The MSRC can be used to study the relocation or redistribution of munitions from one installation to one or more other installations. Load plans can be quickly analyzed against available storage facilities at other installations. The rapid analysis capability of the MSRC, in conjunction with the ESS software, allows multiple alternatives at multiple locations to be

analyzed and compared. The consistent, repeatable analysis methodology ensures that each alternative is held to the same criteria, considering physical space and explosives safety criteria.

The MSRC can also be used for planning for new sites. A completely new site can be planned using only a load plan. The ESS software is used first to find the constraints surrounding the available area and estimate the upper bound of the available NEW limits. The upper-bound NEW available limit can be used in the MSRC to determine the number of new "proposed" magazines required to store the provided load plan. Multiple magazine types can be quickly investigated (e.g., MSM vs. Box Cs or Ds). The MSRC will report whether the new magazines are limited by NEW or by physical storage space. These data can be used to further refine the proposed layout in the ESS software.

The MSRC, along with the user's manual and other helpful tools, can be found on the NAVFAC Portal website.

A&EFS

The success of the FCAMS program at the six fleet concentration sites led the Navy to expand the effort to all Navy installations worldwide. Those installations with 16 or more storage magazines will be assessed as part of the A&EFS contract, led by AECOM and supported by APT. Installations with 15 or fewer explosives storage magazines will be self-assessed using the methods and tools developed during the FCAMS project.

The A&EFS project differs from the FCAMS effort in that it seeks to produce a region-based and Navy-wide assessment of available and required explosives storage space. As part of this effort, Explosives Safety Site Plans (ESSP) will be developed for each magazine. BFRs will be generated for each installation, providing the Navy will a current, accurate assessment of the existing and required facilities. The A&EFS effort includes both continental U.S. (CONUS) and foreign installations (OCONUS).

The workflow for the A&EFS program is shown in Figure 1.

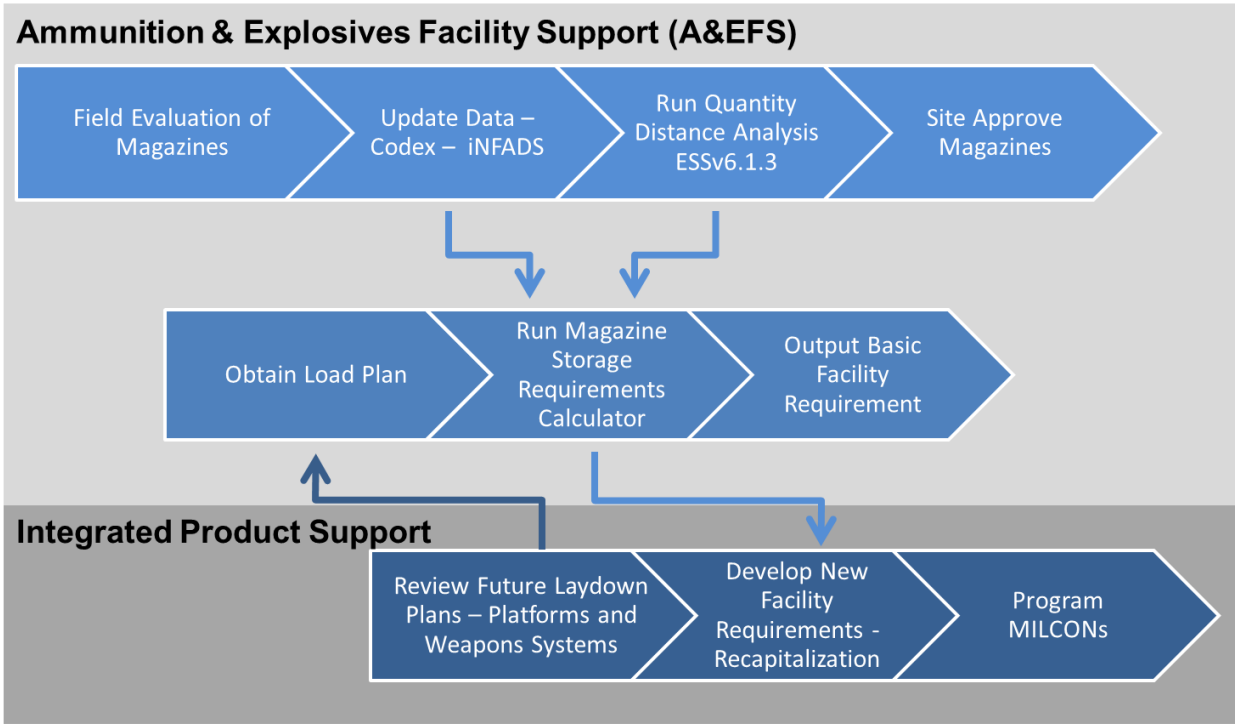

Figure 1. Navy Explosives Facility Planning (Courtesy of NAVFAC and NOSSA)

Conclusion

The A&EFS project exists due to the success of the FCAMS effort and subsequent Navy adoption of methods and tools developed during the FCAMS effort.

Upon completion of the A&EFS effort, the Navy will have completed ESSPs for nearly all magazines across the world, current BFRs for each installation, current accurate facility characterizations for each individual magazine, and a global understanding of required MILCON projects.

References

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