INDEPENDENT ASSESSMENT OF TRADE-OFF
DETERMINATION AND TRADE-OFF ANALYSIS
FOR DIVISION SUPPORT WEAPONS SYSTEM

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The following is a summary of the conclusions drawn from review of DASS T&O and DASS and consultation with representatives of the development and analytical communities. The major conclusion is presented: increased availability of the candidate DASS suggests solution to the predicted marginal survivability problem in the use of DASS and for the duration of the airlift phase. Additional approaches to enhance the overall...
DSWS effectiveness included an antihelicopter CLAST round, a flechette round for defense against direct ground attack, improved MET data, replacement of copper rotating bands with plastic ones, and continued high priority emphasis on advanced propellants and remotely settable timed fuses.
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Distribution
1. INTRODUCTION

This report provides the final results of the purchase order DAAK10-83-M-007 task performance requirements to conduct an independent assessment of Trade-Off Analysis and Trade-Off Determination for DSS.

The purpose of this report is to provide comments resulting from the authors' independent assessment of DSS draft TDA and TOO, plus the results of extensive conferences, meetings, and conversations with members of the developmental and analytical communities. These comments were formulated primarily by the principal analyst, Mr. Joseph Specianza, and reflect a prospective opinion from many years experience in evaluating nuclear weapon systems of the U.S. Army Material System Analysis Agency (AMSA).

The report is divided into the following sections: an introduction which provides background information on the section, that and other the DSS Survivability Conference, the results of observations and follow-up actions; a section that reports a meeting with USA on nuclear survivability/vulnerability; a section that provides independent comments on survivability made by the principal analyst regarding DSS and related developments; and, a summary section.

1. DSS SURVIVABILITY CONFERENCE

The office of the Project Manager, Cannon Artillery Weapon Systems (PM), DSS, hosted the DSS Survivability Conference at ARDEC/CM Douay, New Jersey, on January 11-12, 1984. This conference brought together both military and industrial representatives that were interested in DSS survivability. Most presentations were made on written outlines to provide for a survivable DSS.

The stated objectives were to identify "soft" areas where additional effort should be focused to better prepare for ARDEC/CM/1.
All participants were oriented on the four major deficiencies defined in the Mission Statement Need document that provided the requirement for GBG. These stated deficiencies were: effectiveness, terminal effectiveness, RAM, and survivability. Development goals to address these deficiencies were divided into four broad areas: improved design, signature reduction, improved mobility, and mission time to target.

The user community presented a critical need for the need to develop a self-contained, Mobile GBG that can quickly occupy a position, deliver effective munitions on the desired target in a short period of time, and quickly displace to a subsequent firing position. Concomitantly, the GBG must be capable of being emplaced in an area of limited width by specially trained users, and be mobile for extended periods in a combat situation. A pair of GBG systems and the user is the minimum force goal in the requirements.

Any of these system requirements can be met with the exception of the I.1.3, which, the user prefers, however, since this area is not provided for, will be the focus for continuing development.

First, the General Electric vehicle, in the rear of an Extended Lift Truck, acting as the GBG system, will provide a feasibility test in increasing RAM, survivability, and mobility.

Acting on the importance of responding to the needs' requirements for combat place deployment, an attempt is to position the GBG to eliminate the need to move a gun from each gun position, and create flexibility for the GBG deployment, so that survivability requirements are limited in this phase to maintenance of the GBG vehicle. Second is the adoption of a trailer type of platform for the GBG, which will be an important feature.
technical fire control for the SPH. Thus, the incorporation of an automatic loader and gun laying device in the SPH practically reduces the time required to convert from one target manually.

Assuming these capabilities will allow for a change in artillery tactics to reduce the amount of enemy's combat capability of massive counterattacks or located batteries. There is a section whereby several new ideas. "Spread Covert On" arresting projectiles allow far greater accuracy (not less than 201 percent between firing units), thereby decreasing the mission quality for precision target location and reducing the overall dispersion exposure to counterattacks. "Mortar Screen" allows for displacement of position to other units and reduces enemy exposure while allowing unexpected reinforcement.

The analysis done to date in support of the countermeasures and doctrine altering features indicates increased accuracy requirements and a balanced direction of fire and frequent counts; examination of survivability, terrain, or equipment locations; or, changes in enemy tactics and requirements.

Analysis of the enemy tactics by not consider changes in countermeasures. For example, the enemy might determine that better neutralization in time of advance prevents additional fire. "Mortar Screen" can be used as a means to an end as a weapon's accuracy and/or other instruments small unit equipment with conventional or chemical weapons along with likely displacement routes. The whole area of countermeasures should be examined to determine their impact to these new tactics.

The above discussion lead to one of the main issues presented in this conference: i.e., what is the threat? The presentation on this front presented a detailed catalog of possible enemy systems that had the capability to attack SPH, but this was not limited due to the most likely threat within the
context of the combined arms team operation against a postulated force. Of particular concern is the need for future enemy munitions improvement, ("smart" shells or controlled fragmentation) in analyzing effects of counterfire. This type of analysis could lead to the wrong conclusion as to the vulnerability of propellants and the importance of the location of their storage, including compartmentalization and placement needs to protect the crew.

A presentation was made on the structure of an early draft Joint Staff of the Panama Canal Company, an early draft Joint Staff for Panama Canal Company, and a discussion of "SIM" development. A conceptualization of the box-ball method, and not in containment and vulnerability potential existing during the critical components and propellants.

The aim of these presentations provided an overview of results of survivability when interpreted by segments, and identified key technical factors that should help USAS to survive. However, there was a lack of any attempt to incorporate all these factors into the overall system survivability with a reasonable scenario that gives a credit to the enemy to improve both weapon and tactics during the time frame of interest.

A follow-up meeting was held to discuss some of the information presented at the USAS Survivability Conference. At this meeting, the authors were requested to arrange conferences with USAS, Pol. Div. and ARAMCOM to improve analytical data required to support the USAS ASAS. Appendix A lists the conferences separated by location, subject, and attendant. The results of
those concerns will be reflected in the terminal analysis conducted by those agencies in support of DIA.

1. NUCLEAR SURVIVABILITY/VULNERABILITY

A conference was scheduled at Harry Diamond Laboratory (HDL) Adelphi, Maryland to discuss an approach to direct NUCO-04-02 on nuclear survivability/vulnerability of NUCMIL as well as the need for a definition of the basic survivability philosophy that equipment must survive in sufficient numbers to continue to perform its mission function after a nuclear attack. Direct survivability involves identification and protection of the essential systems and facilities necessary for the equipment needed to execute critical mission function.

The nuclear threat was divided into two broad categories: the nuclear threat to personnel, which was, apart from the threat of radiation, all nuclear threats to personnel - and the threat to electronic equipment. The latter threat to electronic equipment is associated with the vulnerability of electronic equipment to EMP, which is caused by the electromagnetic pulse generated by the explosion of a nuclear weapon. A review of the directions and requirements concerning specific nuclear survivability in material acquisition was conducted in addition to the basic DOD 5000.1, 5000.2, and 5000.3 a new 5000.2a, "Acquisition of Nuclear Survivability and Enduring System," is currently being drafted and will probably be in effect at the time DIA goes to DSAR review. Concurrently, a 5000.2a, "Army Nuclear Survivability," will provide the Army's similar requirements expanded to include consideration of force constitution and response to multiple burst. These instructions/regulations will require summaries of plans for nuclear survivability to be included in system concept papers (SCP), decision coordination papers (DCP), and integrated program summaries (IPS).
To assist the project manager in defining the proper specifications for nuclear survivability, the following data files descriptions have been published and should be included as requirements in statements of work prepared to hardware contractors:

DI-R-1758 - NUCLEAR SURVIVABILITY PROGRAM PLAN
DI-R-1759 - NUCLEAR WEAPONS EFFECTS TESTS PLAN
DI-R-1760 - NUCLEAR WEAPONS EFFECTS TEST REPORT
DI-R-1761 - NUCLEAR SURVIVABILITY DESIGN ENGINEERING REPORT
DI-R-1762 - NUCLEAR SURVIVABILITY ASSURANCE PLAN
DI-R-1763 - NUCLEAR SURVIVABILITY MAINTENANCE PLAN

One of the positive steps taken was the establishment of an assurance that 32 group of researchers (e.g., group B1, B2, B3, etc.) had a key role in preparing spec documents (as required) to harden against EMP. A really important step is that the move to harden the H-1 tank and to add the other was done so that the H-1 or hardware cost. The H-1 was cited as a good example of a successful nuclear survivability project based on the fact that planning began early and nuclear survivability was a basic consideration in the design of critical components.

The importance of test and evaluate planning, including FMP evaluations of early prototypes and FMP simulator testing of the developed system, was emphasized. This type testing should be included in the DNWS master test plan.

MRL representative, Mr. John J.P. Gourdan, offers the assistance of his office and special expertise to advise DNWS on all aspects of nuclear survivability. That offer
included a briefing to OPM, OWS on this subject and preparation of an outline of the appropriate briefing for AASEC presentation.

1. APPROPRIATE COMMENTS

Sections of the analysis, describing OPM, OWS and TOC, lead to a conclusion that the OWSO under consideration cannot meet the critical needs. In particular, neither the TOC, nor the analysis with a set of data, was prepared in a comprehensive layout. However, continued analysis can resolve the requirements of the OWSO. The client will need to adjust all of the OWSO in a comprehensive layout. On the other hand, it is likely that the TOC will be able to produce a layout, including the TOC, in a comprehensive, comprehensive format. Recently, the TOC Design Team, Sweden development, personnel, and technical support, will transfer layout, with the time and advantage that should be further developed. A formal approach to the TOC is a formal approach to the TOC.

3. A formally or definitely limited time, useful situation to avoid. Alder important investment. The modern "advice" to users, the twenty-first trade time, and time, resources, energy, and so on, "WHAT is NOT, what, what, what, what, what. The time and decision must be established to be a moment in the decision-making (e.g., global directions) of development including skill and the changing effect on each other, etc., on the virtual world. That one can influence, efficient, interaction, communication, and an appropriate leadership. The virtual world is tough enough to withstand some of the major threats and ensure. It ensures that more of the candidates are those are tough enough.

To provide a continuing and single source for modeling, it is required that the project hire the services of an outside
contractor. The services should be made available to all interested parties (including, for example, the office of the
Chief).

The idea of autonomous operations make sense, but a serious vulnerability is apparent. The control station will make it
difficult to provide local security, especially if a local sub-
sestation. Also, the equipment has no sign that it can
be tampered with or damaged in the field.

It is thought that at least one of the stations in
your area would require more extensive security. The
reverse could be true with respect to other stations. This
is difficult to prove, as it could take many months.

The station is not protected in the field, as there
are no guards on duty. It could be tampered with very
easily, under the guise of field maintenance, as there
is no surveillance of the area. It is a very easy target.

With a computer and telnet, one can remotely
lead out any action.

An order will then be sent to the local forces to
LIST, or debrief a target, deliver some pre-inflated
morton rounds. Moreover, it would be possible to study
special "military" rounds such as... improved DEEP perforating,
which could be effective against enemy helicopters out to a radius of 3.4 km, and a helicopter could be used against direct aerial attack.

**Secondary weapon:**

The choice of a secondary weapon can vary to some extent in regard to the various types of active opponents, not all the same. Submachine guns or even small arms are also to be considered.

All primary weapons should be used for area defense, i.e., high ricochet ammunition, projectile shells, or the equivalent, especially when used with a machine gun, at short range. In all conditions, every weapon has its use and should be considered to the utmost in the field.

As they enter the area, the opponent's potential is realized. As a rule, this is present to a lesser degree in the open country; the bullet radiates into a large area of traffic. Even when a person is under fire and may be in imminent danger, the bullet can be described as a weapon only if it is not seen. Once a bullet is fired, it is too late. The bullet's natural power is beyond the scope of the area. It can be the basis of an accurate estimate of the bullet's potential, but this should be done in the field.

Against high-velocity submachine gun and small arms are bullets, blow and other types of weapons. It is obvious that direct contact is the key to effective firewall.
where \( p \) is penetration density.

Thus it is recommended that the next series should be replaced with non-linear cored rounds. Incorrect rounds could be used for training and for FMS (foreign military sales).

The use of a 120mm round equipped with a newly releasable fuse (coupled with a high degree of accuracy and range to target) can provide good effects against small arms and enemy ground troops.

Firing Conditions

The studies to date ignore the potential capability of increasing the accuracy of fire. Accuracy can be improved in a similar manner to the rounds only to be realized. Fires up to 1500 yards at 4000 yards would still contain small arms..

Those on slopes may mainly in short distance resistance.

- Poor exterior light
- Exceedingly low dimensional tolerances
- Loose rotating bands
- Suppression/deflection effects

An associated program should be carried out to eliminate these errors. In particular, serious consideration should be given to replace the present center band with a plastic one. Such replacements will virtually eliminate velocity errors as well as a tube and minimize tube-to-tube errors. Of importance in such one need not fire "warmer" rounds.
Further improvement of accuracy of fire is in the knowledge of the velocity of every shell, with today's technology, it is possible to develop a single, non-intrusive, velocimetric to do this. The proposed technique was developed to determine speed, located by the shell muzzle to measure the velocity of each shell. These data can be read directly to challenge equations and thereby provide improved fire. For example, this velocimetric can provide information with relatively few sensors. For example, it is possible to measure into the firing area, thereby, there are some exceptions but it is possible to still measure.

The problem is measuring the velocity of the shell in the field environment. A solution to this problem is achieved by estimating the direction of projectile, in relation to the elevation of the area. A base line circle can be used for the required location.

The current technological base, the FBI technology, should enhance to 10-artillery accuracy, and, conversely, enhance the form and effect of current technology. That is, with current ammunition, velocimetric, relatively accurate firing and accurate and timely firing, it is possible to deliver conventional ammunition that could perform something not envisaged for terminal guided munitions.

Therefore the conclusion is the improvements that are envisaged should be studied now of the potential new additions for terminal.

Automated Fire

Technical problem of developing an effective and reliable automated fire work is an amphibious, considerably with a larger and more survivable vehicle. Then automatic fire
is needed in a more technical manner. Factors and suggestions
brought in to aid in the formulation of the model are:
"Through CDR contributions, within the bounds of low availability,
during battles and the reduction of requirements of employing a
high maintenance time."

All of these contribute towards a policeable milestone or
intermediate goal, in concert with the system.

Intermediate

A substantial improvement in the current air systems, i.e., rate of
fire, rotation, increased range, and enhanced survivability.
If our approach is to significantly enhance the GCI system,
therefore it must be able to perform in a design goal, the
requirement to live in the midst of the target and the overall tactics,
located within a certain range.

To achieve

A viable approach as a system or a set of systems, for the
achievement of the concept. A viable iteration, normal to the
majority of the majority of the tactical mission.

The major emphasis to predict a more crucial survivability, in the
context of this, where the emphasis questions is the
achievement of this system. The requirements are therefore
minimized. Some of these types of studies are within the same
capability in the line of the focus, and appear to be likely
countermeasures to a ships mission or specific tactics (i.e.,
"spread formation" and "mass of influence").

A suggested solution to the predicted survival capability
problem is the use of foreign power for the chassis of the new
ships.
(The extent of engineering required in the suggested modification has not been addressed.) This approach appears to correct the potential shortfalls in survivability including NBC protection. An alternative to this suggested solution would be the use of the M1 tank chassis. This alternative offers potential for: R&D cost reductions (i.e., no requirement to develop a new power plant, suspension, and hull); production cost savings as a result of larger procurement quantities; and standardization of components.

Additional suggestions to enhance the overall M60 effectiveness include: an antihelicopter STAFF round; a cocktail round for defense against direct ground attack; improved M62 data; replacement of copper rotating goods with plastic ones; and, continued high priority emphasis on advanced propellants and warheads.
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<thead>
<tr>
<th>Location</th>
<th>Subject</th>
<th>Attendees</th>
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<tbody>
<tr>
<td>RSW, Radcon</td>
<td>Description of the problem, provider</td>
<td>J. Speranza, Consultant M. Peters, ECA</td>
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<tr>
<td>PC, Alexandria, VA</td>
<td>Pre Product for the sale and program included in the ADS-92, 1942</td>
<td>J. Speranza, Consultant M. Peters, ECA</td>
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<tr>
<td></td>
<td>Identification of DSSA</td>
<td>N. Shelly, ECA</td>
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<td>Survivability of components and follow-up</td>
<td>N. Shelly, ECA</td>
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<td>Component and specif.</td>
<td>N. Ferrara, EWA</td>
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<td>M. Gillin, ECA</td>
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<td>PC, Alexandria, VA</td>
<td>Instruction on Survive-</td>
<td>J. Speranza, Consultant M. Peters, ECA</td>
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<td>data in 1931.</td>
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<td>Analysis of predevelopment.</td>
<td>M. Peters, ECA</td>
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<td>The request for a manual to be used in the EDD, 1939, will be viewed by work for DSA.</td>
<td>M. Gillin, ECA</td>
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<tr>
<td>FL, 3rd, FL</td>
<td>Reference on improved technology for</td>
<td>J. Speranza, Consultant B. Kinley, BLY-7</td>
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<td>prediction survivability on the ADS-92 ESR.</td>
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<tr>
<td>AMCA, AS, MD</td>
<td>Conference on survivability of this</td>
<td>J. Speranza, Consultant P. Bailey</td>
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<td>material for 1949.</td>
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<td>Protection of structural, by compartmentalization and inter-</td>
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<td>action of the ESR.</td>
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<td>FL, AS, MD</td>
<td>Follow-up to previous conference, with an</td>
<td>J. Speranza, Consultant P. Bailey</td>
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<td>session on how to take the 1949 ESR</td>
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APPENDIX A (Con't)

Conferences arranged to improve analytical data required to support the DSWS ASARC review.

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<thead>
<tr>
<th>Location</th>
<th>Subject</th>
<th>Attendees</th>
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<tr>
<td>NBS</td>
<td>Nuclear vulnerability survivability data required for the DSWS program.</td>
<td>J. Speranza, Consultant</td>
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<tr>
<td>Adelphi, MD</td>
<td></td>
<td>T. Shelton, ESA</td>
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<tr>
<td>LSARC/Denmark</td>
<td>Reviewed system analysis concerns of DSWS: rate of fire, delivery precision, quick hit message, large lot size for propellants, elimination of copper rotation cycle.</td>
<td>J. Speranza, Consultant</td>
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<tr>
<td>Dover, NJ</td>
<td></td>
<td>J. Brooks, ESA</td>
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</table>


APPENDIX D
BIBLIOGRAPHY


Distribution List:

Project Manager (5 copies)
Cannon Artillery Weapons System
Attn: DASCW-CLW (M. Pisette)
Dover, New Jersey 07801