SURVIVABILITY REQUIREMENTS FOR UNMANNED ARMY PLATFORMS AND SYSTEMS

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ABSTRACT

The introduction of high-tech equipment into the Army inventory has substantially increased battle effectiveness, reduced personnel requirements, and in some cases allowed the replacement of several manned operational platforms and systems with unmanned equivalents. The continued trend toward digital robotics in the battle space has become extremely attractive to military planners, so much so that future war fighters are expected to employ a considerable number of unmanned platforms and systems. Up to this point in time, however, equipment nuclear hardening criteria have been applied principally to manned systems and have been balanced to the nuclear survivability of the operating crew.

This summary provides the rationale for establishing reasonable nuclear hardening criteria for unmanned mission critical equipment. It includes the process used to establish criteria for five unmanned equipment classes. Also included are the factors to be considered and the steps to be taken to establish hardening criteria for all nuclear weapons effects (NWE), specifically nuclear-induced blast, thermal, initial nuclear radiation (INR), and electromagnetic pulse (EMP), for all weapon yields of interest. The details given in this summary form the basis for proposed Quadripartite Standardization Agreement (QSTAG) 2041, a standard for the Armies of the United States, the United Kingdom, Canada, and Australia.

1. INTRODUCTION

Quadripartite Armies (also known as ABCA Armies of America, Britain, Canada, and Australia) presently use QSTAG 244 for the philosophy, methodology and database in establishing nuclear hardening criteria for manned equipment. QSTAG 1031 then uses this information to standardize specific criteria for five mobile equipment classes: (1) Class I: Equipment Associated with Troops in the Open, (2) Class II: Equipment Associated with Troops in Wheeled Vehicles (Including Signal Shelters), (3) Class III: Equipment Associated with Troops in Main Battle Tanks, (4) Class IV: Equipment Associated with Troops in Light Armored Vehicles, and (5) Class V: Helicopters.

In all five classes, equipment criteria are designed to meet the minimum requirements for operator survivability; the rationale being that the equipment must work only as long as a specified number of operators survive. This rationale implies the operator is the "weak" link in all manned systems. Since operator survivability is dependent upon specific levels of nuclear-induced blast, thermal and INR, these criteria vary from class to class. EMP, on the other hand, is not fatal to operators; hence, there is a single set of source-region EMP (SREMP) criteria and high-altitude EMP (HEMP) criteria in QSTAG 244 and QSTAG 1031 for all equipment classes. Both QSTAG 244 and 1031 will continue to be used for manned equipment.

2. THE SURVIVABILITY REQUIREMENT

Equipment supporting a critical mission must meet a nuclear survivability requirement. This requirement generally stipulates that equipment must be operational a specified time after exposure and must be maintained throughout the equipment's life cycle. For some equipment, the requirement simply states it must not be permanently damaged after exposure. For other equipment, the requirement specifies an allowable time after exposure before the equipment must be back on line (e.g., it must operate with no down time, or it must be back on line after one minute, one hour, or some other specified time).

3. THE NEW SUSCEPTIBILITY CHART

First-generation unmanned equipment will be similar to manned, legacy equipment (equipment developed and/or fielded in the 1980s and early 1990s). It is therefore convenient to modify the five classes given in QSTAG 1031 and use them to establish first-generation susceptibility levels. For example, QSTAG 1031 Class IV (Equipment Associated with Troops in a Light Armored Fighting Vehicle) becomes Class IV (Unmanned Equipment in a Light Armored Fighting Vehicle). Similarly, Class V (Helicopters) is modified to be Class V (Unmanned Airborne Systems).

Using these five new equipment classes, a susceptibility matrix (Table 1) is formed, with each nuclear weapons effects environment forming a row and each of the five equipment classes forming a column. Such a table will quantify the nuclear hardening criteria for each of the five unmanned equipment classes of legacy-like equipment. As new, unique equipment designs are added to the Army inventory, the matrix will expand to accommodate them.

Table 1. Predominant* Susceptibility Chart for Five Unmanned, Legacy-Like Equipment Classes.

	CLASS I Unmanned Equipment Exposed	**CLASS II** Unmanned Equipment in Shelters	**CLASS III** Unmanned Equipment in MBTs	**CLASS IV** Unmanned Equipment in AFVs	**CLASS V** Unmanned Airborne Systems
Blast	DPI_{classI}	$DPI_{classII}$	$DPI_{classIII}$	$DPI_{classIV}$	DPI_{classV}
Thermal	$[fluence, flux]_{classI}$	$[fluence, flux]_{classII}$	$[fluence, flux]_{classIII}$	$[fluence, flux]_{classIV}$	$[fluence, flux]_{classV}$
INR	$[total\ dose, neutron\ fluence, gamma\ dose\ rate]_{allclasses}$				
SREMP	Derived from $[total\ dose, neutron\ fluence, gamma\ dose\ rate]_{allclasses}$				
HEMP	ABCA Standard in Vol. II, QSTAG 244 and QSTAG 1031				

* Dominating susceptibility, but associated effects criteria are also stated.

DPI: dynamic pressure impulse

INR: initial nuclear radiation

SREMP: source region electromagnetic pulse

HEMP: high-altitude electromagnetic pulse

It should be noted that these equipment susceptibilities are derived from non-ideal blast tests on items from each of the five equipment classes and from INR tests on systems, subsystems and components.

Past testing has shown Class I, Class II, and Class V are susceptible to translation damage from blast-induced dynamic pressure impulse (DPI). These DPI levels can occur at large ranges from ground zero. Class III and Class IV are also susceptible to DPI, but at much higher levels occurring closer to ground zero. The semiconductor technology that appears in all five equipment classes, however, has the same INR susceptibility.

The steps for establishing susceptibility criteria for Class I, Class II, and Class V are:

(1) Use minimum blast DPI values that cause MOD I damage (as defined in NWE handbooks) to that equipment class for theater battle space weapon yields. It is expected that each class will have a unique DPI value; hence, the table shows DPI_{classI}, $DPI_{classII}$, and DPI_{classV}.
(2) Select the thermal values associated with the DPI values for that equipment class. These are identified as $[fluence, flux]_{classI}$, $[fluence. flux]_{classII}$, and $[fluence, flux]_{classV}$.
(3) Identify a single set of INR threshold levels $[total\ dose, neutron\ fluence, gamma\ dose\ rate]_{allclasses}$ for all five equipment classes.
(4) Derive the SREMP values from the INR values in (3).
(5) Use the HEMP values given in QSTAG 244 vol II and QSTAG 1031 Vol II for all five equipment classes.

The steps for establishing Class III and Class IV criteria are:

(1) Use the DPI values that cause MOD I damage to equipment on the inside of Class II and Class IV vehicles. Equipment outside the vehicles must meet the same values.
(2) Use the thermal values associated with the above DPI levels for Class II and Class IV equipment.
(3) Use the same INR levels for all five equipment classes.
(4) Use the same SREMP values calculated earlier for the above INR levels.
(5) Use the same HEMP values for the previous three classes.

REFERENCES

QSTAG 244, "Nuclear Hardening Criteria for Military Equipment" (UNCLASSIFIED), Edition 4, Vol. I (CONFIDENTIAL), VOL. II (SECRET), January 1992.

QSTAG 1031, "Consistent Sets of Nuclear Hardening Criteria for Classes of Equipment" (UNCLASSIFIED), Edition 1, Vol. I (CONFIDENTIAL), VOL. II (SECRET) 6 September 1996.

Draft QSTAG 2041, "A Rationale for Establishing Nuclear Hardening Criteria for Unmanned Platforms and Systems," Edition 1, pp. 1-11.

CONCLUSION

The philosophy and methodology for establishing nuclear hardening criteria for unmanned platforms and systems are described in the terms and format used in QSTAG 1031 for establishing nuclear hardening criteria for equipment associated with troops. Table 1 provides the criteria matrix for five unmanned system classes.