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FRENCH UNIT RISK ASSIGNMENT FOR IM OFFERS VISIBLE LOGISTICAL GAINS AN EXPERIENCE WITH A MURATIZED GUIDED WEAPON

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MINISTÈRE DE LA DÉFENSE

UNIT RISK ASSIGNMENT FOR IM OFFERS VISIBLE LOGISTICAL GAINS

PRESENTATION GOALS :

- **TO HIGHLIGHT FRENCH UNIT RISK FOR IM / MURAT IMPLEMENTATION**
- **TO HIGHLIGHT POSSIBLE BENEFITS ON LOGISTICS DURING IM LIFE-CYCLE**
- **TO DEMONSTRATE ACHIEVABLE BENEFITS TO BALANCE ACQUISITION EFFORTS**

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SUMMARY

- **FRENCH UNIT RISK DEFINITION AND IMPLEMENTATION DIRECTIVE (1358 DGA / IPE INSTRUCTION IN SEPT 1997)**
- **OVERALL FRENCH LEGAL APPROACH AND CONSTRAINTS FOR USERS**
 - French Decree 79-846 and implementation documents
 - Military directives to Forces (Instruction 1007)
- **BONUS WITH MURAT ***
 - Q/D reductions
 - Detonation probability decrease
- **EXAMPLE: OVERALL GUIDELINES TO DESIGN A TESTING STATION FOR A MURAT ONE * GUIDED WEAPON**



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FRENCH IM POLICY

- French Doctrine for MURAT issued in July 1993
- AFTER STANAG 4439 ratification by France it remains a driver for IM implementation :
 - 3 levels of IM-ness (labels)
 - A National Explosive Safety Authority to award labels
 - A dossier :
 - to demonstrate reduction of probability of inadvertent accidental initiation by adapted design and architecture
 - to strengthen demonstration by small-scale and read-across testing
 - to present response descriptors under IM mandatory tests

SEE « Ten years after » presented in session 4



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FRENCH UNIT RISK

A « One Star » MURAT is equivalent to 1.2 « Unit Risk »

	HD 1.1	HD 1.2	HD 1.3	HD 1.6	Stanag 4439	MURAT One STAR	French Unit Risk
FCO	I	I ⁽¹⁾	V	V	V	IV	IV
SCO				V	V	III	III
BI				III	V	III	III
SR	I	III	III	III	III	III	III

(1) No simultaneous detonation

A MURAT one star munition :

- **will not detonate** in response to any of the associated stimuli (**fire, slow heating, bullet impact**), **nor by sympathetic reaction**. This last point ensures that in the event of detonation due to a different stimulus (eg. Shaped charge, sabotage by explosives, etc.) only the munition actually involved will detonate.
- **will lead only to projection effects** limited in number, energy, distance, **in the event of fire**.



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TOWARDS « UNIT RISK » in NATO NATIONS

- **NATO AC 258 and NIMIC are preparing a new HD that could be devoted to IM :**

HD : 1.2.3 « NATO Star »

- **USA has already worded instructions on this issue :**

DOD 6055.9-STD dated August 1997

TB 700-2 dated January 1998

- **France issued in September 1997**

DGA Instruction n° 1358



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THE TWO MAIN PROVISIONS OF FRENCH MEMORANDUM

:

■ Q/Ds REDUCTION by taking into account :

- one single munition for blast and fragments harmful effects**
- the total NEQ in Potential Explosive Site for thermal effects**

■ REDUCTION OF ACCIDENT PROBABILITY by considering :

- a lower level of blast and projection hazard than for thermal flux**

**BOTH DRIVERS ARE BONUS SOURCE TO DEMONSTRATE
ACCEPTABLE RISK UNDER FRENCH RULES**



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BRIEF REMAINDER OF APPLICABLE RULES FOR EXPLOSIVE SAFETY

■ DECREE 79-846 dated September 1979

- to draft a dossier identifying all likely sources of accident and determine precautions to prevent them and limit consequences
- to determine Quantity / Distances for PES
- to analyze situations of exposed sites (ES)

■ MILITARY DIRECTIVE TO FORCES (Inter-Services Instruction 1007 dated June 1988)

- to implement Explosive Safety Rules in Forces

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OVERALL ACCEPTANCE METHODOLOGY

The risk is quantified by the triplet formula :

$$a_k \quad Z_i \quad P_j; \quad a_k = \text{type of installation exposed}$$

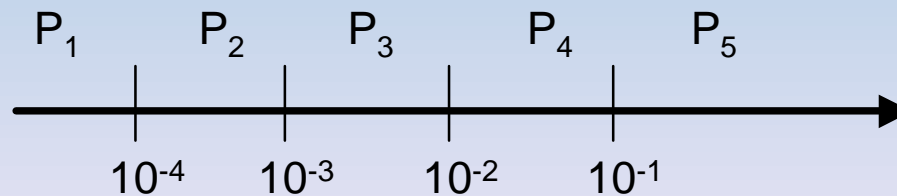
Z_i = hazardous zone created by harmful effects from PES

Hazardous zones from Z_1 to Z_5 are French Q/D corresponding to decreasing harmful effects on humans and buildings. Z_1 / Z_2 is the lethal zone and Z_5 is the maximum distance for possible light injuries.

They are rated for each kind of hazard : blast, projections and thermal effects.

The largest one to be retained when several harmful effects are simultaneous (e.g. blast = 1.1 and projections = 1.2 for a detonating WH).

P_j = probability of accident at PES



Annual accident probability by operation



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ACCEPTANCE METHODOLOGY AND BONUS WITH IM

For the risk to be considered as acceptable by French legals only some triplets are possible according to :

- the type of acceptor considered (a_k)
- Its position in hazardous zone (Z_i)
- the probability of the possible accidental event (P_j)

Usually only one way is possible : modifying the hazardous zone by addition of barricades or by reinforcing the potential explosive site

IM-ness offers the opportunity :

- 1) to reduce the hazardous zone with Unit-Risk,
- 2) to demonstrate a lower probability of accident.

**THE WAY IS OPEN TO EASIER AND CHEAPER SOLUTIONS
THAN USUAL PRACTICES**



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BONUS WITH MURAT ONE STAR

■ QUANTITY – DISTANCES REDUCTION WITH « UNIT RISK »

- Simulation of this situation was already presented by Club Murat during 28th DDESS on 1998 at Orlando - see paper : « Comparison of French and US Unit Risk 1.2 ».
- A storage of 940 MK 82 bombs (equivalent to 80 tons of total NEQ) was considered

FRENCH IBD AND PTRD CALCULATION HIGHLIGHTED POSSIBLE DISTANCE REDUCTIONS AT LEAST 33 %



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BONUS WITH MURAT ONE STAR

■ DETONATION EVENT PROBABILITY DECREASING

« *By transition from classical munition to IM, different probability levels of (P_j) potential accident can be determined considering the harmful consequences* »

Harmful events	Detonation (I/II)	Explosion/Burning (III/IV/V)
Non IM	P_j	P_j
IM	P_{j-1}	P_j

THIS REDUCTION OF DETONATION PROBABILITY BY AN ORDER OF MAGNITUDE FAVOURS TRANSITION FROM UNACCEPTABLE SITUATION TO ACCEPTABLE ONE.

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OVERALL GUIDELINE TO DESIGN A TESTING STATION FOR A MURAT ONE STAR MISSILE (FIELD SERVICE ; OPERATIONS)

MAIN ASSERTIONS IN SAFETY DOSSIER AT WORK :

- Munitions has : a 5 kg HE warhead with a TNT Equivalent Weight = 10 kg (a total NEQ = 50 kg)

The operations to be performed at working position are :

- handling of packaged munition
- munition extraction from packaging
- bare munition handling and positioning on test bench
- electronics testing and mission parameters uploading

Failure modes analysis takes into account following statements :

- munition is blocked on test bench designed to resist nominal thrust in case of inadvertent RM ignition
- safety pin presence to guaranty WH SAU disalignment
- ignition fuse of RM in line
- rocket motor functioning does not lead to any WH reaction
- no detonation of rocket motor under accidental WH detonation. Maximum NEW of one single item is 10 kg (from SR test result).



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QUANTITY – DISTANCES (Z_i) AND PROBABILITIES OF ACCIDENT (P_j)

Quantity distances are as following for the missile considered

Hazardous Zones (in meters)	Blast effects HD 1.1	Fragments effects HD 1.2	Thermal effects HD 1.3 (Facing nozzle)	RM Bursting Effects Type III
Z_1	11	100	15	8
Z_2	17	200	20	11
Z_3	32	250	25	16
Z_4	47	300	30	25
Z_5	94	400	-	150
Probability of accident during test	P_2		P_3	

« Instruction 1007 » to Forces states :

P_2 = handling bare munition

P_3 = plugging any munition to electrical source

BOTH SITUATIONS ARE TO BE CONSIDERED TO DETERMINE ACCEPTABLE RISK



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ACCEPTANCE OF ES

Hazard ZONES	PROBABILITIES OF ACCIDENT				
	P_1	P_2	P_3	P_4	P_5
Z_1	a_0	a_0	$a_0 (*)$	$a_0 (**)$	$a_0 (**)$
Z_2	a_1 a_2	a_1 $a_2 (*)$	a_1	$a_1 (*)$	$a_1 (**)$
Z_3	$a_1 b_1 c_1$ a_2 a_3	$a_1 b_1 c_1$ a_2	a_1 a_2	a_1	$a_1 (*)$
Z_4	$a_1 b_1 c_1$ $a_2 b_2 c_2$ a_3	$a_1 b_1 c_1$ $a_2 b_2 c_2$ a_3	$a_1 b_1 c_1$ a_2	a_1 a_2	a_1
Z_5	$a_1 b_1 c_1$ $a_2 b_2 c_2$ $a_3 b_3 c_3$	$a_1 b_1 c_1$ $a_2 b_2 c_2$ $a_3 b_3 c_3$	$a_1 b_1 c_1$ $a_2 b_2 c_2$ $a_3 b_3 c_3$	$a_1 b_1 c_1$ $a_2 b_2 c_2$ $a_3 b_3 c_3$	$a_1 b_1 c_1$ $a_2 b_2 c_2$ $a_3 b_3$

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ACCEPTABLE SITUATIONS

■ WORK DESIGN STATION

The situation $a_0 Z_1 P_3$ is the driver to determine working station design as situation $a_0 P_1 P_2$ is acceptable with maximum five persons exposed to lethal injuries.

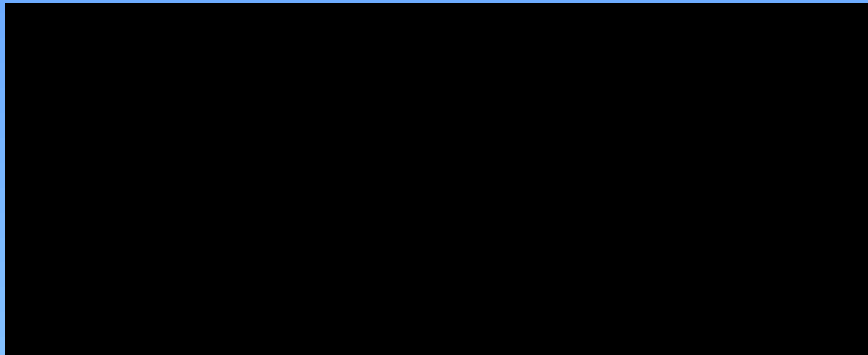
Operators must stand beyond 15m (Z1) unless a protective wall is settled to prevent possible injuries under rocket motor bursting (max response descriptor is type III).

Whithout IM-ness and Unit Risk assignment it could have been mandatory to adopt a reinforced building with frangible wall

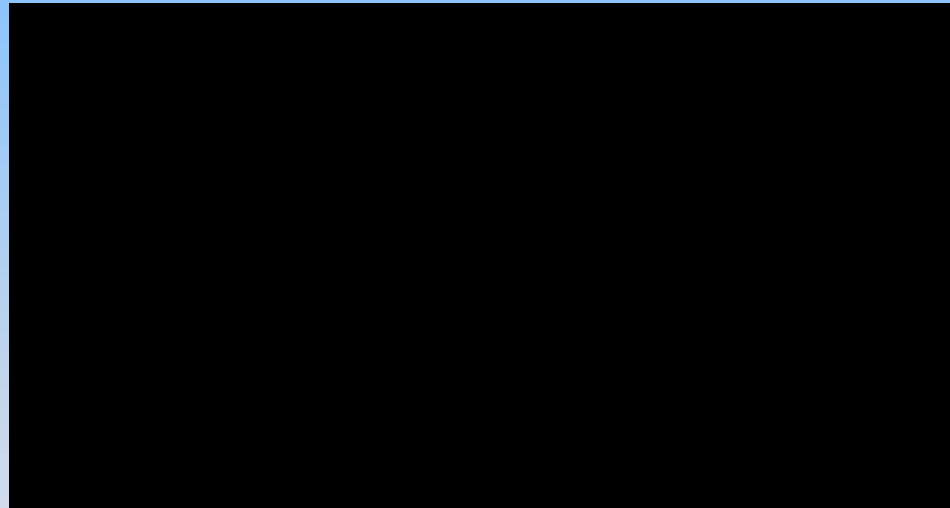
(to protect workforce from an higher risk of warhead detonation) or in deployment situation to request for a waiver to National Authority.

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ACCEPTABLE SITUATIONS



Conventional testing station (Z1/Z2, P3) forbidden



M (Z1, P2 for thermal)



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ACCEPTABLE SITUATION

ISOLATION DISTANCES FROM POTENTIAL EXPLOSIVE SITE (PES)

Isolation distances have to be determined for ES like other working stations or external roads or inhabited buildings.

In this case, the possible accidental IM warhead detonation positioned in P_2 will be the driver.

For example :

- Non explosive internal building must stand beyond 250m (situation a_3, Z_4, P_2 acceptable) i. of 300 m
- Medium traffic public roads distance is beyond 250m (b_2, Z_4, P_2) i. of 300 m
- Large inhabited buildings must stand beyond 400m (c_4, Z_5, P_2): no change

TEST STATION FOR MURAT ONE STAR CAN BE LIMITED TO AN OPEN AIR SITE INSIDE AN EXPLOSIVE AREA WITH PROTECTION BARRIERS TO PREVENT MAX TYPE III HARMFUL EFFECTS

IT'S A COST EFFECTIVE POSITION IN FULL CONFORMITY WITH IN FORCE RULES (NO WAIVER) AND AT ACCEPTABLE RISK LEVEL



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CONCLUSIONS

Benefits granted by rules in France can lead to significant reduction of safety distances for stored large quantities of IM.

A strict application of those regulations allows moreover the design of a lightened munition testing station under acceptable risk conditions without any severe constraint or waiver demand to authorities.

Unit Risk concept is a useful complement in explosive safety in peace time as well as during crisis to avoid waivers when confinement of explosion is difficult to realize.

IM-ness properties to reduce accident probability is now clearly recognized in French rules, and can be fully used for cost-benefit analysis of new munitions

**SHALL THIS EXPERIENCE BE INCORPORATED BY AC 258 / AC310
IN COMING Q/Ds FOR NATO UNIT-RISK**

