Policy Development and Why

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ABSTRACT:

Insensitive Munitions (IM) policies and procedures were first articulated in the early 1980s within the US Navy and have since been adopted and improved upon by many organizations, Nations, and NATO. Indeed several Nations have codified IM requirements into their National laws and legal frameworks. These IM laws, policies, and procedures define and document the implementing Nations' and alliances of Nations (NATO) will, desires, and requirements to develop, design, produce, acquire, and field IM munitions.

1. POLICY DEVELOPMENT AND WHY

The earlier lecture, paper, and presentation (Approach to IM Policy – Defining the Need) answered the question of why IM is needed. That lecture, paper, and presentation pointed out specific examples of where history is replete with accidents and incidents that involved or where caused by the unintended functioning or reaction of munitions, which resulted in hazardous consequences to the owning or using forces and Nation. The emphasis arose within the US Navy, due to several large self-inflicted and in some cases combat related incidents, during the 1960's, 1970's, and early 1980's, and their catastrophic consequences; to define, develop, produce, test, and utilize munitions with less sensitivity to stimuli that could produce the unintended functioning or reaction of munitions. This desire to have munitions that are less sensitive to commonly defined, and ultimately agreed upon, threats, aggressions, or adverse stimuli drove the development of the concept of Insensitive Munitions (IM).

The concept behind IM; is that through research, development, technology, and evaluation (RDT&E) the inherent sensitivity of munitions to adverse stimuli or threat aggressions could be reduced or mitigated and thus result in munitions that would inherently increase the overall safety of National stockpiles. However, to bring this concept to fruition, policies were required to define and document the goals and to measure the successes or non-successes of the efforts. Policies were also required to document Nation's will, financial commitments, approach (all of a Nation's munitions or certain families/natures), timing (immediately or as opportunities arise), what to do about non-compliance, and many other issues that are National culture or military structure dependent.

Nations and Nations' military have had organizations and policies regarding munitions safety for quite a number of years. The United Kingdom probably has the longest history, over 600 hundred years, with its Ordnance Board or Board of Ordnance and now their Defence Ordnance Safety Group (DOSG). The US Navy, a little younger, has had its own Bureau of Ordnance for approximately 100 years and now the Naval Ordnance Safety & Security Activity (NOSSA) responsible for Naval munitions safety. The US Army, Air Force, and the overall Department of Defense also have munitions safety organizations and policies. These organizations have had policies in place for many years, for example, the US Navy has had policy documents like WR-50 (Naval Weapons Requirements; Warhead Safety Tests, Minimum for Air, Surface and Underwater Launched Weapons (Excluding Mine and Nuclear Weapons), Bureau of Naval Weapons, Washington DC, 13 February 1964) which describe munitions safety tests. However, it was not until the mid-1980's that a formal program and US Naval policy was formalized for Insensitive Munitions.

"On 29 March 1984 the CNO and members of the CNO Executive Board received a presentation on the Insensitive Munitions (IM) program for the purpose of: a. Assessing the direction and adequacy of the program in light of the increased emphasis on improving ship survivability…the Navy needs a clear policy statement supporting IM conceptually and with requisite funding. The CNO stated that a new management structure was needed for IM to put high level emphasis and oversight on this relatively obscure, disparate program, otherwise, IM will go unfunded, and associated munition problems will remain unsolved. …The CNO stated that he wanted clear separation of the IM management from other munitions management initiatives. …The CNO emphasized that in pursuing IM, no reduction in weapons performance is acceptable." Reference; The History of Insensitive Munitions by Raymond L Beauregard.

This direction from the US Navy Chief of Naval Operations (CNO), which is the most senior US Navy (four-star) Admiral, lead to the creation and publication of the first formal IM policy document; OPNAV (Naval Operations) Instruction 8010.13, OP-354, dated 18 May 1984; Subject: U.S. Navy Policy on Insensitive Munitions. Many organizations and Nation have since created and published their own IM policies. The following portions of this lecture and paper will discuss and address: Current and Future directions on IM policies, National approaches, Issues implementing IM policies, Policy as it relates to IM technology (development and utilization), Standardization testing, and Relationship of IM and Hazard Classification (HC).

As noted the US Naval Instruction 8010.13, now in fourth revision (8010.13D dated 16 Aug 2006), was codified in the late 1980's throughout the US as MIL-STD 2105. The current version is MIL-STD 2105 Revision D – Hazard Assessment Tests for Non-Nuclear Munitions Tuesday, June 14th, 2011. This US Military Standard provides or references tests and test procedures for the assessment of safety and Insensitive Munitions (IM) characteristics for all conventional (i.e., non-nuclear) munitions, munitions subsystems, and explosive devices. MIL-STD 2105 also served as a starting point for the creation of NATO STANAG 4439. STANAG is NATO abbreviation for Standardization Agreement, which is a NATO policy document that has been agreed to by NATO Nations.

STANAG 4439, the NATO policy document covering the introduction and assessment of Insensitive Munitions (IM), and its detailed supporting guidance document, Allied Ordnance Publication (AOP-39) were developed in the early 1990's. The first formal draft of STANAG 4439 was released in 1995 to NATO CNAD Ammunition Safety Group (CASG) which at that time was designated as NATO AC/310 (the precursor to the current designation of AC/326). This was ratified by the NATO Nations in November 1998 and has been improved over time by the NATO Nations and their Partners. AOP-39 provides detailed guidance concerning tests, test set-up, evaluation of test responses, and other technical guidance.

In addition, at that same time in the early 1990's several Nation had developed their specific IM policies; Australia, Canada, France, The Netherlands, United Kingdom, and the United States. By the 2012 time frame there were more Nations which had IM policies or were deeply into the development of National IM policies. As can be seen below, there have been many advances in Nations developing, implementing, and utilizing IM policies. Refer to slide 4 of the presentation and Figure 1 below.

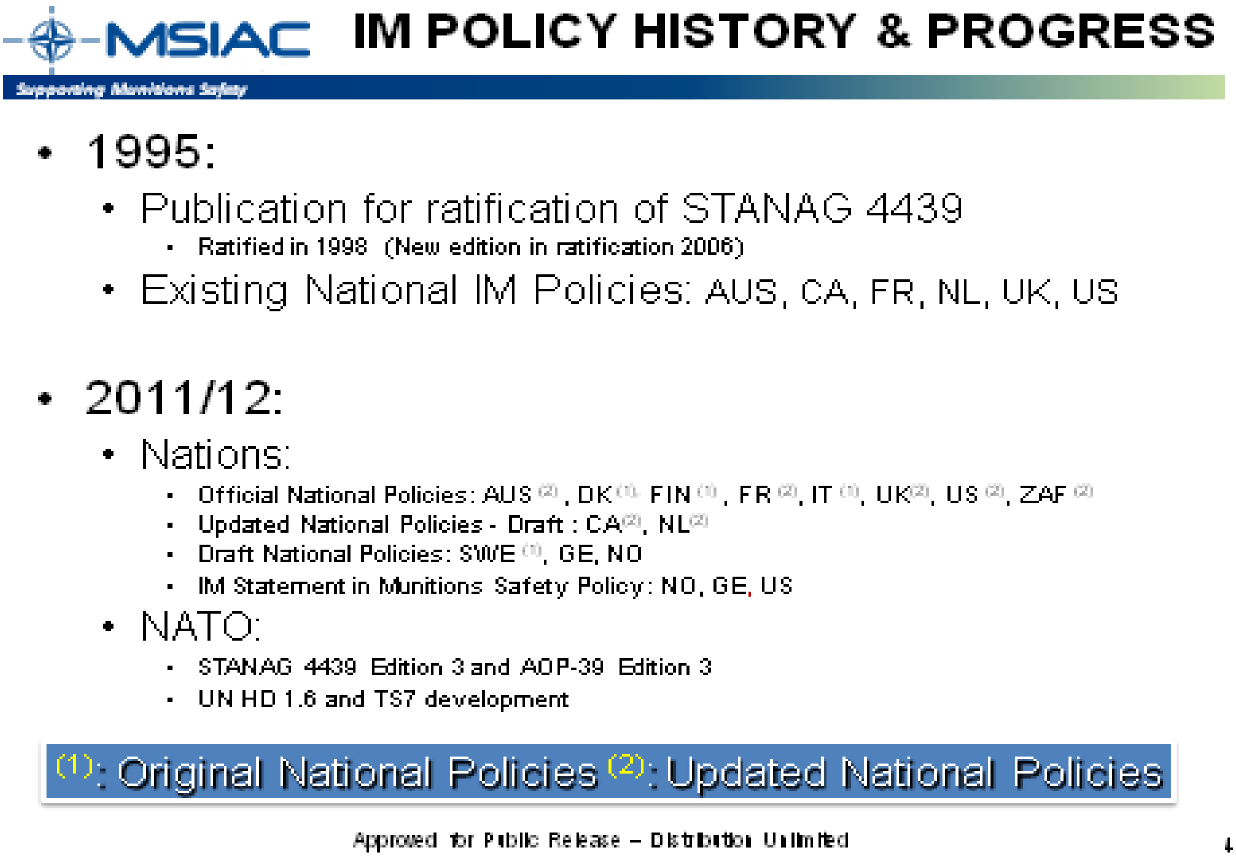


Figure 1

The aim of the NATO agreement, STANAG 4439 and its supporting detailed guidance document AOP-39, is to define a policy for NATO and NATO Partner Nation regarding the assessment and introduction into service of Insensitive Munitions (IM) / Munitions à Risques Atténués (MURAT)

Ratifying nations agree to: develop and/or introduce into service munitions that are as insensitive as reasonably practicable, apply the guidance of AOP-39 for the development and assessment of insensitive munitions, that an IM assessment may encompass the full range of testing, modeling, simulation and analyses used to develop increased confidence in the IM response of the munitions, and that the IM level should be assessed for any particular configuration of the munitions during its total life cycle. This is a significant achievement and advance in IM policy.

The baseline threats identified by STANAG 4439 are represented in Figure 2 below. Analysis of the munitions' life cycle may identify credible threats that are either additional or which are outside the range specified below. At which point Nations' may require or use additional tests above or beyond those in STANAG 4439 and AOP-39. Conversely, analysis of the munitions' life cycle may identify situations where the threat ranges above are not considered credible for the munitions due to their methods of storage, deployment, or use. Nations could, depending on National policies could reduced or discounted some of the threat scenarios and tests. That is a National decision, but may impact the ability of that Nation or other procuring Nations to agree on the exact same "IM Signature" for the munitions in question. This decision should be weighed by the Nation or collaborative Nations.

THREAT	REQUIREMENT	BASELINE THREAT RANGE
Magazine/store fire or aircraft/vehicle fuel fire (Fast Heating)	No response more severe than Type V (Burning)	Average temperature between 550°C and 850°C until all munitions reactions completed. 550°C reached within 30s from ignition.
Fire in an adjacent magazine, store or vehicle (Slow Heating)	No response more severe than Type V (Burning)	Between 1°C and 30°C per hour heating rate from ambient temperature.
Small arms attack (Bullet Impact)	No response more severe than Type V (Burning)	From one to three 12,7mm AP round, velocity from 400 m/s to 850m/s.
Fragmenting munitions attack (Fragment Impact)	No response more severe than Type V (Burning)	Steel fragment from 15 g with velocity up to 2600m/s and 65 g with velocity up to 2200m/s.
Shaped charge weapon attack (Shaped Charge Jet Impact)	No response more severe than Type III (Explosion)	Shaped charge caliber up to 85 mm.
Most severe reaction of same munition in magazine, store, aircraft or vehicle (Sympathetic Reaction)	No propagation of reaction more severe than Type III (Explosion)	Detonation of donor in appropriate configuration.

Figure 2

The overall structure of NATO IM policy document, STANAG 4439 is displayed in slide 7 of the accompanying presentation and immediately below as Figure 3.

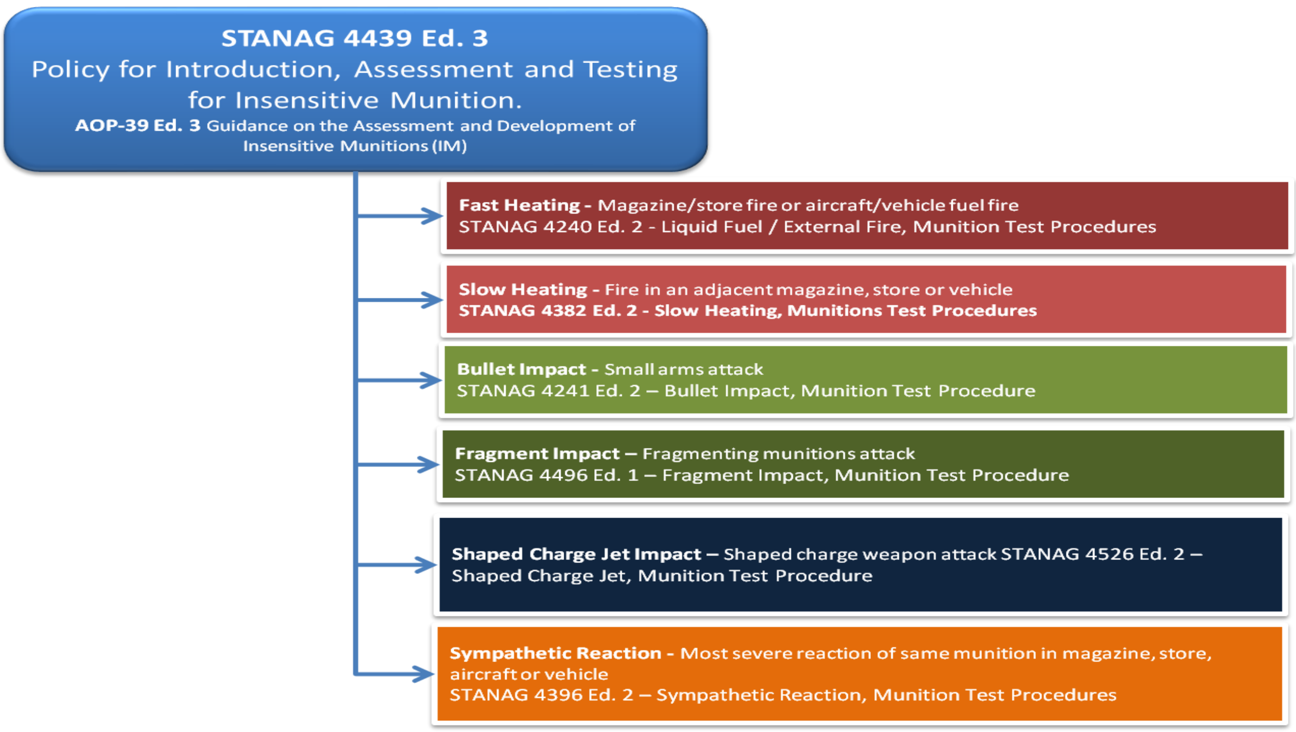


Figure 3

As can be seen, there are six basic threats or aggressions and corresponding tests for an IM assessment. AOP-39, the supporting document to STANAG 4439, contains guidance on the following areas:

IM assessment methodology, whole body of evidence approach, use of small scale testing and modeling data; Application of the hazard protocols; Guidance on conduct and reporting of IM tests; Full scale test procedures; Conduct and reporting of full scale tests; Interpretation of munitions responses;Response Descriptors; and Presenting the IM signature.

Of course, the use of STANAG 4439 and AOP-39 does not imply that the tests and assessments documented in those two documents are the only tests or assessments that a Nation's munitions safety board or a munitions assessment panel in any Nation is limited to utilizing. Most Nations have additional methods to address other hazards to munitions and the means to assess and ensure themselves regarding the safety acceptability of munitions they are developing, procuring, or introducing into their National military structure and service. The above are the IM tests and assessment / scoring criteria agreed upon by NATO and Partner Nations. CASG (AC/326) has and continues to develop STANAGs for NATO and Partner Nations additional munitions safety guidance. For further information regarding those documents, please contact your National representative to CASG (AC/326) or MSIAC for assistance within the NATO organization for such documentation.

Slide 9 of the presentation, also immediately below as Figure , displays the IM policy implementation of most of NATO Nation and Partner Nations. As can be seen, the great majority of Nations do not have their own IM policy and/or have not implemented STANAG 4439 in their Nations. However, if one would compare this chart with the same chart 20 years ago, the chart would show only a couple of Nations implementing IM. Progress has occurred and is continuing to occur.

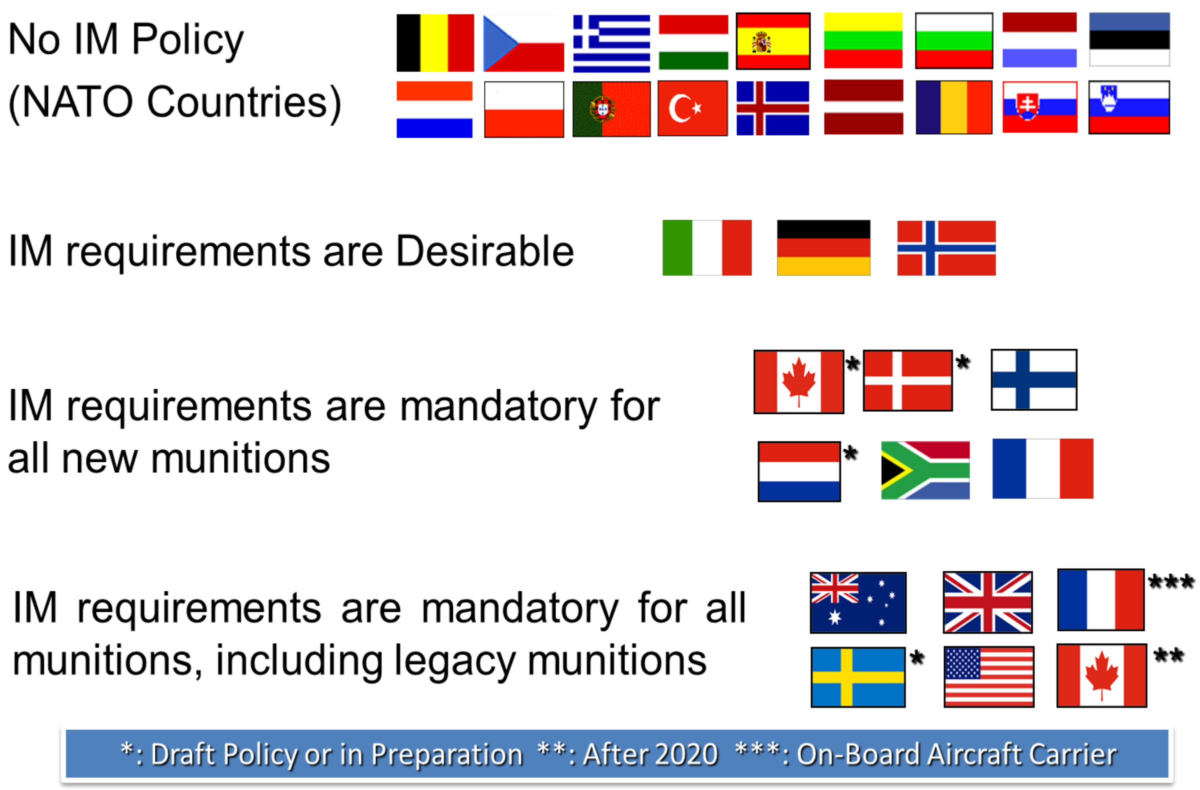


Figure 4

Nations that are implementing NATO or their own IM policies will have a National policy statement of will or intention to implement, their IM requirement goals, and their IM Procurement Strategy. They will often address cost benefit analysis and their desire to achieve stakeholder (operational military services) buy-in. Nations should and quite often address their National prioritization of IM procurement and R&D efforts to support their National munitions development plans. Some in that prioritization will also address National industrial strategies. All should address their internal ability for IM testing (test execution capabilities) and assessment or their use of external IM testing capabilities. And all should address their policies regarding assessment of existing or legacy and future munitions.

As noted immediately above, implementation of IM policies at the National level can take many different approaches. Some Nations use a Progressive approach to IM, an example is the French approach, which will be addressed in greater detail later in this paper where they have three pre-defined levels of IM that they which to obtain; 1, 2, or 3 star. Some Nations, for example the United Kingdom and to a degree the United States, where they specify / define an ultimate IM goal but will allow "waivers" for non-compliance of a system to achieve that goal. Refer to slide 11 of the presentation and Figure 5, immediately below. THA refers to Threat Hazard Assessment, which was addressed near the bottom of page 3.

- Progressive Approach
  - 3 pre-defined levels 1* 2* 3*
  - IM requirements determined by THA
- IM Ultimate Goal Associated with a "Waiver" System
  - IM requirements = IM ultimate goal
  - High level decision board (2 to 4-Star, US JROC 4-Star panel) to authorise "waivers" for any non-compliance
  - THA has been used as a means to:
    - Eliminate the less relevant threats
    - Tailor the tests
    - Evaluate risk of any non-compliance to inform waiver process
- Note: US mandates Standard / Required tests and uses THA as a part of the munitions safety assessment process to require, as necessary, **ADDITIONAL** "IM" (Safety) tests beyond the STANAG 4439 required tests

Figure 5

The United Kingdom IM implementation policy states that the vulnerability of the munitions in the MOD inventory will be reduced over time to meet the requirements of STANAG 4439. And, that all new munitions requirements are to stipulate compliance with the criteria for IM set out in STANAG 4439. The United Kingdom further states that all legacy munitions are to be kept under review to identify opportunities to achieve IM compliance (e.g.; mid life update, refurbishment and re-provisioning programmes). As noted in Figure 5, the United Kingdom requires that formal 2-Star dispensation is required for any non-compliance (for both new and legacy munitions) with their IM policy.

Figure 6 displays this approach graphically and shows where IM insertion opportunities are perceived to exist in a traditional munitions development program and where the 2-star waiver might be granted if required. Nations using the waiver approach always have the right to grant or not grant waivers, depending on their National needs, desires, and munitions' assessments. PT refers to Programme Team, which manages the development and acquisition of the munitions in question.

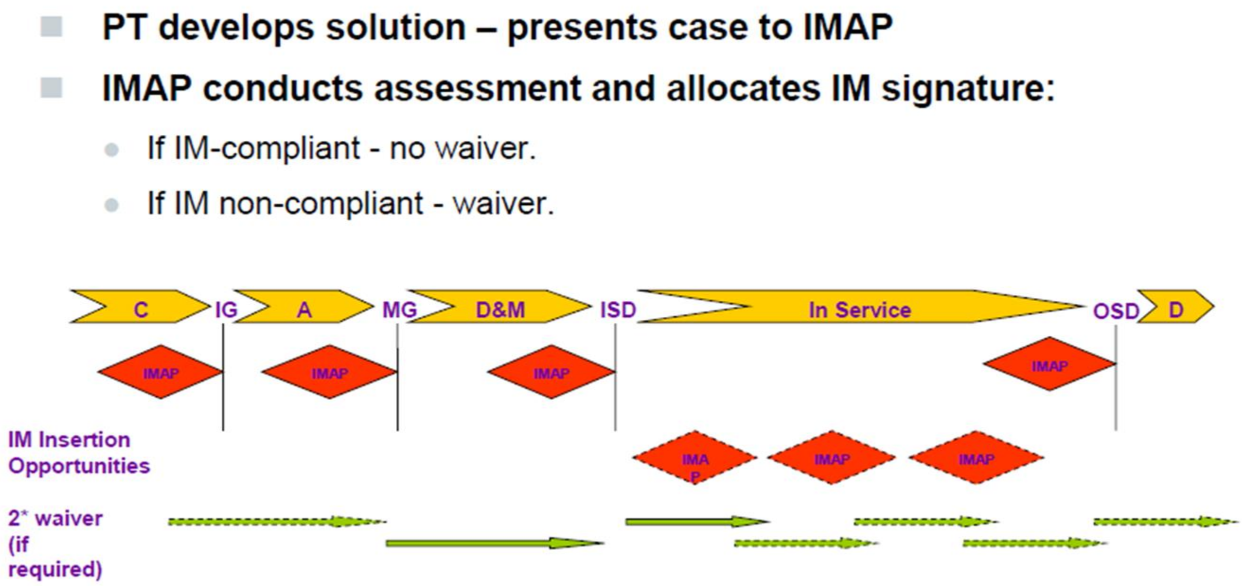
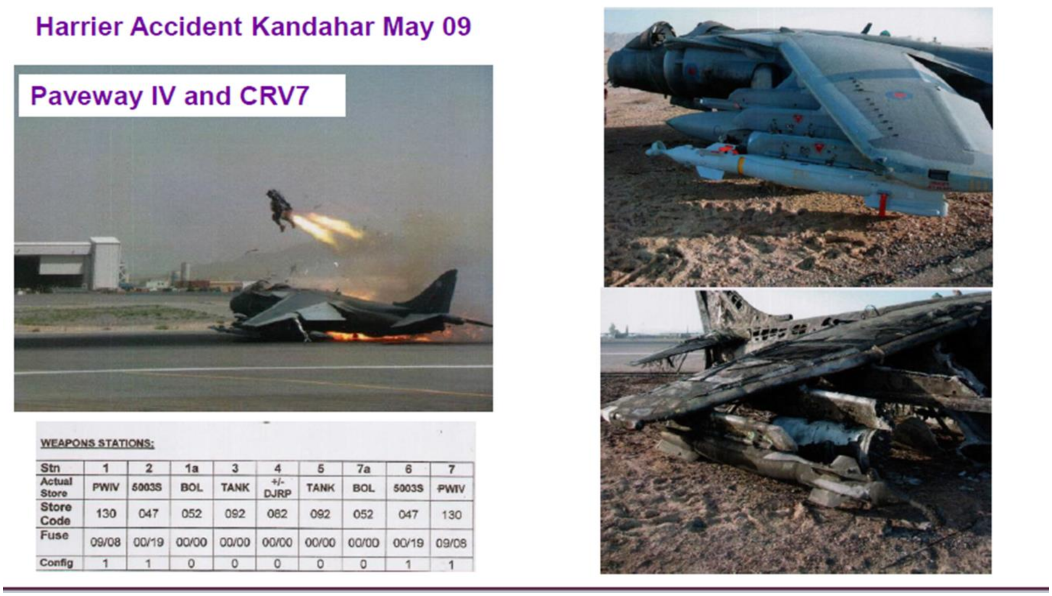


Figure 6

Figure 7, and slide 14 of the accompanying presentation, shows the positive; i.e., reduce consequences of an IM success. In this case the non-explosive reaction of Paveway IV bombs in a fire which resulted from the crash of a Harrier aircraft.

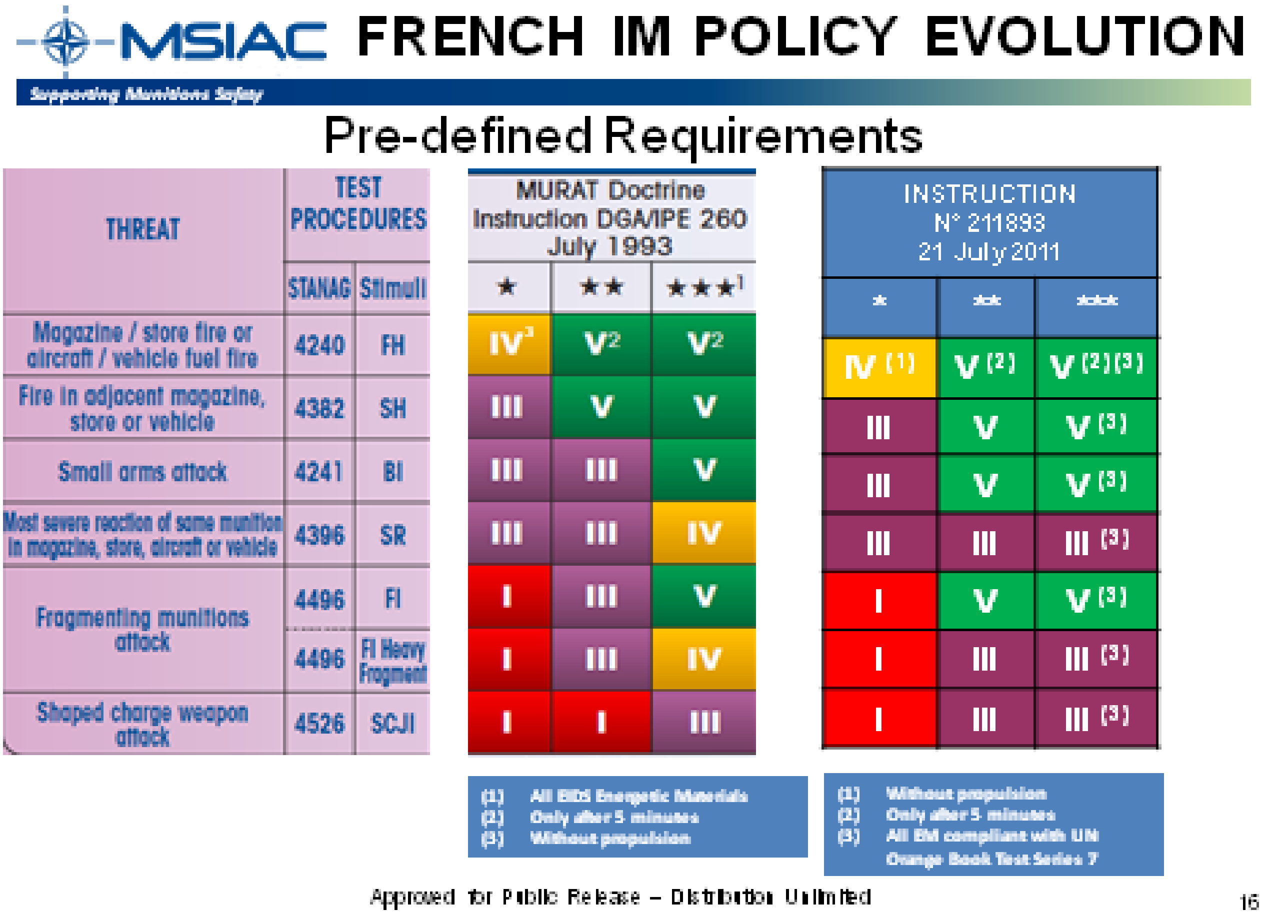


Stn	1	2	1a	3	4	5	7a	6	7
Actual Store	PWIV	5003S	BOL	TANK	+/- DJRP	TANK	BOL	5003S	PWIV
Store Code	130	047	052	092	082	092	052	047	130
Fuse	09/08	00/19	00/00	00/00	00/00	00/00	00/00	00/19	09/08
Config	1	1	0	0	0	0	0	1	1

Figure 7

The French approach to implementing IM policy is described in their Munitions à Risques Atténués (MURAT) Policy document last updated 21 July 2011. The French MURAT policy references (STANAG) requirements which are specified in all new acquisitions. Any waiver to the MURAT reference requirements must be justified using risk based analysis methods. IM signature assessment is generalized to munitions in inventory to give the French military (Forces) better knowledge on explosive hazards in operations. The implementation of the policy should create a MoD common dialogue tool to insure the coherence between operational needs, necessary retrofits, and French research and technology (R&T) priorities. The National implementation is described in several new Inspector of Propellants and Explosives (IPE) Instructions/Guides: Specification of MURAT level for new acquisitions, IPE Instruction n°1184 (20/12/2012) for MURAT signature assessment and MURAT signature database management.

Refer to Figure 8, and slide 16 of the presentation for a graphic of the evolution of French IM policy. More munitions families or natures are being required to achieve the highest 3-star level.



THREAT	TEST PROCEDURES STANAG	TEST PROCEDURES Stimuli	MURAT Doctrine Instruction DGA/IPE 260 July 1993 ★	★★	★★★[1]	INSTRUCTION N° 211893 21 July 2011 ★	★★	★★★
Magazine / store fire or aircraft / vehicle fuel fire	4240	FH	IV[1]	V[2]	V[2]	IV (1)	V (2)	V (2)(3)
Fire in adjacent magazine, store or vehicle	4382	SH	III	V	V	III	V	V (3)
Small arms attack	4241	BI	III	III	V	III	V	V (3)
Most severe reaction of same munition in magazine, store, aircraft or vehicle	4396	SR	III	III	IV	III	III	III (3)
Fragmenting munitions attack	4496	FI	I	III	V	I	V	V (3)
	4496	FI Heavy Fragment	I	III	IV	I	III	III (3)
Shaped charge weapon attack	4526	SCJI	I	I	III	I	III	III (3)

MURAT Doctrine notes:
(1) All EIDS Energetic Materials
(2) Only after 5 minutes
(3) Without propulsion

Instruction N° 211893 notes:
(1) Without propulsion
(2) Only after 5 minutes
(3) All EM compliant with UN Orange Book Test Series 7

Figure 8

Figure 9 on next page, slide 17 of the presentation, shows haw the current French IM requirements line-up very well with the current NATO and the US, Germany, Italy, and UK requirements. That should not come as a surprise as France, UK, US, Germany and Italy have all been instrumental in NATO CASG (AC/326).

Threat	Test Procedures STANAG	Test Procedures Stimuli	NATO		UK	Germany	Italy			France			USA	UN	
			STANAG 4439												
							DG-AT IM Guidelines 2000			Instruction No 211893 July 21st, 2011					
			IM Requirements	AASTP-1 SsD 1.2.3	JSP 520	Fü S IV3	Φ	ΦΦ	ΦΦΦ	*	**	***	MIL-STD-2105D	HD 1.6	UN Test Procedure 7
Magazine/store fire or aircraft/vehicle fuel fire	4240	FH	V	V	V	V	V	V	V	IV[2]	V[3]	V[3,4]	V	V[4]	7(g)
Fire in an adjacent magazine, store or vehicle	4382	SH	V	V	V	V	V	V	V	III	V	V[4]	V	V[4]	7(h)
Small arms attack	4241	BI	V	V	V	V	V	V	V	III	V	V[4]	V	V[4]	7(j)
Most severe reaction of same munition in magazine, store, aircraft or vehicle	4396	SR	III	III	III	III	III	III	III	III	III	III[4]	III	III[4]	7(k)
Fragmenting munitions attack	4496	FI	V		V	V		I[1]	V		V	V[4]	V	V[4]	7(l)
		Heavy FI						I[1]	V		III[5]	III[4,5]			
Shaped charge weapon attack	4526	SCJI	III		III	III		I[1]	III		III	III[4]	III		

Figure 9

Number notes: 1 - Type I or better as per THA, 2 - Without Propulsion, 3 - Only after 5 minutes, 4 - Energetic materials required to meet substance criteria specified in UN orange Book TS7 , 5 - French National Standard NF T70-512.

United States implementation, as noted earlier started with the US Navy 7010.13, then MIL-STD 2105. However, US IM policy is also noted in US law and top level US Department of Defense acquisition policy. Refer to Figure 10, which is also slide 18 of the presentation.

U.S. IM Law

- United States Code, Title 10, Chapter 141, Section 2389.

  § 2389. Ensuring safety regarding **insensitive munitions**. The Secretary of Defense shall ensure, to the extent practicable, that munitions under development or procurement are safe throughout development and fielding when subjected to unplanned stimuli.

DoD Policy

- DoD Directive 5000.1 The Defense Acquisition System May 12, 2003.

  All systems containing energetics shall comply with insensitive munitions criteria.

Joint Chiefs Policy

- Chairman, Joint Chiefs of Staff Manual 3170.01A, March 12, 2004

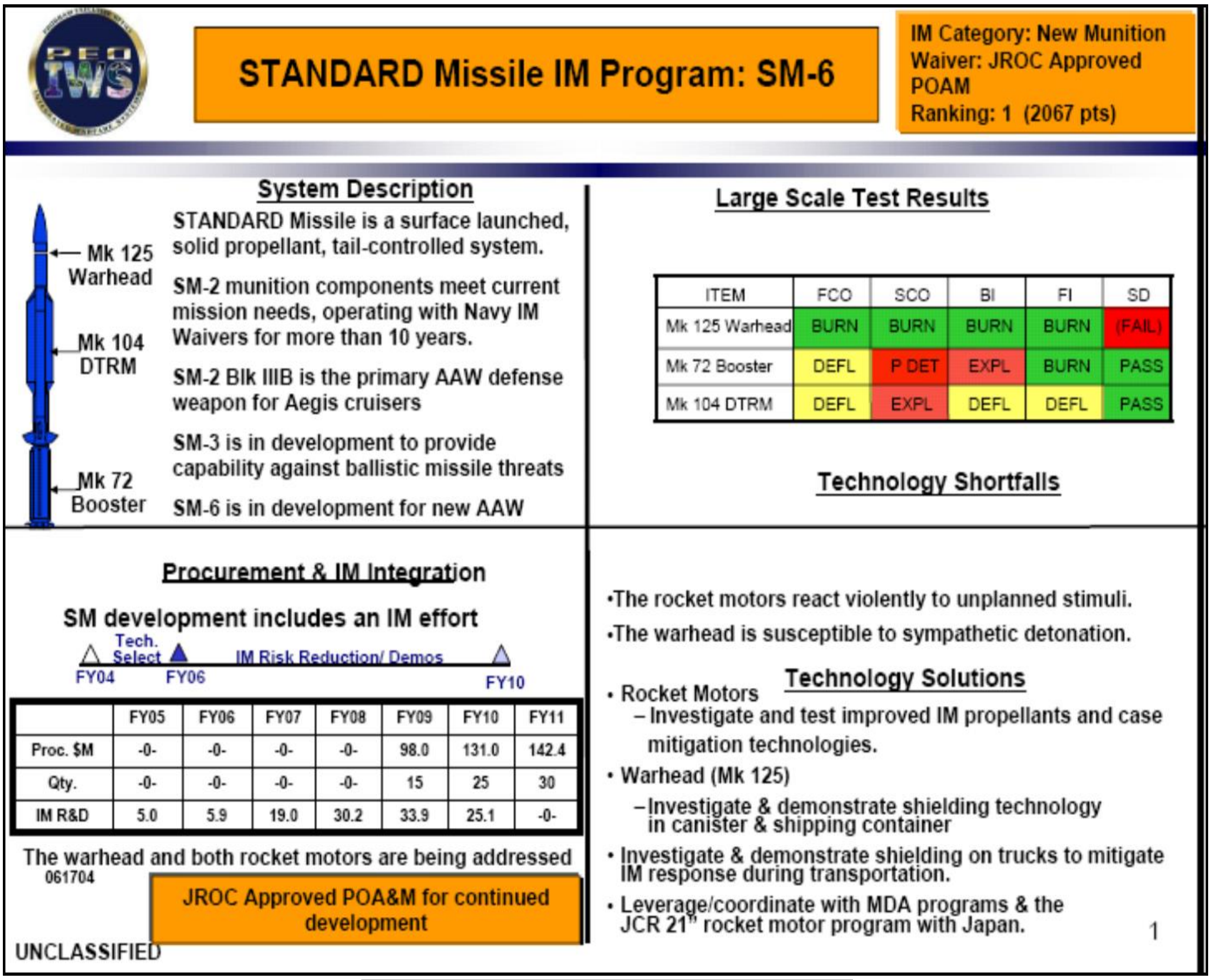
  Enclosure C, page C-5, para 2.b(2), **"Insensitive Munitions Waiver Requests. Insensitive munitions waiver requests require approval by the JROC.** Insensitive munitions waiver requests shall include a Component or agency approved insensitive munitions plan of action and milestones to identify how future purchases of the same system or future system variants will achieve incremental and full compliance.

  - **Currently "waivers" are not granted, instead "Insensitive Munitions Strategic Plans (IMSPs)" which are specific acquisition plans (POA&Ms) are Approved**

Figure 10

The most significant point to note is the US approach to "waivers". Essentially waivers for the life of a munitions system are not granted. However, if a "waiver" is required during the time frame of the individual munitions' Insensitive Munitions Strategic Plan (IMSP) due to lack of availability of technology, the acquisitions of that specific IMSP will be approved or granted a waiver. This in effect requires the acquisition program to address technology availabilities every two years when they are required to submit new IMSPs. The effect is that waivers are granted for limited acquisition buys not for all future buys of those munitions. This approach is used as it is assumes that technology will advance.

The US also uses the IMSPs to drive technology requirements for their research and development programs. Each acquisition Program Executive Officer (PEO), usually a 1 or 2 star military Officer or civilian equivalent, is required to submit to the US Office of the Secretary of Defense (OSD) office responsible for IM policy, implementation, and technology their IMSPs every two years. Thus their technology needs are submitted every two years to OSD, which drives the budgetary requirements of what is referred to as the OSD D-Line IM technology budget. Refer to slides 19 thru 25 of the accompanying presentation and Figure 11 where slide 23 showing an old data from the US Navy Standard Missile program is displayed for an example of a munitions' acquisition program IMSP.



Old data – for Example Only

Figure 11

IMSPs from all US munitions acquisition programs analyzed and the technology requirements are utilized to identify priority technology needs and opportunities for research, technology, and development. These needs then drive budget development and execution in defined areas of endeavor. Refer to Figure 12 below, which is also slide 24 of the accompanying presentation. This is presented as an example of how one Nation addresses their technology needs; other Nation's also address their technology needs ad requirements via internal budgetary practices. The bottom line is that IMSPs drive US Science and Technology (S&T), research and development (R&D), and National weaponization investments.

OSD (D-LINE)

Individual Services / PEOs may have additional 6.1/6.6 monies

- Funds 6.2/6.3 technology development
- Provides technology foundation to mature and transition to weapon PMs
- PEOs, via IMSPs, provided technology needs across DoD munitions portfolio
- DoD IM Roadmap Munition addresses technologies in 5 munition areas
- Approved additional FYDP investment more robustly funds 6.2 and funds 6.3 demonstrators

Technology Shortfall Areas (IM Strategic Plans)

IM Roadmap Munitions Area

- High Performance Rocket Propulsion
- Minimum Smoke Rocket Propulsion
- Blast/Frag Warheads
- Anti-Armor Warheads
- Large Caliber Gun Propulsion

($M)

Category	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FYDP Total
6.2 Joint Munitions Technology	$11.133	$15.542	$15.283	$15.517	$15.401	$15.603	$15.823	$104.302
6.3 IM Advanced Technology	$0.000	$6.000	$16.000	$21.000	$18.000	$23.000	$25.000	$109.000
FY Total	$11.133	$21.542	$31.283	$36.517	$33.401	$38.603	$40.823	$213.302

Old data – for Example Only

Figure 12

Another area that should be address by all Nation's implementing IM is the Cost Benefit Analysis (CBA) of IM vice non-IM munitions. Most Nations' feel the significant benefit of IM is the increased safety and the reduced probability of a catastrophic event resulting from an accident or hostile action against their military forces which involved their own munitions. As such the greatest benefits are often likely to be gained during combat phase where the probability of munitions being exposed to a threat is greatest.

Most CBA studies have probably underestimated the potential durations of this phase in analyzes given current international operations. Results of some CBAs suggest that analysis focused on operation deployment scenarios would identify the greatest benefits. Therefore, focusing resources on munitions likely to be deployed to conflict areas would seem to be a priority. However, it may be difficult for any Nation to determine which of its projected stockpile is most likely to be deployed to a specific conflict area

Therefore, it may be better for Nations' to attempt to identify which munitions types or natures will not be deployed or will spend the greatest per cent of its life time in secure storage.

It should also be noted that it can sometimes be difficult to present a convincing case to the decision makers, in probably every Nation, to invest in IM as potential benefits from not having accidents can be subjective. It is quite difficult or impossible to "prove a negative". And, as major incidents are fortunately rare, current data is limited. However when accidents occur the consequences are often catastrophic.

A side question to be asked but not always necessarily during a CBA is; Are we “Addicted” to weapon performance at the expense of the platform? Is performance driving or over shadowing the safety of the platform or vessel unnecessarily? Further, one must always be aware of munitions lifecycle situations where the munitions unintended reactions can cause catastrophic consequences both immediately to the operational platform (vessel) and operationally in terms of National military capabilities. Typical examples would be munitions destined for aircraft carriers or, forward deployed logistics or operational bases with large munitions stockpiles, or large munitions resupply vessels or Ports where an unintended adverse reaction of one’s own munitions could be catastrophic. Refer to Figure 13, which shows the hanger deck of a US career as it readies for armed sorties or Figure 14 showing bomb built-up within the confines of the ship; i.e., the mess deck where sailors also eat.

Paul Hanna / Reuters

Figure 13

Figure 14

Other issues to consider in the development and implementation of IM policies are the IM assessment and test methodologies where Nations lack confidence in other Nations IM signatures. Depending on how the IM assessment is done and by whom Nations can assign different IM signatures to the same munitions. In addition, not all Nations follow the Whole Body of Evidence (WBE) approach outlined in AOP-39 which utilizes tests & models. Nations using WBE, use National models and methodologies which may not be standardized across or with other Nations and as such results may not be transferable to other Nations. Therefore, one should ask; do we need standardized models & methodologies? If the answer is positive, how shall those be achieved?

The next issue is that full scale testing philosophies varies between Nations. Some ask are we testing to simulate the worst case of should we? If we should test the worst case, what is the worst case in each of the threat scenarios? Do the standardized tests represent real threats and/or help inform munitions IM or safety assessor on the appropriate risk? Does the test characterize reaction mechanisms and confirm predicted response? Inevitably the above questions lead to discussion of the relevance of the IM test and the value of standardized tests. However, it should be noted that without standardized tests it is difficult to compare results of different munitions or test executed at different test arenas.

An example of the discussion concerning standardized tests is the discussion pertaining to whether or not to continue to mandate liquid fuel (kerosene) for the fast cook-off test or to allow or mandate propane (gas) fires. Refer to slide 31 of the presentation, Figure 15 below for a visual of the differences between the two fire types.

Figure 15

NATO CASG (AC/326) Sub Group C is currently discussing alternative heat sources to hydrocarbon fuels for fast heating test (STANAG 4240) for both IM and Hazard Classification (HC) assessments. As such, comparison of propane with hydrocarbon as a heat source is on-going within the NATO and Partners international technical community. The community hopes to that fire characterization and heat flux/transfer will become sufficiently better understood to rewrite the standard with sound science. The basic question to be asked and answered is are any differences important with respect to response mechanisms?

Many claim there is no such thing as a standard accident and hence there is no such thing as a standard accident threat or aggression stimulus. Others point out that the Liquid Fuel Fire Test probably most likely simulates actual accident scenarios (or at least one real event – USS Forrestal with JP-5 fuel) and as such should remain. Conversely the Slow Cook-Off Test exposes munitions to a heating rate that will probably / may never be seen in an accident scenario; i.e., a precise 3.3 ^{o}C (6 ^{o}F) per hour heating rate for days until a reaction occurs. Therefore, some suggest trying to justify one standardized slow heating rate over another is likely to be a fruitless exercise given the variability of the real threat stimulus. However, most individuals in the IM and HC technical community feel together the tests envelope thermal response and characterize reaction mechanisms of concern and believe it to be important to capture the reaction mechanisms that occur when munitions are exposed to threat stimuli.

However, if one focuses only on standardized test the risk is that such an approach can result in:

Designing munitions to pass a specific all-up-round test, particularly if a standard test is always used

Question; is this good or bad? If the design only passes IM /HC tests for a narrow range of heating rates or bullet / fragment types and numbers then it may not be the best acceptable design in terms of total Life Cycle threat situations. Conversely, not using a THA approach to tailor test conditions potentially results in application of a less severe threat stimulus than what might be encountered in real life and which does not capture credible response mechanisms to possible real threats. Other thoughts to consider in developing, implementing, and using IM policies is a chaotic accident scenario is likely to experience a range of threat conditions.

One must also be aware of the limitations of using an IM assessment methodology focusing on a few full scale tests. One must realize that no Nation is conducting a statistically relevant number of tests.

As such, no Nation is attempting to develop a “Statistically Significant” probability of our IM signature. Should we and can we afford or not afford to do such; what are Cost limitations?

The good news for most is that the relationship between IM and HC tests are such that for most cases there is no need for duplicate testing. The harmonization between IM and Hazard classification has been achieved to an extent that STANAG 4439 Policy for Introduction, Assessment, and Testing for Insensitive Munitions and STANAG 4123 Methods to Determine and Classify the Hazards of Ammunition use the common test standards: STANAG 4396, Sympathetic Reaction, Munitions Test Procedure; STANAG 4240, Liquid Fuel / External Fire, Munitions Test Procedures.

To sum up IM policy; IM policy implementation varies at National levels and at this time no major policy changes are envisioned at the international level (NATO). Increasing numbers of Nations are implementing IM policy, which is highlighting some technical issues which will be resolved by the international NATO and Partner Nations community (CASG AC/326) as the review of IM testing and assessment methodology is an on going and important activity. And, last but not least, hazard classification and IM testing are becoming more harmonized, which will reduce or eliminate duplicative testing.