# Explosive Safety/Insensitive Munitions Activities

April 2004

**Anthony J. Melita**
OUSD (Acquisition, Technology & Logistics)
Deputy Director, Defense Systems,
Land Warfare and Munitions

# US Update: Explosives Safety

**Recently completed DoD Inspector General review outlined proposed changes to the oversight of Explosives Safety:**

- **Establish clear roles and responsibilities for DoD authorities.**
- **Develop a comprehensive safety management strategy.**
- **Perform periodic assessments of Service explosive safety programs to identify strengths and weaknesses.**

# NATO Update: Explosives Safety

- **As S3 and IM continue to converge, the scope of NIMIC had to be expanded to consider the full life cycle of munitions.**

- **CASG will require more support than either AC 258 or AC 310.**

  - **NIMIC will transition into a new NATO Project Office, the Munitions Safety Information and Analysis Center (MSIAC).**

  - **A Pilot MSIAC operation started within NIMIC on 1 January 2003. The full transition to MSIAC will take place in no less than two years.**

  - **The scope of MSIAC will cover Munitions Safety across the total life cycle of munitions.**

  - **The activities of MSIAC will still center around "Information & Analysis". Document Support activities will be added, in order to support the new Ammunition Safety Management Group in developing munitions safety standards and related documents.**

# US Update:
# The Move Toward ISA's

- **The use of International Standardization Agreements (STANAGS/APs/ITOPS) are becoming more commonplace.**

- **Eg: The U.S. has ratified five STANAGs on IM and HC testing:**
  - **STANAG 4240/2 Liquid Fuel/External Fire,**
  - **STANAG 4241/2 Bullet Impact**
  - **STANAG 4375/2 Safety Drop**
  - **STANAG 4382/2 Slow Heating,**
  - **STANAG 4396/2 Sympathetic Reaction**

- **U.S. now implements these with MIL-STD-2105C which removes all detailed discussion of the above tests and replaces them with references to the STANAGS.**

# NATO Update: ISA's

- Many International Standardization Agreements are now available online at:
  - http://nsa.nato.int
  - Registration required

# IM Update- The Policy

## Congressional Special Interest

- **USC, Title 10, Chapter 14, December 2001**: "§ 2389. Ensuring safety regarding insensitive munitions." "The Secretary of Defense shall ensure, to the extent practicable, that insensitive munitions under development or procurement are safe throughout development and fielding when subject to unplanned stimuli."

## Department of Defense Policy

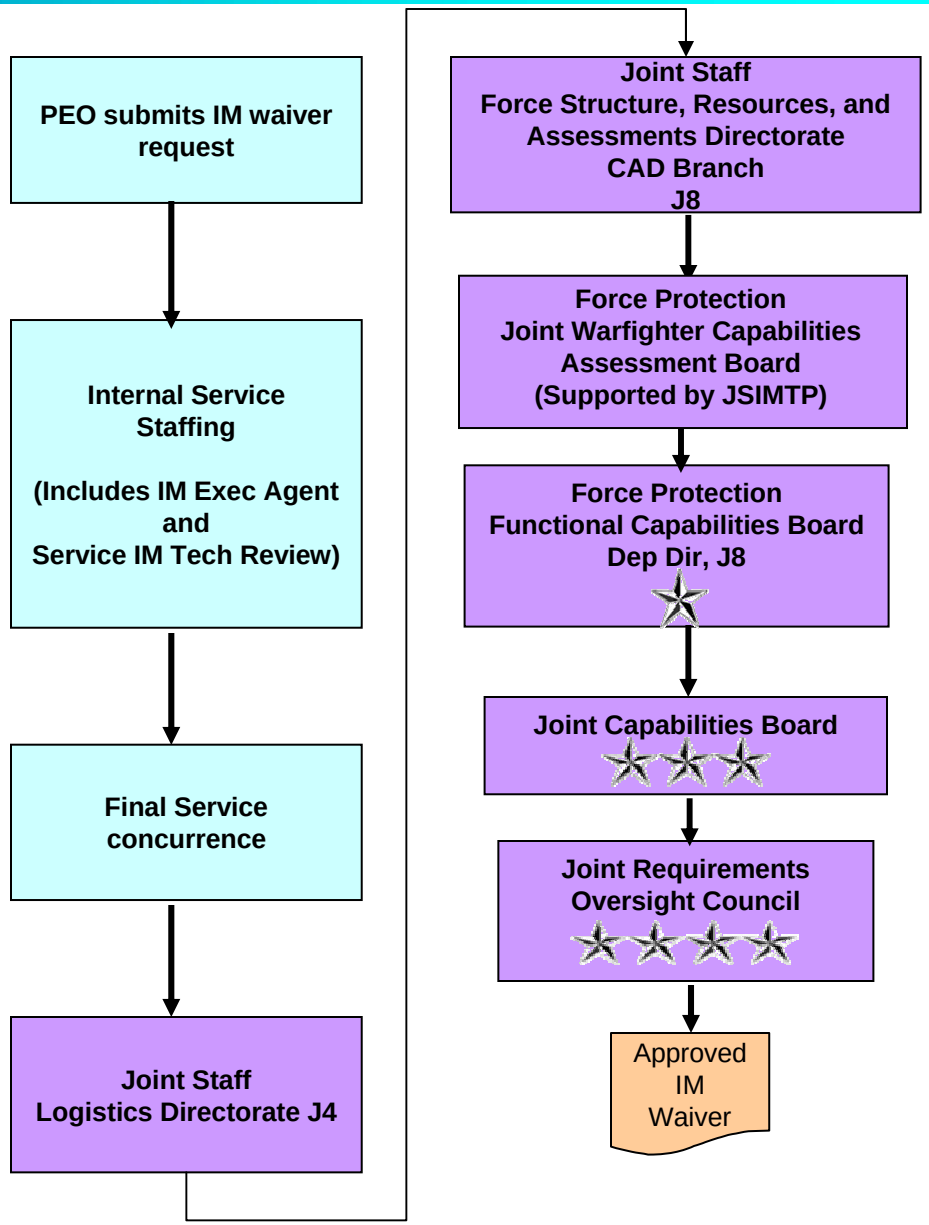
- **DoDD 5000.1, May 12, 2003**: E1.23. Safety. "… All systems containing energetics shall comply with insensitive munitions criteria."

## Joint Chiefs Policy

- **Chairman, Joint Chiefs of Staff Manual CJCSM 3170.01, June 23, 2003**: "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. Waiver requests will be submitted to J-4 for review, then forwarded to the JROC Secretariat in conjunction with JCIDS staffing for JROC consideration ."

# IM Waiver Process

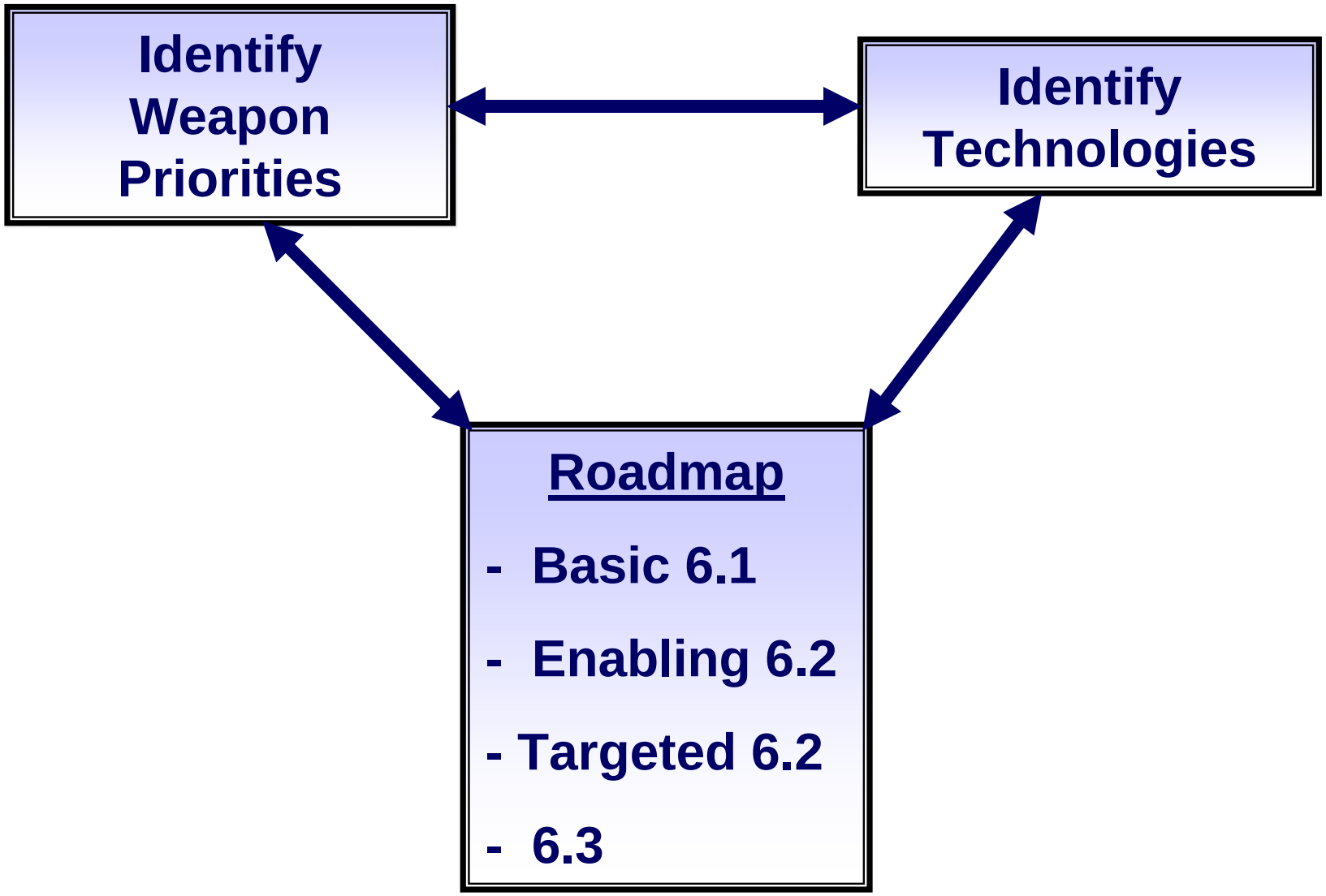
- Waivers required per DoD 5000.1 and CJCSI 3170.01C
- IM waivers historically based on lack of technology
- Waiver requests staffed by all Services
  - Push technology across Service lines
  - Contribute to DoD-wide technology plan
- JROC requiring funded POA&Ms to achieve IM in all waiver requests
  - Technology catalyst needed to avoid perpetual waiver scenario



# US IM Trends

- JROC desires new munitions be “born” IM compliant.
- For existing munitions, JROC desires to see some level of IM compliance and emphasis on IM technology insertion…checking Service POM’s
- JROC concerned with lack of DoD and Service wide IM S&T efforts.
- Services working on S&T “Roadmap” to push for additional investment in basic sciences and advancement of emerging technologies.
- Strategic Planning

# Roadmap Structure



# JSIMTP Technology Prioritization

| Legend / CATEGORY | FCO | SCO | BI | FI | SD | USA | USAF | USMC | USN | SOCOM | Score | Joint Priority Top Five |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gun Propellant Large Caliber | IV | IV / III | IV | III | P | 1 | 9 | 8 | 5 | 5 | 28 | 1 |
| General Purpose Explosives | IV | V | V | V | F | 13 | 1 | 15 | 2 | 3 | 34 | 2 |
| Solid Rocket Propulsion Minimum Smoke | IV | I | I | I | P | 3 | 12 | 5 | 6 | 7 | 33 | 3 |
| Metal Accelerating Explosives Castable (Heavy) | V / I | IV / III | V / IV | V / IV | P / F | 5 | 6 | 3 | 8 | 12 | 34 | 4 |
| Advanced Penetrator Explosives | V / IV | V / IV | V / IV | V / IV | P / F | 8 | 2 | 16 | 4 | 6 | 36 | 5 |
| Metal Accelerating Explosives Pressed (Light) | V / III | V / IV | V / IV | IV / III | P / F | 7 | 3 | 4 | 11 | 10 | 35 | 6 |
| Solid Rocket Propulsion High Performance | IV / III | III / II | IV / III | V / III | P | 2 | 11 | 7 | 3 | 14 | 37 | 7 |
| Metal Accelerating Explosives Pressed (Heavy) | III | III | IV | IV | P / F | 6 | 3 | 10 | 7 | 14 | 40 | 8 |
| Gun Propellant Medium Caliber | IV | IV | V | V | P | 4 | 9 | 11 | 15 | 15 | 54 | 9 |
| Metal Accelerating Explosives Extruded | V / I | V / I | V / I | V / I | F | 11 | 8 | 1 | 12 | 14 | 46 | 10 |
| Underwater Explosives | IV | IV | V | III | F | 18 | 18 | 2 | 1 | 11 | 50 | 11 |
| Metal Accelerating Explosives Castable (Light) | V / IV | IV / III | V / IV | V | P | 12 | 6 | 6 | 13 | 12 | 49 | 12 |
| Solid Rocket Propulsion Reduced Smoke | IV | IV / III | V / IV | IV | P | 9 | 12 | 9 | 10 | 13 | 53 | 13 |
| Thermobaric | V | V / IV | V | V | P | 10 | 17 | 14 | 9 | 4 | 54 | 14 |
| Booster Explosives | V | V | | | | 14 | 3 | 13 | 18 | 8 | 56 | 15 |
| Pyrotechnic / Illumination | IV / III | IV | V / IV | IV | P | 15 | 16 | 12 | 14 | 1 | 58 | 16 |
| Propellant Actuated Devices (PADs) | V / IV | V | V / IV | V | P | 17 | 14 | 17 | 16 | 16 | 80 | 17 |
| Cartridge Actuated Devices (CADs) | V | V | V | V | P | 16 | 14 | 18 | 17 | 16 | 81 | 18 |

Top Seven

# IM Weapon Priorities

| Legend<br>CATEGORY | FCO | SCO | BI | FI | SD | Joint Priority |
|---|---|---|---|---|---|---|
| Gun Propellant Large Caliber | IV | IV / III | IV | III | P | 1 |
| General Purpose Explosives | IV | V | V | V | F | 2 |
| Solid Rocket Propulsion Minimum Smoke | IV | I | I | I | P / F | 3 |
| Metal Accelerating Explosives Castable (Heavy) | V / I | IV / III | V / IV | V / IV | P / F | 4 |
| Advanced Penetrator Explosives | V / IV | V / IV | V / IV | V / IV | P / F | 5 |
| Metal Accelerating Explosives Pressed (Light) | V / III | V / IV | V / IV | IV / III | P / F | 6 |
| Solid Rocket Propulsion High Performance | IV / III | III / II | IV / III | V / III | P | 7 |

| | | |
|---|---|---|
| Pass | V | Burning Reaction (FCO, SCO, BI, FI) or No Propagation (SD) |
| Fail | IV | Deflagration or Propulsive Reaction |
| Fail | III | Explosion |
| Fail | I / II | Detonation or Partial Detonation (Except SD and SCJ) |

# Technologies

## Energetic Material

New Crystals/Molecules
Crystal Morphology & Quality
Nano-Technology Material
Advanced Binders
Binary Energetics
Crystal Coating
Suppression Agent
Modeling & Simulation

## System Design

Liner Materials
Passive/Active Venting
Coating
Scoring
Thermal Protection Material
Barrier/Ballistics Material
Sensors
Fuze and Initiators
Modeling and Simulation

## Packaging

Suppression Systems
Passive/Active Venting
Storage Configuration
Packing Container Material
Thermal Protection Material
Barrier/Ballistics Material
Modeling & Simulation

| | | | | | |
|---|---|---|---|---|---|
| 1 Gun Propellant Large Caliber | 2 General Purpose Explosives | 3 Solid Rocket Propulsion Minimum Smoke | 4 Metal Accelerating Explosives Castable (Heavy) | 5 Advanced Penetrator Explosives | 6 Metal Accelerating Explosives Pressed (Light) |
| 7 Solid Rocket Propulsion High Performance | 8 Metal Accelerating Explosives Pressed (Heavy) | 9 Gun Propellant Medium Caliber | 10 Metal Accelerating Explosives Extruded | 11 Underwater Explosives | 12 Metal Accelerating Explosives Castable (Light) |
| 13 Solid Rocket Propulsion Reduced Smoke | 14 Thermobaric | 15 Booster Explosives | 16 Pyrotechnics/ Illumination | 17 Propellant Actuated Devices (PADs) | 18 Cartridge Actuated Devices (CADs) |

# Roadmap Structure

## Identify Weapon Priorities

### IM Weapon Priorities

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| Advanced Penetrator Explosives | V<br>IV | V<br>IV | V<br>IV | V<br>IV | P<br>F | 5 |
| Metal Accelerating Explosives Pressed (Light) | V<br>III | V<br>IV | V<br>IV | IV<br>III | P<br>F | 6 |
| Solid Rocket Propulsion High Performance | IV<br>III | III<br>II | IV<br>III | V<br>III | P | 7 |

| | | |
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## Identify Technologies

### Technologies

**Energetic Material**
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## Roadmap

- Basic 6.1
- Enabling 6.2
- Targeted 6.2
- 6.3

# IM Strategic Planning

- Approach:
  - **Identify IM Status of Developmental and Current Force Munitions**
  - **Identify Opportunities for Individual and Economy of Scale Improvements (by Munitions Family)**
  - **Develop Meaningful Criteria and Prioritize Improvement Opportunities**
  - **Develop Detailed Program Plans to Include Cost/Schedule**
  - **Provide an Overarching Plan With Sufficient Analysis to Serve As the IM Waiver Documentation for Re-Buys**
  - **Provide PEO With Capability to Provide Executive Level Oversight And Assist in Budget Decisions**
  - **Identify Basic and Applied Research and Advanced Technology Development Efforts Needed to Support PEO Requirements**

**Developing a Comprehensive Plan for Incorporating IM Improvements Into PEO/PM Managed Items**

# Acquisition Life Cycle

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There is a high probability of success in modeling energetic materials and those predictive technologies needed to mitigate the reaction of materials to unplanned stimuli.

6.4

**Weapons Qualification**

6.3

**Testing Performance & Sensitivity**

Sympathetic Detonation Test Setup with MK-82 General Purpose Bomb

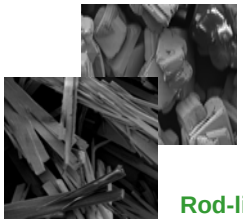
6.2

**Mesoscopic Process & Formulation**

Processing characteristics (e.g., viscosity) are dependent upon crystal morphology

Enabling 6.2

**Microscopic Crystal Morphology**

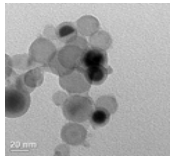


Spherical crystals are preferred shape for processing.

Rod-like crystals process poorly

6.1

**Molecular Morphology**



On the molecular level, need to understand basic properties of crystal to determine if it will meet your mission needs.

As with all tech base efforts, there is no guarantee that concepts will deliver the desired energetic materials effect, life cycle stability, or insensitive munitions qualities.

Basic Research → Transition to Production