NATO IS CHANGING SO IS NIMIC

After a three-year transition period that started in 1988, NIMIC was established in 1991 as an Information and Analysis Center (IAC) dedicated to Insensitive Munitions.

Over the years NIMIC has constantly and effectively supported the development and implementation of IM technologies. The point has now been reached where the NIMIC Nations are looking into the near future and see the development and fielding of insensitive munitions becoming a normal part of the safety design process. In other words, Insensitive Munitions and Safety and Suitability for Service (S3) issues are converging. And, the need for considering the whole life cycle of munitions keeps growing. For these technical reasons, the scope of NIMIC had to be reconsidered.

This need was in fact anticipated, both by NIMIC and by its customers. Many of the questions asked by customers and answered by NIMIC are beyond the scope of Insensitive Munitions. Even some of the major products of NIMIC have been dealing with broader Munition Safety issues, since the 1994 Specialists’ Meeting on Streamlining Safety Testing for Munitions.

This dilemma was addressed at-length during the October 2002 NIMIC Steering Committee meeting with the following decisions:

- NIMIC will transition into a new NATO Project Office, the Munitions Safety Information and Analysis Center (MSIAC).
- A Pilot MSIAC operation will start within NIMIC on 1 January 2003. The full transition to MSIAC will take place in no less than two years.

In October, the NATO North Atlantic Council approved a large set of NATO committee reductions and restructuring. As a result, the two Conference of National Armament Directors Partnership Groups (CPGs) in charge of munition safety issues were merged. A NATO “Ammunition Safety Management” Group will replace both AC/258 and AC/310 in 2003. The new subgroup structure will be lighter than in the past and will be encouraged to take advantage of existing resources, like NIMIC, to advance work on high priority activities. Again, this is a strong call to reconsider the scope of NIMIC.

Meanwhile, however, the development and fielding of insensitive munitions remains one of the contributions to Defence against Terrorism, one of the highest priorities of NATO. Thus while the NIMIC scope needs broadening, the need to reduce munitions system sensitivity must remain a priority within the overall context of munitions system safety.
Solid Rocket Propellants for Improved IM Response - Recent Activities in the NIMIC Nations

NIMIC has prepared a brief overview of approaches used by various organizations to develop less sensitive, or IM propellants. This article is a summary of the paper, which was presented at the RTO Specialists Meeting in Aalborg, Denmark in September 2002.

As part of a systems approach to meeting Insensitive Munitions requirements, the NIMIC member nations have expended a great deal of effort on the development and qualification of less sensitive rocket propellants. The desired characteristics of such “IM propellants” are discussed in terms of general methods of tailoring the propellants to counter thermal and mechanical (shock/impact) threats. Examples that illustrate the application of these methods in real, useful propellants are presented, along with the corresponding results of component and/or full-scale IM tests, where possible. Tradeoffs of component reduced vulnerability and other propulsion system design drivers (e.g., performance, cost, signature, environmental concerns) are also discussed. New energetic materials and propellant ingredients that show promising IM characteristics are presented, along with a look at future research and development efforts and technology trends in this area.

Hazards reduction is a systems problem, and, therefore, the approach most likely to significantly reduce a munition’s sensitivity and vulnerability to IM stimuli is a systems approach. For a solid rocket propulsion system, such an approach consists of a less sensitive propellant, loaded in a motor case that will reduce confinement of the propellant when subjected to IM stimuli, and may include some type of mitigation device(s). In addition, a systems approach to IM can also be influenced by munition storage and packaging concepts (e.g., packaging/storage configurations, barriers and deflectors, pumice, munition container vents), and must also take into account the influence of the hazard stimuli (fast and slow heating, bullet and fragment impact) and the environment on the munition response.

Obviously, choosing the best propellant from an IM perspective is not a simple process. Besides considering the influence of other system components and factoring in a scientific evaluation of the hazard/munition interaction, the designer must also weigh the IM requirements against other system constraints when tailoring propellants for specific applications. Performing the appropriate trade-offs between hazard reduction and the other considerations involves a “subtle understanding of the interaction of the normal (i.e., non-IM) propellant selection criteria with their influence on desensitizing the propellant to the hazard threats.” The question to answer, then, is can the designer reduce propellant sensitivity to IM hazards without compromising other system requirements?

IM Propellant Characteristics

Despite the fact that the rocket propellant is only one aspect of a munition system, there are specific characteristics that have been identified as contributing factors to the achievement of IMness. For the purposes of this report, the IM propellant traits are categorized (roughly) according to the general method by which they affect a formulation’s IM sensitivity. Using this means of categorizing propellant characteristics might lead us to three general approaches to reducing sensitivity:

1) Changing the friability or “toughness” of the propellant. Propellants with good elongation properties (particularly at low temperature limits), those that absorb energy and deform with minimum damage, tend to perform well against shock and impact threats.

2) Managing the Partitioning of Energy

- Reducing the solids loading. In general, decreasing the total solids level (for an equivalent energy level) improves the mechanical properties and decreases detonability of the propellant. This can be accomplished by: increasing the density of crystalline oxidizers (development of new oxidizers); use of an energetic binder system, which allows a corresponding decrease in solids loading without decreasing total energy; use of high-density additives to maintain or increase propellant density-impulse while decreasing the total level of solids.

- Controlling particle size and distribution – using particle distributions that are optimum for binder wetting and particle-to-particle bond strength. For example, fine grinding of nitramines reduces shock sensitivity.

- Using less sensitive solid ingredients (i.e., reducing the level of nitramines, reducing or changing ballistic modifiers, reducing the amount of ammonium perchlorate). This may involve the development of new ingredients, or the use of new combinations of existing propellant ingredients, such as energetic plasticizers.

3) Developing extinguishable propellants - propellants that smolder or extinguish at atmospheric pressure.

These approaches to tailoring propellants for IM are not new, as they have been proposed, discussed and debated in the IM and propulsion communities for quite a few years. So, it should be interesting to take a look at how various organizations have made use of these methods in the development of IM propellants over the past decade. Part 2 of this article, to be presented in the next NIMIC Newsletter, will review some examples, highlight the approaches used to reduce sensitivity to IM stimuli, and provide IM test results that illustrate the degree of success (or failure) achieved by each example.
IM ASSESSMENT METHODOLOGY WORKSHOP – PART 2

In part 1 of this article (3rd Quarter 2002 NIMIC Newsletter), the structure and activities of the IM Assessment Methodology Workshop were described, including the generation of process flowcharts that were integrated into an overall, risk-based methodology. This methodology was defined as an iterative process, with each flowchart representing an individual stage of the munition acquisition/development cycle, and providing increased levels of confidence in the eventual assessment.

The subject of part 2 of this article is the output of an IM assessment based on this methodology: the IM Dossier. The table below provides a summary of the responses to questions that were used by the workshop participants to define the IM assessment dossier.

The dossier should be prepared in a manner that is consistent with the IM risk assessment methodology formulated at the workshop: threat data and munition data should be compiled; their interaction should then be recorded and the IM risk assessed; and finally, information should be presented in support of a change strategy and/or program office decision. The basic format prepared reflects this approach:

- An Executive Summary, with references to key supporting documents
- Introduction: objective/purpose, and system approach
- Munition Data Package
- Threat Data Package
- Hazards Data Package
- Threat Hazard Assessment (preliminary, and updates)
- IM/HC Assessment Data Package
  - IM/Hazard class assessment/evaluation of achievements
  - Suggestions for change strategy
  - Recommendations for waiver/modification of requirements
- Cost Benefit Analysis
- Conclusions: IM performance predictions, with level of confidence

The Proceedings of the workshop (L-85) and the Final Report (L-89) are currently available to all NIMIC members.

Merry Christmas and a Happy 2003 to all our readers!
NIMIC SHOCK MODELLING WORKING GROUP

It has been known for more than fifty years that the initiation and detonation of heterogeneous explosives is affected by the behaviour of density discontinuities and other defects. Mathematical models to describe this reactive behaviour are almost as old.

Nevertheless, as there still is lack of knowledge about the microscopic phenomena that affect hot spot formation, initiation, and burn (how much material corresponds to hot spots after initial shock loading, what is the temperature range of these hot spots, how do material microstructure and loading conditions affect hot spot formation, etc.), and as the associated time and length scale is exceedingly short to be accurately modeled, realistic descriptions are still not available to hydrocode users.

Following discussions initiated during the NIMIC workshop entitled “Small-Scale Testing and Modelling” (January 2000), NIMIC proposed to the community to set up a group of experts including model developers and code users. Created in June 2001, this group of almost 40 experts, compiled work conducted and being conducted in the NIMIC nations in the field of shock initiation modelling. More than 30 models have been reviewed mainly using the Internet as a media. Results of the discussion are now available in a NIMIC document entitled “NIMIC Nations Collaborative Efforts in Shock Modelling: Reactive Models for Hydrocodes: Past, Present and Future”.

The Objective of this document is to present to the community the results of this review, some identified shortcomings and recommendations for the future.

This will enable the community to have access to relevant databases in form of records and/or tables including:

1. A review of 31 reactive empirical, semi-empirical and physical models. All the summaries of models follow the same structure in order to answer the set of questions proposed in the first section of this document, i.e.:
   A. Questions relevant to model description: Model description paragraph.
   B. Questions relevant to model parameters: Table and equation(s).
   C. Questions relevant to model possibilities: Model achievements paragraph
   D. Questions relevant to model implementation: Model improvement paragraph

   A list of 56 available hydrocodes for solving the detonation of explosives and shock propagation including a short description.

   3. A discussion about reacting mixture rules.
   An exhaustive review of reactive shock waves treatment in continuum mechanics models.

   5. A review of reaction rate laws.

   6. A list of 83 energetic materials investigated using the 31 reviewed models and 150 open publications.

A copy of this report can be obtained by emailing NIMIC.

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- The scope of MSIAC will cover Munitions Safety across the total life cycle of munitions.
- The activities of MSIAC will still center around “Information and 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.

The NIMIC Steering Committee envisions that the Document Support activities will consume around 20% of MSIAC time, with the remaining 80% dedicated to the information and analysis activities. And, the current IM focused activities will smoothly decrease over time while the broader munition safety activities will grow accordingly.

These major changes will help NIMIC adapt to its evolving environment and focus on the highest priorities of its member nations. The challenge of implementing these changes is an opportunity for NIMIC to remain a successful team, and even maybe to further increase its membership.

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LATEST NIMIC REPORTS

Limited Literature


Open Literature

O-75 Intrinsic Benefits of Insensitive Munitions by Pascal Marchandin, December 2002
O-74 Solid Rocket Propellants for Improved IM Response - Recent Activities in the NIMIC Nations by M. Fisher & M. Sharp, 4 October 2002
O-73 Insensitive Munitions and Ageing by M. Sharp, 3 October 2002

\[ GOTO\Page\1 \]
AN OVERVIEW OF THE IM/EM RESEARCH AT TNO-PML

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1. INTRODUCTION

IM research and EM research in relation to IM, started at TNO Prins Maurits Laboratory around 1986 with a large programme called “Less Sensitive Explosives” and some smaller programmes on DDT and Cook-off. Since then, interest in IM has increased and nowadays several projects and programmes are carried out in this field.

Figure 1 illustrates the different aspects in reaching IM. This figure shows the different ways in which IM-techniques can be utilised in order to achieve safer situations. Each level will be briefly discussed in the following sections.

2. PROPERTIES OF THE CRYSTALLINE EM

The most fundamental level to obtain IM-ness of a munition item lies in the intrinsic properties of the energetic material itself, either by:

- Synthesis of new, less sensitive crystalline materials, or by
- Improving the properties of existing materials (improved shape, less crystalline imperfections).

Research within TNO-PML is focused on the second subject. It has been shown that both crystal shape and crystalline imperfections influence the sensitivity of the explosive [2,3]. These parameters can be controlled through the applied methods and processing conditions during the crystallisation of the crystals, like crystallisation technique, solvent(s), crystallisation kinetics (nucleation/growth), hydrodynamics, hardware geometry etc.

In recent years, considerable progress has been achieved on the recrystallisation techniques for several energetic materials, like RDX, HMX, HNS-IV and HNF; nicely shaped particles have been attained, generally with a low level of (micro-)inclusions. Two examples are shown in Figure 2. The effect on the shock sensitivity of HMX is shown in Figure 3 [2]. Due to the absence of the (micro-)inclusions, the mean density of the crystalline material increases.

1 Shortened and updated version of a paper which was presented at the IM/EM Symposium in Bordeaux, France, 6-11 October 2001 [1].
resulting in an increase of the critical shock initiation pressure from 4 to about 7 GPa [2]. Recently similar results have been obtained with HMX and CL-20 crystals in a density-matched liquid, subjected to flyer impact tests determining the shock initiation pressure [4].

![Improved crystal shapes of RDX (left) and CL-20 (right).](image)

**Figure 2:** Improved crystal shapes of RDX (left) and CL-20 (right).

### 3. PROPERTIES OF THE COMPOSITE

Parallel to these developments, also other improvements are achieved; an example is the recent introduction of insensitive RDX (I-RDX) by SNPE (France).

The next level to reach a less sensitive material is the use of a polymer matrix embedding the crystalline material. The binder system improves the mechanical properties but also the porosity, both having a major influence on reducing the probability of a DDT or XDT reaction of an energetic material. Similar to the research of new crystalline energetic materials, also in the development of new composites, there is always a compromise between performance and insensitivity.

#### 3.1. Mechanical properties

For several years now, TNO-PML is investigating the properties of energetic composite materials, in particular HTPB based, in order to determine the critical parameters leading to a less sensitive material. For e.g. an HMX based PBX the mechanical properties have been determined as a function of the strain rate, but also as a function of the temperature and even degree of decomposition. The data obtained are used in the computer code Autodyn (see also Figure 4) with an implemented erosion model to simulate impact phenomena. The results are compared with experimental data, the recovered sample after impact as well as high speed camera pictures.

![Figure 3: A decrease of the shock sensitivity of HMX due the absence of (micro-)inclusions in the HMX crystals [2].](image)

#### 3.2. IM Properties

Furthermore, considerable effort has been put in the understanding of mechanisms leading to and the parameters influencing the response for several types of stimuli like pure shock impact, bullet and fragment impact as well as fast and slow cook-off.

To investigate the SDT, DDT and XDT phenomena induced by impact of a bullet or fragment, a 30mm rifled gun test set-up has been established at TNO-PML to test bare explosives, as well as confined ones. Besides high-speed film, also a digital camera is used to investigate in detail the processes during impact. In Figure 5, as an example, the remainder of unreacted HMX based PBX (bimodal, 85 wt% solid load) is shown after an impact of a tungsten fragment with a diameter of 22 mm.
This type of new explosives displays an extreme difference in response: if the fragment velocity exceeds the critical impact velocity, the explosive detonates as a result of a prompt shock; below the critical velocity it does not react at all. Together with the newly “improved” or “insensitive” crystalline explosive I-RDX, and the expected future developments of I-HMX or even I-CL-20, this will lead to a next generation, high performance and insensitive explosives.

4. PROPERTIES OF THE MUNITION ITEM

The next level to achieve less sensitivity is related to munition design. This includes techniques like the utilisation of composite casings or venting holes, but also the use of newly developed ignition systems. The experience available at TNO-PML with the MAP of the flyer test set-up in combination with the knowledge to manufacture HNS-IV, led to the development of a mechanical-electric microsystem exploding foil initiator (MEMS-EFI) based on commercially available electronic systems. MEMS-EFI inhibits the insensitivity required to reach a fully insensitive munition item or missile system with modern guiding and functioning systems.

Besides the careful design of munition components, other techniques can be used that lead to safer situations. The experience gained at TNO-PML in the area of cook-off has been used to set-up a software programme tool enabling one to estimate the time to explosion in case of a fire on board a ship. In Figure 6, a comparison of formula calculations and experimental results of cook-off experiments with HMX-based explosives is made. In this figure the temperature of explosion is given as a function of the heating rate. The implementation of this kind of calculations in a system control can give a quick estimate of the explosion temperature and also the time to explosion. This could be of considerable help during the attempt to extinguish the fire, to minimize victims and to save the platform.
5. MITIGATION AND PROTECTION

The last two levels of techniques to achieve safer situations with munition transport or storage are mitigation to prevent sympathetic reaction between munitions and proper barrier design to prevent sympathetic reaction between storage modules. Water, for example, may be used to prevent the sympathetic reactions between munitions but at the same time it can reduce effectively the blast loading on the surrounding structure [5].

The intermagazine distances and construction methods used for static ammunition storage sites are not practical for use in Out-of-Area storage. Because of the increase in the number of Out-of-Area situations in which The Netherlands are involved, techniques to prevent munitions and explosives against the threats accompanying the accidental explosion/detonation of an adjacent storage module have raised increased interest in The Netherlands. This has led to a programme in which the effects of a detonating magazine containing 5 tonnes of munitions on a typical Out-of-Area compound are studied (Q-D distances), as well the effects on nearby magazines (sympathetic reactions). A full-scale test has been performed in Australia in October 2002. Four different barriers have been incorporated into the experiment. Most important, these barriers were designed based on the relatively new Sensitivity Groups of munitions and their corresponding criteria. Each barrier in the experiment was backed by an acceptor magazine “instrumented” with inert munitions, a few live munitions, and various gauges in order to verify the design principles for the prevention of sympathetic reactions between storage modules.

6. CONCLUDING REMARKS

TNO-PML will carry on with the research of the different aspects of explosives and munition in relation with IM and safer storage and transport situations for our Dutch MoD. Furthermore, also effort is put into the strengthening of the knowledge position, by involvement in national and international partnerships and collaboration programmes. Besides collaboration with (national) universities, this includes partnerships with FOI (Sweden), DREV (Canada), DSTL/GinetIQ (UK), DSTO (AUS), SNPE (France), ICT (Germany) and cooperation within European programmes (CEPA, EU, WEU) and exchange programmes with USA, like Data Exchange Agreements (DEA’s).

ACKNOWLEDGEMENTS

The financial support by the Netherlands Ministry of Defence is gratefully acknowledged.

REFERENCES

[1] G. Scholtes et al., presented at the IM/EM Symposium Bordeaux, France, 6-9 October 2001
ACCIDENTS INVOLVING MUNITIONS AROUND THE WORLD


Only accidents related to military munitions and military-grade energetic materials, from production to disposal, are reported in this section.

30 September 2002 - Germany - Burbach, North-Rhin & Westphalia - Production

An explosives factory was badly damaged in an explosion which destroyed part of the production line for dynamite sticks. The explosion apparently occurred in the section for the purification of nitroglycerine. No injuries. According to the office for industrial safety, a fifty square metre building was completely destroyed and damage to surrounding property was considerable.

15 October 2002 - Bulgaria - Veliko Tynovo - Demil

Ivalio factory. Four persons were injured while destroying Soviet-made R-17 missiles. The press service of the Bulgarian Foreign Ministry reported that the explosion happened “due to failure in the electricity grid when high voltage was switched on.”

16 October 2002 - Russia – Vladivostok - Storage

A fire in a naval arsenal of the Russian Pacific fleet caused numerous uncontrolled explosions of ammunition supplies. Three engineers destroyed 500-1bs bombs when the fire spread to an open storage area. The fire caused the explosion of 12 railroad cars of old artillery shells, and police evacuated residents from the area. The arsenal is being moved to a storage facility in the Kiparisovo area 40 kilometers north of Vladivostok (cost of transfer is 2.5 millions USD). No injuries are reported.

12 November 2002 - Germany – Lübben, Brandenburg - Demil

An explosion in a bunker at a plant destroying munitions killed four persons. The earth-covered concrete bunker was completely destroyed by the explosion, with debris scattered for up to 500 metres. The company confirmed that the workers were defusing 500-1bs bombs. 9 bombs were stored in the bunker at the time of the explosion and at least 2 detonated. On 11.14, it was announced that the public prosecutor’s office had opened a case against persons unknown, because of a suspicion of negligence.

12 November 2002 - Nicaragua – Managua - Handling

A box of gunpowder exploded inside a military warehouse, killing five soldiers and critically wounding five others. A group of soldiers were carrying gunpowder from a warehouse on the grounds of a training school when one of the boxes exploded. The first explosion triggered a series of subsequent explosions and fires that eventually ignited boxes filled with smaller ammunition. Soldiers later removed remaining stores of gunpowder and ammunition from the warehouse in order to prevent more explosions.

13 November 2002 - South Africa - Cape Town - Storage

Ammunition factory. One employee was injured in an explosion in a store for powder cartridges and primer cases. The cause of the explosion is not yet known and will be investigated.

19 November 2002 – Norwegian Coast – KNM Orkla – Training

(Source: Norwegian Navy – forwarded to NIMIC by Andrew Clark – RAN)

A fire broke out by the lifting-fans near the engine room of the Norwegian Alca-class air-cushion catamaran minesweeper KNM Orkla during the Norwegian naval exercise Flotex 02. Although intensive efforts were made to control the fire, the remaining crew was evacuated 3 hours after the fire started and firefighting continued from other ships. Munitions (4000 12.7-mm rounds and 1500 20-mm ammunition were on board) cooked-off and the fuel tanks burnt. It was the burning of composite materials in the hull, which caused the main problems, but additional problems were caused by parts of the vessel’s construction being in aluminium. The fire burnt during 24 hours before the ship sunk. The procurement cost of the ship was US $ 50 million in early 90s. Only minor injuries were reported.

20 November 2002 - Ecuador – Riobamba, 170 km South of Quito - Handling

Seven people were killed and 274 injured (74-115 seriously injured depending on the sources) in an explosion at an ammunition depot at Ecuador’s largest military base. The Army spokesman said the explosion was caused by an artillery shell being dropped on “explosive materials” (?), which started a fire and a cook off reaction. This first detonation caused a second larger explosion. Severe damage to the buildings within a radius of 300 meters, and windows were broken in a radius of 2 kms. Munitions were scattered inside and outside the depot.

The mayor claims that the reconstruction of the city will cost 80 million USD.

To be investigated – Near Misses

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Description</th>
<th>Consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 Oct.</td>
<td>USA, GA, Atlanta</td>
<td>Truck carrying explosive materials overturned</td>
<td>Dynamite, blasting cap and liquid gel explosive spill – evacuation (400 meters)</td>
</tr>
<tr>
<td>18 Nov.</td>
<td>South Africa Air Force Range</td>
<td>Accidental explosion during EOD</td>
<td>1 EOD operator killed.</td>
</tr>
<tr>
<td>20 Nov.</td>
<td>USA, IND, Bloomington</td>
<td>A tractor-trailer carrying explosive materials overturned</td>
<td>AN and blasting caps spill – 1500 persons evacuated</td>
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NIMIC NEWS

NIMIC STAFF

LEUT Robert Elphick, RAN, has just completed a 3 month detachment at NIMIC. During this time he worked hard on answering questions, adding data to the EMC and creating an EM suppliers catalogue. NIMIC wishes him well in his new posting in Canberra.

ENERGETIC MATERIAL SUPPLIERS CATALOGUE

NIMIC is putting together a catalogue of suppliers of ingredients and formulations. We are often asked for information on suppliers and availability of new ingredients and formulations. Therefore, the idea is to compile this information in a supplier’s catalogue. The document will concentrate on ingredients and formulations that show IM potential. However, we will also include data on new ingredients that are of interest. Additional company information will be included, if provided, and will detail manufacturing capabilities and experience. A number of companies have already provided information. If you feel that you would like to add your company to the document, please feel free to contact us for more details.

The EM suppliers catalogue will be attached to the new version of the EMC/AOP-26 due to be released early in the New Year.

IM DESIGN TECHNOLOGY WORKSHOP 2003

The UK DOSG and NIMIC will be co-sponsoring a workshop on IM design technology during the fourth quarter of 2003. The workshop will focus on the current state of the art of IM design technology for munitions and their respective packaging. The principle aims of this workshop will be to identify the key design principles, review the current technological solutions and to identify the key areas where any shortfalls exist in IM technology.

In a break with the traditional workshop structure, an innovative approach will be adopted. The two-part workshop will be structured around a pre-determined taxonomy and will aim to answer a series of pre-determined questions. This will form the basis for the final workshop report. The taxonomy will be split into five key chapters:

1. Introduction (design principles)
2. Payload (warheads, bombs etc)
3. Delivery Systems (rocket motors, gun propellants etc)
4. Packaging (individual and multiple munitions)
5. System Integration (architecture)

The taxonomy, together with the questions will be circulated with the calling notice in January 2003.

Received presentations will be given sequentially so that the attendees have the opportunity to see all of them. This part of the workshop is open to any representatives from NIMIC member nations.

The key design technologies identified in the presentations will be summarized by pre-arranged chapter/sub-chapter leads. These summaries will be displayed & discussed in the second part in a freeform manner so that all participants can readily contribute. In order to keep this part at a manageable level, the second part of the workshop will be open to invitees only. The information generated will be used to facilitate the drafting of an IM design technology state of the art report.

Hope to see you there.

DO NOT FORGET YOUR NOMINEES FOR THE IM AWARD

Visit our website for further details http://hq.nato.int/related/nimic