



INSENSITIVE MUNITIONS UNDERSTANDING THE RISKS REAPING THE BENEFITS

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NDIA IM & EM Technology Symposium

Bristol - 25 April 2006

USS FORRESTAL '67



DOHA '91

IM AND RISK

- **IM: minimise the probability of inadvertent initiation and severity of subsequent collateral damage.**
- **Risk: the combination of the frequency, or probability, and the consequence of an accident**
- **IM: munitions which minimise risk**
- **But IM assessment does little to inform risk assessment**

IM ASSESSMENT (1)

- **IM Assessment: response to selected threats**
- **NATO 'Response Levels' – provide a widely accepted threshold**
- **'Full body of evidence' approach leads to comprehensive and rigorous assessment**
- **But IM assessment does not:**
 - **Address risk**
 - **Assess probability of inadvertent initiation**
- **We expect munitions to react at the assessed levels**
- **Probability of not reacting at all – the longer term 'Holy Grail'**

IM ASSESSMENT (2)

- **IM assessment focuses on level of response, not on level of collateral damage**
- **The higher the level of response, the greater the damage (for a specific munition)**
- **But Deflagration of a large munition may generate greater collateral damage than Detonation of a small munition**

Conclusion:

- **The IM assessment process**
 - **Is robust in terms of IM signature but**
 - **Does not address probability of initiation**
 - **Does not measure collateral damage**

IM ASSESSMENT AND RISK

- **Goal: closer link between IM Assessment and Risk**
 - IM assessment to provide a key input to risk based safety assessment
 - IM is an integral part of munition safety assessment
- **Probability of initiation**
 - If a munition sees a threat, assume it will react
 - IM assessment is deterministic, not probabilistic
- **Exposure to IM threats - this is where probabilities belong**
- **Probability of exposure and subsequent response are key inputs to risk-based safety assessment**
- **Measure of collateral damage needed**

COLLATERAL DAMAGE

- **IM tests do not measure collateral damage – only response type**
- **1997 NIMIC workshops on IM Testing proposed:**
 - **Measurement of blast, heat flux and fragment energy at set distances**
 - **Quantify output against a standard scale**
- **Continue to measure response Type as well**
- **Test procedures unchanged but gather more data**
- **8 years later, no progress!**
- **Measurement of collateral damage:**
 - **Relevant to Hazard Classification, especially HD 1.2.3**
 - **Key to informed and objective assessment of risk**

BENEFITS OF IM (1)

- **New munition programmes: IM is a basic requirement**
- **IM upgrade programmes: seen as a ‘Spend to Save’ measure and often a casualty of financial review**
- **IM upgrades will remain a key part of UK MOD IM strategy for some years**
 - **Large legacy inventory**
 - **Lack of IM compliance**
- **Benefits of IM – operational and logistic – should be evaluated to inform and support upgrade decisions**

BENEFITS OF IM (2)

➤ **Benefits of IM**

- **Direct benefits – improved safety**
- **Consequent benefits – greater flexibility in storage, transport and operational use**

➤ **Direct benefits**

- **Reduced probability of a major catastrophe or accident is key**
- **Models such as CBAM available to evaluate and compare options**
- **CBAM more suited to major new munitions programmes, less suited to legacy upgrades**
- **For legacy upgrades, issue is often simply whether to choose upgrade option or not**

MAJOR ACCIDENTS

- **Very few major accidents**
- **Last major UK munitions accident: loss of NAV Bedenham, Gibraltar 1951**
- **USS Forrestal, Camp Doha provide evidence of catastrophic consequences**
- **Would the causes of either have been identified as important risks in a PRA?**

CONSEQUENT BENEFITS

- **Not as dramatic as those associated with safety**
- **But since benefits are tangible, not probabilistic, may provide useful evidence**
- **NIMIC Workshop, Sweden 2001 – valuable reference material**
- **HD 1.2.3 (cf Unit Risk) for IM compliant munitions now a reality – eg Storm Shadow**
- **Potential benefits from lower Haz Class for storage and transportation – situation specific**

EXAMPLES OF CONSEQUENT BENEFITS

- **Depot storage – UK has plenty so benefits limited to increased flexibility and optimisation**
- **Deployment airfields – significant benefits for storage and handling of munitions and parking of armed aircraft**
- **Greater flexibility in loading/offloading of munitions onto warships and berthing of ammunitioned warships**
- **Easing of operational constraints designed to mitigate against sympathetic reaction**
- **Many benefits can be quantified without need for complex model**
- **Example of a simple protocol included in the Paper**

CONCLUSION

- **Great progress in developing and delivering IM**
- **Less progress in quantifying reduction in risk and understanding implications**
- **Need to quantify collateral damage as a standard element of IM testing**
- **Use this information to inform both safety assessment and consequent benefits**
- **IM assessment is not a stand alone activity – it is an integral part of munition safety assessment**