DDESB SEMINAR 2010 –
RISK MANAGEMENT PROCESS FOR AMMUNITION & EXPLOSIVES

Aim

This paper provides an outline of an overarching risk management process that can be tailored to selected portions of the life cycle of ammunition and explosives (A&E), including acquisition, in-service use, and disposal. The aim is to reduce the risk of an undesired event, thereby preserving personnel, materiel and infrastructure. The process is one that addresses required deviations from established minimum accepted levels of safety by: identifying the risk; analyzing it in terms of probability and consequence; mitigating the dangerous activities; having the proper authority accept and approve the risk; and, ensuring that the risk is properly monitored.

Of special interest is that aspect of the process that addresses ammunition aspects in deployed operations. The recent profile of deployed operations typically includes situations where the footprint of a camp is too small for safe storage according to accepted standards and is exacerbated by the requirement for large NEQs to be in that storage, usually in a state of high readiness for use and exposed to extremes of climate and undergoing a significant amount of handling. The situation is made worse by the exposure of personnel across a wide spectrum: multi-national forces, contracted civilian personnel and the Host Nations' public. From the operational perspective the materiel and infrastructure that are threatened by an undesired explosive event may also affect mission capability. The process that has been developed is one that is aimed at allowing the senior ammunition technical authority to compile and present a risk management case to the appropriate level of operational commander so that he understands the situation and provides authorization for the acceptance of the risk.

Background

A&E brings with it the potential for an undesired explosive event with resultant personnel injuries or death and damage or destruction to stores, equipment and infrastructure. The safety approach to this possibility has often been one of strict compliance with established standards, considering only the possible consequences of an event. Modern risk-based approaches – which include consideration of the probability of an accident occurring and not just the predicted consequences of it – allow for the development of a risk management process which could result in situations which meet a prescribed minimum level of safety, but would be less costly in terms of resources. In addition, there have been developments of knowledge and tools that permit a risk-based approach.

In Canada, the *Explosives Act* is the federal legislation that assigns regulatory responsibility for explosives safety to the government department of National Resources Canada. The *Explosives Act* also recognizes the unique aspects of defence explosives (including ammunition) and so provides an exemption to the Department of National Defence (DND) for A&E deemed to be under its care and control[1]. This exemption comes with the

[1] There is a similar exemption for the DND under the *Transportation of Dangerous Goods Act* which has to do with regulations for the transportation of dangerous goods, including explosives.

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expectation that DND will provide proper oversight for the complete life cycle of A&E safety. The recently-created (2006) Directorate Ammunition and Explosives Regulation (DAER) not only provides an enhanced management capability for that regulatory responsibility, but also an appropriate sponsor for the risk management process.

The DND and the Canadian Forces (CF) A&E risk management process has been developed based upon corporate risk management guidelines of the federal government for risk assessment and acceptance. The specific A&E aspects are based upon the extensive work of NATO's international group of experts, resident in the Conference of National Armaments Directors' Ammunition Safety Group, AC/326, and its series of guidelines, the Allied Ammunition Storage and Transportation Publications (AASTP's), notably: AASTP-4 Explosives Safety Risk Analysis.

DND/CF involvement in NATO-led, mid-intensity operations in Afghanistan during the first decade of the 2000's has lead to increasing pressure to develop procedures for the assessment and approval of risk for situations where normal, peacetime storage and handling rules are not able to be applied.

Principles

The following principles apply to the development of this process:

> The policy must be able to be tailored to selected A&E activities, from acquisition through use to disposal of items.
>
> The basis for the policy is that there are basic minimum safety criteria that should be followed in every case – it is the deviations from the norm where the policy would apply.
>
> Where possible quantitative analysis will be used as a tool, but it is recognized that this must be in conjunction with a qualitative assessment.
>
> Approval and acceptance of the risk-based decision will lie at the appropriate level within the DND/CF chain of command.

Risk Assessment Steps

The following are the five generally accepted steps in any risk management process:[2]

> Step 1. The identification of the hazard, assessed against an established standard.
>
> Step 2. The process of analysing the risk, by considering the consequences and probability.
>
> Step 3. Determining what mitigating activities can be used to lessen the risk.

[2] Many references but mainly AASTP-4 Edition 1 and DND/CF Integrated risk Management Guidelines, January 2007

Step 4. Determining the appropriate level within the chain of command for accepting and approving the risk.

Step 5. Ensuring that the approved risk is monitored for any changes.

Step 1 – Hazard Identification

This step is where the situation of concern is defined, that is, the circumstances around which it is thought that an undesired event or accident might occur. Typically, the scenarios are out of the norm in that they do not meet the minimum accepted safety standards. The A&E technical expert would usually initiate the examination of the situation as a case to be presented. The details of the hazardous situation are examined under the parameters of:

The probability of the event occurring;

The probable effects and consequences if it does occur; and,

The nature of the exposure of persons to the possible event.

This initial work is the completion of an options analysis whereby the factors are examined and various options are arrived at. In most cases operational input is required ie what is the operational requirement that mandates increased risk from the minimum acceptable safety standards? The technical expert ensures that all possible mitigation measures are considered in developing the desired course of action.

Once it is determined that the desired activity is to be carried out and that the level of risk is thought to be higher than acceptable, a formal Ammunition and Explosives Risk Assessment Safety Case (AERASC) is prepared and submitted for approval, following Steps 2 to 5 of the risk management process.

Step 2 – Risk Assessment

Frequency / Probability / Likelihood

The probability of an undesired event can be determined as follows:

Quantitatively. Establishing a numerical probability, based upon historical record of events of similar occurrences.

Qualitatively. Establishing a description of probability by analytical examination of the scenario by a panel of experienced technical specialists.

The former aspect of using historical records presents many challenges. Firstly, there is the conundrum of the fact that the usual method of A&E regulation (rules and consequence based) has resulted in a good safety record, even if it was overly conservative in its application. This means that there are few records of accidents with which to compare. There would also be the challenge of ascertaining whether the event that one wished to utilize as a data point was sufficiently similar to that process that is being examined. Secondly, there is the question of a reporting system -has it been rigorous in its parameters and is it used?

The latter aspect of analytical examination relies heavily on knowledgeable, experienced A&E technical expertise, analyzing and attempting to quantify all the aspects of the scenario under discussion. In some cases the likelihood of an accident can be effectively assigned using tools such as SAFER[3] for storage-related situations. In actuality, the best determination of probability is a combination of the quantitative and qualitative methods and should not be determined by a single expert, but by a panel of experts and a consensus.

The aim of the panel is to assign a hazard probability level based upon the qualitative and quantitative terms shown in the table below. The threshold numbers shown are the commonly accepted international standards, both in the A&E world and elsewhere.

Hazard Probability[4]

Description	Qualitative Definition	All Exposed Personnel	Threshold
Likely -frequent -almost certain	Likely to occur many times	Over someone's lifetime can be expected to occur intermittently or occasionally	Greater than 1×10^{-3}
Probable -very possible	Expected to occur one or more times	Over someone's lifetime can be expected to occur randomly	Less than 1×10^{-3}
Remote -moderate -occasional	Unlikely, but possible to occur	Over someone's lifetime can be expected to occur	Less than 1×10^{-5}
Improbable -unlikely -seldom	Not expected to occur	Over someone's lifetime can be expected to occur rarely	Less than 1×10^{-7}
Extremely Improbable -rare -practically impossible	So unlikely, it may be assumed that it will never occur	Over someone's lifetime is not expected to occur	Less than 1×10^{-9}

[3] SAFER - Safety Assessment for Explosives Risk. A software program developed by the Risk Based Explosives Safety Criteria Team, a working group reporting to the US Department of Defense Explosives Safety Board (DDESB).

[4] This table was developed based upon use of the qualitative descriptors of commonly-accepted international standards and combined with the quantitative threshold figures of A-GA-005-000/AG-001, DND/CF Airworthiness Program, 14 Nov 2006

Consequence

The physical effects of an A&E accident are well established and can be detailed within the following categories: blast, fragmentation/debris, thermal effects, ground shock, and propagation. The consequences are all to do with the above physical effects' results on exposed personnel, supplies, equipment and infrastructure. The A&E technical experts preparing the risk assessment case will use a variety of tools in order to determine the probable results of the physical effects, primarily existing guidelines for safety distances which have been established based on trials, tests, and modeling. The experts' knowledge and experience within the A&E realm is a vital ingredient in this assessment.

The accepted critical measure of consequence has to do with fatalities. The generally accepted standard for discussing acceptable risk is that of individual risk – the chances that a person might be killed due to an undesirable event.[5] This individual risk is often expressed in terms of annual probability of death for the exposed person. An annual probability of death of one in a million is often taken as an acceptable level for members of the public (1×10^{-6} per year). A commonly used level for unacceptable annual probability of death is one in 10,000 (1×10^{-4} per year).[6]

Exposure

The critical aspect of consequence as outlined above is affected by the degree to which those persons are exposed to the risk. Also, it is deemed that risk to persons that are doing work related to A&E is different than those persons who are not related, or to the general public.

The consideration of the exposure of different groups of persons, sometimes termed "societal risk", is another aspect of consequence to persons. This estimation is done in terms of the average number of people exposed at the same site over a year. This can be calculated based upon the likelihood of those persons being present when an undesired event occurs. Consideration is given to whether persons are always present, sometimes present or just passing through.

For situations where quantitative probabilities can be established, the table below gives the figures that may be utilized for determination of risk to personnel.[7]

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[5] Some risk assessment probability-consequence calculations do consider injury to persons, but always in conjunction with fatalities as the primary consideration. Where there are injury considerations "minor" and "major" injuries are further defined in terms of whether there was admission to hospital.

[6] "Risk Assessment Guidelines for Municipalities and Industries – An Initial Screening Tool", Major Industrial Accidents Council of Canada, 1997 Edition.

[7] For purposes of this CF/DND risk management policy these figures were developed in the paper "Quantitative Risk Assessment". Lacking nationally-established regulatory figures for risk acceptance, study was done of NR Can groundwork as well as international standards published in AASTP-4.

CF/DND A&E Risk Acceptance Levels

Risk to:	Acceptance Criteria
Individual Risk – Worker	Limit maximum risk to 1 x 10^{-4}. Risks below 1 x 10^{-4} are acceptable.
Group Risk – Workers	Attempt to lower risk to 1 x 10^{-3}. If above apply ALARP principle.
Individual Risk – Public	Limit maximum risk to 1 x 10^{-6} Risks below 1 x 10^{-6} are acceptable.
Group Risk – Public	Attempt to lower risk if above 1 x 10^{-5} Risks below 1 x 10^{-5} are acceptable.

Hazard Severity

The determination of the likely consequences, both in terms of the assessment of blast damage and taking into consideration of peoples' exposure is by the A&E technical experts preparing the risk assessment case. The aim of this is to determine a category of hazard in accordance with the table below. The severity of a hazard is labelled in four categories shown:[8]

[8] B-GJ-005-502/FP-000 CF Joint Doctrine Manual "Risk Management for CF Operations" Change 1 November 2007 uses four classifications, as does Allied Range Safety Publication-1 Volume 1 "Weapon Danger Areas/Zones for Unguided Weapons in a Ground Role – Deterministic Methodology – Factors and Processes" June 2007. Other references cited throughout this paper utilize five classifications; DAER has opted to use four.

Hazard Severity Table

Description	Definition
Catastrophic	All Hazard Conditions which would prevent continued safe operations and could result in death of personnel and/or members of the public. The consequences are severe and in all but urgent operational requirements would be unacceptable.
Major	Hazard Conditions that would reasonably be expected to result in a large reduction in safety margins. Hazard Condition that could result in major injury. The consequences are critical and acceptance implies operational imperatives.
Minor	Hazard Conditions that could reasonably be expected to result in a moderate or marginal reduction in safety. Hazard Condition that could result in minor injury.
Negligible	No effect on safety. Negligible or insignificant effect on safety margins.

At this point the technical experts preparing the risk assessment case incorporate the determination of probability and hazard to the Risk Index Table below. This allows the experts to identify the risk and so determine the level of approval and acceptance that is required. The Risk Index Table provides a visual summary that facilitates presentation.[9]

The table also provides an indication as to what level in the chain of command the request for approval must be presented. (The coloured levels of the table indicate various levels of authorization for acceptance of risk, which will be amplified in Step 4 below.) Of course when a higher the level in the chain of command is indicated there will also be further review by that level's own technical authority of the risk case.

[9] Adapted from A-GA-005-000/AG-001, DND/CF Airworthiness Program, 14 Nov 2006

Risk Index Table

HAZARD SEVERITY / PROBABILITY		CATEGORY			
		Catastrophic	Major	Minor	Negligible
LEVEL	Likely	Extremely High	High	Medium	Low
	Probable	High	Medium	Moderate	Low
	Remote	Medium	Moderate	Low	Low
	Improbable	Moderate	Low	Low	Extremely Low
	Extremely Improbable	Low	Low	Extremely Low	Extremely Low

Step 3 - Risk Control

Once the technical expert(s) has/have prepared the risk assessment to the point where the activity has been assigned on the Risk Index Table, the information must be briefed to the appropriate operational approval authority for a decision. Typically, that authority will want to be assured that all mitigation possibilities have been considered and will want options; it is incumbent upon the technical authority to be fully prepared by having considered all possible details. It may be necessary to prepare full risk assessment cases for different options.

The spectrum of risk ranges from acceptable to unacceptable.[10] The former is that activity which falls within established norms and is the set of uncoloured/undhaded boxes in the Risk Index Table. The latter is an activity that simply is not acceptable and therefore requires definitive action to remove the risk. The region between the two – tolerable with conditions – is the area where various actions could alleviate the hazardous situation. This is often referred to as As Low As Reasonably Practicable (ALARP) and implies that the hazard can be mitigated by such actions as:

Ensuring that A&E holdings are kept to a minimum in order to support the operation.

Ensuring that a minimum number of persons are exposed to the hazard for the minimum amount of time.

Ensuring that the activity is essential.

Changing the type of construction for either the Potential Explosion Site or the Exposed Site.

It should also be noted that the consideration of lessening risk is one that can be approached from a systems aspect. This indicates the application of engineering and management principles, criteria and techniques to identify hazards and either eliminate them or reduce the associated risks to an acceptable level. A system is the composite of personnel, procedures, materials, tools, equipments, facilities, hardware and software that are used together in the operational or support environment to accomplish a specific mission or perform a specific task.[11]

Step 4 – Risk Acceptance and Approval

Having determined the level of risk and considered possible mitigation measures, the technical expert must present the risk assessment case to the appropriate command level of authority. It is imperative that the documentation and/or briefing is: clear and concise; that the assessment of the level of risk is consistently determined where there are different safety cases prepared for different options; and, that the decision is clearly communicated.

In determining the region of risk, the responsible authority's response can be in one of four forms:

Avoidance – cancellation of the activity, task or project.

[10] AASTP-4 Edition 1 and from UK MOD development of their risk assessment process in concert with their civil regulator, the Health and Safety Executive

[11] Presentation "Ordnance, Munitions and Explosive Safety Risk Management" by Mr Jim McLay, GBR Director Defence Ordnance Safety Group, to the NATO CNAD Ammunition Safety Group (AC/326) December 2007

Transfer – horizontally or escalated to the appropriate level. This can also be in the form of to a third party, for example, contracting.

Acceptance – determined that the efforts to mitigate are not worthwhile. In this case a contingency plan is developed in order to deal with an undesired event and can include planning to react at the time of the accident.

Mitigation – reduce the probability or consequence, but noted that the action has limited effect and the risk has not been eliminated.

Since there is liability involved with any risk acceptance decision, the responsible authority will normally seek legal review as part of the decision-making process.

The Approval and Acceptance Protocol table shows the level of approval as assigned by DND/CF orders and directives.

Approval & Acceptance Protocol

Current Risk Index	Technical Approval Authority	Operational Approval Authority
Extremely High	DAER	Chief of Defence Staff/Deputy Minister
High	DAER	Chief of Defence Staff/Deputy Minister or written delegation to L1[12]
Medium	L1 Specialist	L1
Moderate	L1 Specialist	L1 or written delegation to subordinate Commanders
Low	Acceptable level of risk; within established minimum safety standards	
Extremely low		

[12] L1 refers to CF Commanders of Environmental or Operational Commands, or to the Assistant Deputy Minister heading a DND Group.

Step 5 – Risk Tracking

As previously identified, the risk management process includes the requirement to prepare a written safety (AERASC). This written record enables the formalized approval process as well as the ability to track it after approval.

In order to complete the risk management process, the specific risk situation must be monitored for changes that may either lessen or increase the risk:

Each risk activity will be tracked and monitored by DAER.

The responsible L1 will provide a quarterly report on the activity, assessing: the continued nature of the risk; the continued acceptability of the risk; and the identification of the affected people.

DAER will include in its annual report to the Chief of Defence Staff and the Deputy Minister an assessment of the activity.

More generally, the monitoring of the risk management process itself – in order to ensure its effectiveness – is also a DAER responsibility. DAER will specifically report on:

Is the policy achieving the desired results?

What are the criteria that are being measured?

What are the standards that determine its effectiveness, including an assessment of the consistency of AERASC's?

How is the data being collected?

Is the policy being properly communicated to CF/DND?

Application

As indicated in the introduction of this paper, it is the intention to apply this risk management policy to the full life cycle of A&E items – any aspects where there are factors that preclude the use of accepted minimum safety standards. Presently there are a number of activities that are either using a risk assessment process or that easily lend themselves to adopting such a process:

Safety and Suitability for Service

Unexploded Explosives Ordnance and Legacy Sites

Storage-related activities

Range Safety

Transportation

Disposal or Demilitarization activities

A significant challenge for this policy is to apply it to deployed operations, for aspects of storage and use where operational requirements put significant pressure on normal "peacetime" standards, especially for storage, transportation and use of A&E.

Deployed Operations

A particular challenge for Canada's recent deployed operations in Afghanistan is that ammunition usage is high, the lines of communication for resupply are long, terrain allocation is limited, and the operations are multi-national in nature. The challenges to the safe use of A&E in this climate are significant. Currently, there is only limited scope for an A&E technical expert to assess risk, beyond citing regulations and standards that are being contravened and advising on the consequence should an accident occur. It is foreseen that the risk management process would be an effective tool in providing insight to Commanders so that they may make appropriate decisions to ensure that injury or death of personnel or damage or destruction to supplies, equipment and infrastructure is minimized.

The use of the risk management process for deployed operations has some unique aspects:

Hazard Identification. Use of ammunition in forward areas is a scenario that typically involves storage and transportation of ammunition outside of its normal service pack with increased handling. This exposes the ammunition to extremes of the environment which at best will shorten its service life and at worst will deteriorate it to the point where it could initiate an accident. As a related issue Urgent Operational Requirements from the deployed operation have put increased pressure on procurement staffs to at least shorten timelines, if not waive safety requirements in order to get the A&E to the field quickly.

Probability. The application of the qualitative-quantitative labels to ammunition activities during deployed operations is even more in the area of an art, as opposed to a science. The probability of an event is considerably exacerbated by the potential of deliberate threat by enemy action and – more routinely – such aspects as increased handling/trundling/loading, inexperience or fatigue of personnel, Material Handling Equipment that itself is overused. All of this increases the probability of an undesired explosive event.

Exposure. The basic fact that the deployed operation is a multi-national one, occurring in a foreign country exacerbates the aspect of different groups of people being at risk.

Consequence. Operational input to the safety case in terms of possible effects on operations due to injury or death or loss or damage of supplies (including ammunition), equipment and infrastructure is an important aspect in the risk assessment. A properly prepared risk assessment will identify the possibility of limitations to operations or in the extreme the possibility of mission failure.

Approval Authority. The current Canadian process is lacking in that it is based on routine, peacetime operations and requires a very high level of approval whenever the basic minimum acceptable safety standards are exceeded. It is difficult to apply

this process in a foreign country when many of the personnel at risk are not Canadian. The adoption of this risk management process would allow the appropriate level of approval to authorize acceptance of risk.

Multi-National Operations. Recent NATO-led operations have all of the challenges identified above, but made more complex by the difficulties of using NATO guidelines where one Nation is the designated lead with other Nations cooperating – all the while on a Host Nation's soil. The development of this Canadian risk management process is one that is aimed at being in concert with that being developed by NATO.

NATO Multi-National Operations

In addition to the QD distances included in AASTP-1 Manual of NATO Safety Principles for the Storage of Military Ammunition and Explosives, AASTP-5 NATO Guidelines for the Storage, Maintenance, and Transport of Ammunition on Deployed Operations was developed over the last several years as explosives safety guidelines for operations. It was always intended that this latter publication would include a risk management process, but that has not yet been developed.

There have been recent indications from NATO operations in Afghanistan that a risk management process for A&E is required. These have arisen from a combination of NATO inspections and studies along with reports from in-theatre, both nationally and through the NATO chain of command.

In response to the above indications AC/326 Sub-Group 6 took action to develop a draft chapter for AASTP-5. The developing Canadian process was examined, modified and the UK's Risk Assessment Safety Case[13] elements were incorporated in order to produce a draft chapter, which has been accepted and will be incorporated into AASTP-5 immediately. Notably, the UK portion involves specific guidelines for consequence analysis associated with damage or loss to mission critical resources.

Conclusion and the Way Ahead

The importance of the Canadian risk management process and why it is unique lies in the basis that it can be tailored to a wide variety of A&E activities where minimum accepted safety standards cannot be met. It will impart the process of a properly staffed risk assessment safety case to be approved by an appropriate authority and then be managed in its application.

The DND/CF A&E risk management process is still under development, lacking – significantly – the promulgation of the policy with its specific allocation of authorities for acceptance of risk. This will be achieved by the issuing of a Departmental order after necessary coordination with senior DND and CF appointments. It is anticipated that it will be promulgated within the next six months, all the while remaining in concert with NATO's developing processes.

[13] JSP 482 MOD Explosives Safety Regulations Chapter 11 Emergency Storage of Explosives During Periods of Tension/Crisis and War.

In its implementation the policy will lead to the application of the risk management to important aspects of the A&E life cycle. The process, for example, can be applied to several aspects that directly relate to deployed operations: where urgent operational procurements require shortening of safety and suitability for service procedures; where storage situations require compromise of Quantity Distance standards; and, where realistic training procedures in preparation for deployed operations require use of A&E in ways that would not routinely be acceptable.

The most important aspect of this policy is as it relates to deployed operations – where a commander will have this process as an important contribution to his operational command toolbox, whereby he can be presented with a measurement of risk and accept it, reject it or modify it based on operational need.

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Dated:
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National Defence / Défense nationale

RISK MANAGEMENT PROCESS FOR AMMUNITION AND EXPLOSIVES

Presentation to DDESB Seminar
14 July 2010

DAER

Canada

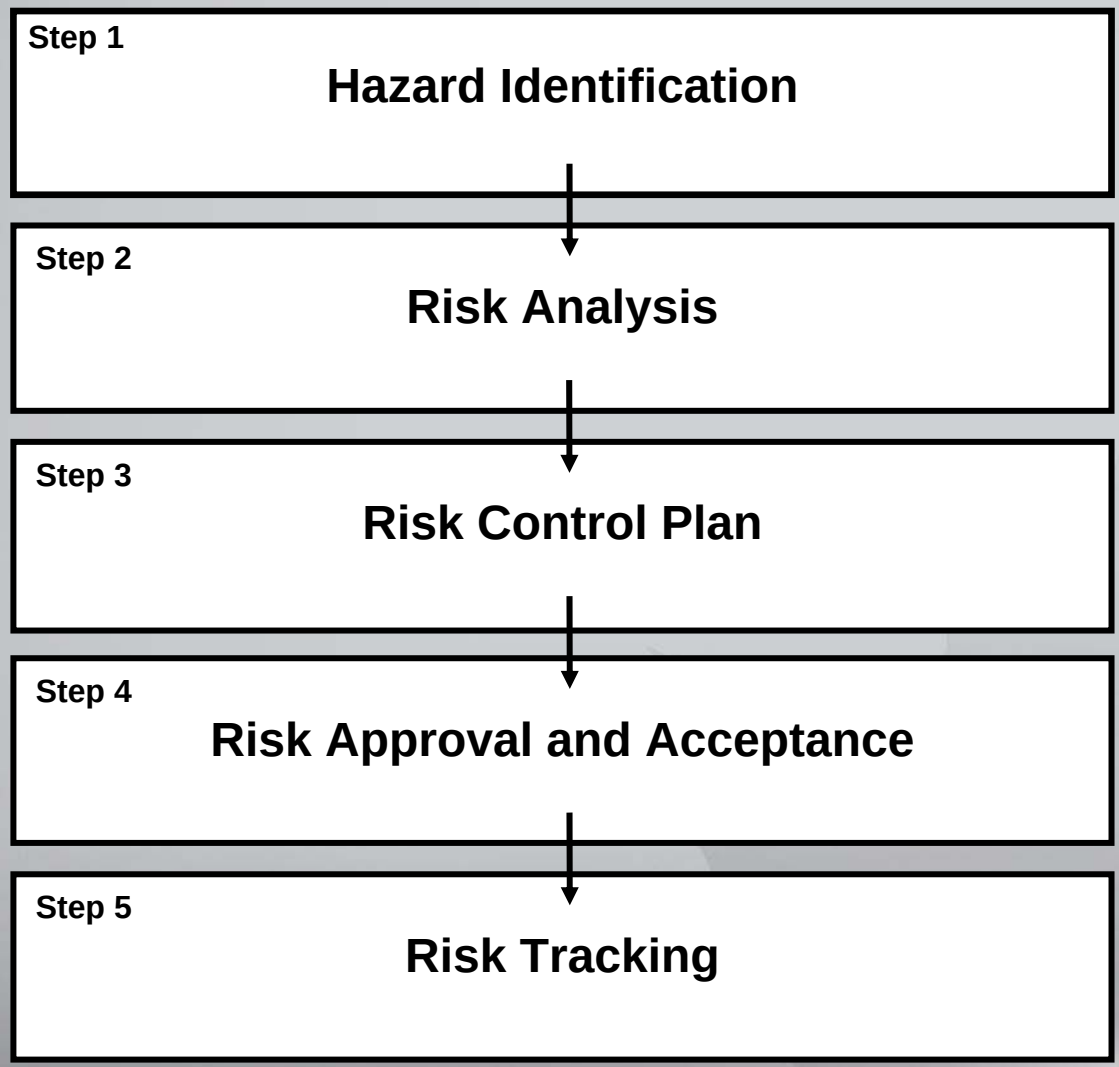
Background

- Potential for unplanned violent reaction
- Led to strict consequence safety rules
- Modern risk based approach could lead to situations that are just as safe and less costly in resources
- Use of ammo in ops is a new paradigm
- More knowledge and tools
- Ability to sponsor it with DAER

Principles

- Policy tailored to select A&E activities (acquisition, use, disposal)
- Based on minimum acceptable standards of safety
- Qualitative and quantitative analysis of deviations
- Approval and acceptance assigned to appropriate level in Chain of Command

Steps of Risk Management Process



Hazard Identification

PROBABILITY →
- HISTORICAL
- ANALYTICAL

PHYSICAL EFFECTS →
- BLAST
- FRAGMENTS/DEBRIS
- THERMAL EFFECTS
- GROUND SHOCK
- PROPOGATION

CONSEQUENCES →
- DAMAGE TO PERS / EQUIPMENT / INFRASTRUCTURE / SUPPLIES
- LOSS / UNAVALIBILITY OF AMMO STOCKS
- CLEAN-UP

EXPOSURE →
- LIKELIHOOD OF PERSONS PRESENT (ALWAYS, PART TIME, PASSING THROUGH)
- TYPE OF PERSON (RELATED, UNRELATED, PUBLIC)

Hazard Probability & Thresholds

Description	Qualitative Definition	All Exposed Personnel	Threshold
Likely -frequent -almost certain	Likely to occur many times	Over someone's lifetime can be expected to occur intermittently or occasionally	Greater than 1×10^{-3}
Probable -very possible	Expected to occur one or more times	Over someone's lifetime can be expected to occur randomly	Less than 1×10^{-3}
Remote -moderate -occasional	Unlikely, but possible to occur	Over someone's lifetime can be expected to occur	Less than 1×10^{-5}
Improbable -unlikely -seldom	Not expected to occur	Over someone's lifetime can be expected to occur rarely	Less than 1×10^{-7}
Extremely Improbable -rare -practically impossible	So unlikely, it may be assumed that it will never occur	Over someone's lifetime is not expected to occur	Less than 1×10^{-9}

1×10^{-6}

Hazard Severity

Description	Definition
Catastrophic	All hazard conditions which would prevent continued safe operations and could result in death of personnel and/or members of the public. The consequences are severe and in all but the most urgent of operational requirements would be unacceptable.
Major	Hazard conditions that would reasonably be expected to result in a large reduction in safety margins. Hazard Condition that could result in major injury and/or loss of critical materiel and infrastructure. The consequences are critical and acceptance implies operational imperatives.
Minor	Hazard conditions that could reasonably be expected to result in a moderate or marginal reduction in safety. Hazard Condition that could result in minor injury.
Negligible	No effect on safety. Negligible or insignificant effect on safety margins.

Risk Index Table

HAZARD SEVERITY / PROBABILITY	Catastrophic	Major	Minor	Negligible
Likely	Extremely High	High	Medium	Low
Probable	High	Medium	Moderate	Low
Remote	Medium	Moderate	Low	Low
Improbable	Moderate	Low	Low	Extremely Low
Extremely Improbable	Low	Low	Extremely Low	Extremely Low

ACCEPTABLE LEVEL OF RISK

Approval & Acceptance Protocol

Current Risk Index	Technical Approval Authority	Operational Approval Authority
Extremely High	DAER	CDS/DM
High	DAER	CDS/DM or written delegation to L1
Medium	L1 Specialist	L1
Moderate	L1 Specialist	L1 or written delegation to subordinate Commanders
Low	Acceptable level of risk; within established minimum safety standards	
Extremely low		

- Level of authority
  - -Kind of activity
  - -Level of risk
  - -Type persons involved
- Clear documentation
- Consistent
- Legal review
- Clear communications

Risk Tracking

- Monitor for change
  - Nature of the risk
  - Acceptability of the risk
  - Identification of affected parties
- Evaluate application of risk management process
  - Is the policy achieving desired results?
  - What criteria to measure?
  - Standards for effectiveness?
  - How will this data be collected?
- Requires compliance authority
- Communication plan an essential aspect

Deployed Operations

- Ammunition stocks
- Small camp footprint
- Ready-use nature
- Multi-national operations
- Enemy activity
- Operational pressures

NATO Developments

- AASTP-1 Storage
  - Static, semi-permanent facilities
- AASTP-5 Operations
  - FOBs & BLAHA
- Risk Chapter
  - Reports/inspections/studies
  - Risk chapter developed

Conclusion

- Can be applied to selected aspects of Life Cycle
- Documented process for risk assessment and acceptance
- Authorized at appropriate level
- Important tool in the Commander’s toolbox