Environment-friendly and safe technologies for destruction of ammunition stockpiles.

ENVIRONMENTAL RISKS

- Emissions of heavy metals (Pb, Sb, Hg, CrVI, Cd, DU, Ba)
- Emissions of toxic gases (HCl, SO₂, NOₓ, H₂S, VOC, HCN)
- Emissions of persistent highly toxic compounds (PAH, HCB, PCDD/F, asbestos)
- Toxicity of organic explosives (RDX, DNT, TNT) and their metabolites (ADNT, nitroso-RDX)
- Soil and groundwater contamination – long distance migration from exposed sites (RDX, ClO₄⁻)
SAFETY AND SECURITY RISKS

- Deteriorated safety features in the ammunition
- Drop in stability of propellants during ageing
- Increase in sensitivity due to incompatibility or ageing reactions in the munitions

Difficult to find a demil plant not experiencing accidental explosion in the past
ECONOMIC CONSIDERATIONS

• General Factors
  • In ammunition demilitarization, economic and capacity requirements should always be behind Safety and Environment
  • Accidents or environmental pollution will destroy any plant economy, capacity and public image
  • Demil plant economy should be considered from long-term perspective of lifecycle costs for overall demilitarization program. Optimum dimension and sharing the technologies for several ammunition types define the economical output.
  • Ammunition demilitarization is very risky business encountering unfavourable market conditions - small, very competitive, very unstable, very regulated and subsidized world market in demil, frequent phasing-out or bankruptcy of commercial companies (insurance problems)

ECONOMIC CONSIDERATIONS

• Investment costs
  • Using areas and facilities of former or still existing ammunition manufacturers for demil plants showed to be the most cost effective solution.
  • Investment costs of the equipment strongly depends on local environmental regulations (maximum permitted emissions to air or water) - e.g. The off-gas or waste water treatment units might than represent 10-90 % of the total investment cost of the technology.
  • As investments costs for some expensive demil technologies (esp. Incinerators) go to millions USD, careful planning of their capacities and technical requirements is necessary for their as widest application as possible.
ECONOMIC CONSIDERATIONS

• Operational Costs
  • From long-term perspective, operational costs (wages, energy, chemicals, wastes) often show to be the most important of the overall costs.
  • Recycling of explosive wastes to military or commercial products (when there is a market for them) improves operational costs.
  • Recycling of metals, plastics and packings from ammunition improves the economy as well.

‘CLASSIC’ DEMIL TECHNOLOGIES

• Sea dumping

• Open Burning
  • Burning on pallets
  • Rocket motor burning in pits
  • Neutralization open burning

• Open Detonation
  • Neutralization open detonation
  • Detonation in deep mines
Safe storage of ammunition

- Rotary furnaces
- Static furnaces for pyrotechnics
- Armored static kilns
- Shaft furnaces with moving beds
- Fluidized bed combustors
- Burning in confined rooms
- Plasma furnaces
- Induction furnaces
- Incineration of desensitized explosives in boilers or waste incinerators
- Confined burning of rocket motors
- Detonation chambers (mobile, static)
Mobile rotary kiln with off gas treatment unit
Mobile rotary kiln with off gas treatment unit
OFF-GAS TREATMENT UNITS

- Secondary combustors
- Heat exchangers
- Wet or dry scrubbers
- Cyclons + particle filters
- DENOX
- Dioxin filters
- Heavy metal traps

AMMUNITION DISASSEMBLY

- Manual or mechanical reverse-assembly operations
- Automatic high-speed reverse assembly
- Mechanical sawing, drilling, machining
- Mechanical pressing-out
- Abrasive water-jet cutting
- Cryofracture
Ammunition disassembly

SEPARATION OF ENERGETICS

- Melt-Out Technologies
- Indirect hot water heating
- Indirect heating with hot air (boxes)
- Indirect steam heating (autoclaving)
- Direct heating with hot medium water or steam paraffin or melted TNT
- Induction heating
- Microwave heating
- Wash-Out Technologies
- High pressure water-jet wash-out HE from shells and warheads, composite propellants from RM
- High pressure ammonia-jet wash-out, Double based rocket propellants, Composite rocket propellants
- Cryogenic LN2-jet wash-out
- Solid CO2, Blast-Out
- Ultrasound Removal
Autoclave melt out system

Detonation chamber with off gas treatment
THE MOST IMPORTANT THINGS ABOUT PLANNING A DEMIL PLANT

General Planning

• Plan to use former or existing ammunitions facilities first (plants or storage areas), analyze what are the plant limitations (safety distances, energy logistics, environmental concerns...)

• National or regional possibilities for application of recycled energetics.

• Analyze safety and environmental regulation relevant to demilitarization technologies.

Technology Analysis

• Make detailed analysis of types and quantities of ammunition considered excess in next 5 or more years.

• Make detailed design characterization of the ammunition, assign all possible demil technologies to each ammo type.

• Analyze enough published technical information to independently asses all relevant pros and cons of the possible technologies, their requirements for installation and operation costs.

• Be conservative trust only well characterized technologies with long enough safe history record.

• The most ‘advanced’ technologies are not always the best in demil - the simplest technologies often shows to be the safest
THE MOST IMPORTANT THINGS ABOUT PLANNING A DEMIL PLANT

Technology Selection

- Analyze the technological alternatives with required capacities, propose several complex technology lay-outs for the plant, make a preliminary cost analysis.
- Select the best available technologies fitting the capacity requirement, site limitations and legal requirements.
- Collect all the technical information on the selected technologies from open literature.
- Plan capacity of the equipment to cover the specific demil program in the reasonable time. Think also about future use of the equipment (serving foreign customers, establishing itself as a regional demil center, selling the technologies abroad).
- Prepare a tender documentation for the selected demil technologies, invite known manufacturers of the equipment, analyze the offers according to the above-mentioned criteria.

Safety Analysis

- Make detailed independent risk analysis of the selected technologies and their suitability from safety, environmental, capacity, and costs viewpoints (in this order)
- Always expect accidental explosion - consider safety distances, multiple safety features, automated operations, carry out risk analyses of the worst scenarios.
- Learn from relevant past experience, mishaps and accidents either national or foreign.
THE MOST IMPORTANT THINGS ABOUT PLANNING A DEMIL PLANT

Training and Operations

• Carefully select personnel for managing and operating the technology
• Train the personnel in general safety of handling with explosives and ammunition
• Repeatedly organize detailed specialized training in the specific demil operations
• Have the standard operation procedures for demilitarization prepared or reviewed by an engineer experienced in this field.
• Establish sensitivity and stability testing system for demilitarized energetics.

Thank you for watching our presentation