EC Project for the Destruction of PFM-1 stockpiles in Ukraine

Standing Committees Meetings
Stockpile Destruction

Geneva
12. February 2004

P. Krejsa
Expert for the European Commission

The following pages provide information and explanation which was presented as ppt file.

EC statement

Stockpile destruction is an important component of the European Community's strategy and action to improve human security. It is in fact crucial to ensure that landmines stockpiled after clearance or stored in deposits are not replanted or transferred to be used elsewhere, as well as it is the responsibility of affected countries and of the international community to protect populations from the threat of such stockpiles –especially if unwanted explosions could cause damage to the neighbouring communities and to the environment.

As the European Commission announced in 2003 in Geneva and in Bangkok, an EC-funded trial project was launched last summer in order to prepare for the destruction of the 6 million PFM-1 mines stockpiled in Ukraine. The first phase aimed at assessing the condition of the mines at the 13 storage sites. The results of the project show that the condition of mines is good and that no undesired explosions are to be expected from the mines themselves. However, their storage condition is considered to be sensitive, as the mines are stored with other ammunition in bad condition –which could result in mine explosions triggered by other explosives.

The European Commission has therefore decided to complement this preparatory project with a second phase, launched at the beginning of February. It will be focused on research into the best technologies available. On the basis of the findings and recommendations of this second project, which should last around six months, a tender will be prepared and launched for the destruction itself. This will be done in parallel with the ratification process of Ukraine to the Ottawa Convention, and in close collaboration with our Ukrainian partners. In this context, the EC reconfirms its commitment to support the total elimination of stockpiles in Ukraine.

The problem
European Commission has been asked by Ukraine to provide help for the destruction of about 6 Mio PFM-1 mines stockpiled on 13 sites. (Slides 2, 3)

1. Destruction is necessary to comply with the Ottawa convention
2. Shelf life of all mines has expired and it is feared that undesired explosion will release toxic substances leading to an environmental disaster

Technical Approach
In February 2001 an international PFM-1 conference was held in Budapest. Technical and scientific information exchange took place, possible environmental effects and destruction methods were discussed, and further investigations proposed.

Essential technical information demanded by EC was not supplied between 2001 and 2002. Therefore in September 2002 EC started a project to fill the gaps and to achieve the information necessary for the decision finding process.

The main question concerned the condition of the mines. In case that their chemical and physical condition was as bad as sometimes expressed, the concept of building a highly sophisticated destruction facility reducing the environmental impacts to a minimum by extensive off gas treatment had to be discussed anew. It would have been difficult to explain that such a facility was to be built at high costs under severe safety and environmental rules, while adjacent stockpiles could explode every moment und release toxic substances into the environment. (Slide 5 shows effects of an explosion of an APM stockpile)

STCU - partner for cooperation
To perform the project, STCU - Science and Technology Institute of Ukraine - was chosen as cooperation partner.
STCU is an intergovernmental organisation established in 1993 by Canada, European Union, Ukraine and the United States of America.
It develops, approves, finances and monitors science and technology projects. The program offers weapon scientists from CIS states that are parties to the STCU agreement the opportunity to redirect their talents to peaceful activities. STCU has therefore specialists for different purposes at hand. They cover knowledge over a wide range as material science, biology, medicine, chemistry, physics and information technology.
Many companies in Canada, the USA and the EU use this chance for cooperation with distinguished experts.
For this project STCU organised institutes, scientists and technicians with the needed qualification and special knowledge. Involving Ukrainian scientists ensures also that Ukraine will not be obliged to accept a certain destruction method. Scientists and technicians from Ukraine are responsible for the tests performed the interpretation of the results and are involved in the decision finding process.

First phase project
The aims of the project were specified

to establish the
- Condition of the mines

and to perform a
- Risk assessment

Slide 7 shows an assembly of mine ammunition. Depending on the launching system different systems with different numbers of cassettes and mines must be treated. The first step is to separate the mines - the disassembling process. Disassembling of war heads (slide 9) has been found to be most difficult.
A usual technique –cryofracture – has been reported leading with the PFM-1 mines to undesired explosions due to the thermic material behaviour.

Another question for which no satisfactory answer had been obtained concerned the chemical condition of the mines. An opinion had been expressed that an autocatalytic process of the liquid explosives may lead to the explosion of the mines, the risk augmenting with shelf life expired.

Slide 11 shows the results of chemical analysis of liquid explosives from different years of production of the mines. The composition from 1978 (oldest) to 1989 does not differ; no anomalies have been found.

For the 13 sites an inventory of the mine ammunition types and years of production has been made. (An example for one site shows slide 12)

Reaction products
The composition of the reaction products has been discussed from the very beginning. A main argument for the necessity to destroy the mines has been the possible environmental impact due to the release of toxic reaction products.

The knowledge of the composition of reaction products is also important for the engineered destruction of the mines. Planning off gas treatment systems depends on the knowledge of chemical compounds. Process planning decides about the quality of secondary wastes, e.g. dust of precipitators, waste water treatment and the resulting residues. These secondary wastes have also to be disposed off. Their quality (substances, leachability and toxicity) decides about costs of disposal.

Several groups had worked on the question of the chemical composition of reaction products. Information was also obtained from some field measurements. Theoretical results differ with the models applied. General approaches are thermodynamic calculations and kinetic reaction simulations. The first method considers a “frozen” situation of physical parameters with no more essential reactions taking place. The kinetic approach designs the development of reactions in the explosion, cooling and expansion of the gases. This method demands for high computer velocities and capacities.

Slide 13 shows the result of a kinetic approach developed by B. Trusov of the Bauman Moscow State Technical University. This method overcomes in a very elegant way by a special theoretical approach the need of sophisticated high velocity computer facilities.
A general problem of all theoretical simulations compared with real measurements consists in the fact that the real reaction conditions differ widely and they decide the essential parts of the reaction and therefore composition of reaction products. This problem exists also for experimental tests – results depend on test conditions. Conditions of real stockpile explosions can be very different from these assumptions. Data obtained therefore allow only understanding the range of concentrations of substances to be expected.
In the project real measurements were performed. The results are shown in slide 14. The experiments showed less toxic components as were expected based on theoretical models. Phosgene, a chemical weapon agent was found only in traces, no HCN was found. Examples of toxic substances are Cl2, HCl, CO; a chemically not identified group of toxic substances was also found.

Based on tests and measurements a risk analysis was performed following standard procedures of Ukraine. From the scientific point of view there can be a discussion of the results and it could be argued that results seem to overestimate the impact of explosions. But the method is a standard procedure and decisions of authorities have to be based on it. (Slides 15 and 16).

Conclusions of the 1st phase research project
The condition of the mines ranges from good to excellent. The probability of undesired explosions of the PFM-1 mines is the same as for mines within their shelf life period.

Likelier than an undesired explosion of PFM-1 mines is an explosion triggered by the explosion of other ammunition, stored at the same site.
Nearby to sites population density is high, this has to be taken into account deciding on priorities for destruction.
Even the condition of the mines is good; transports should be avoided because of time, costs and additional costs for a buffer storage facility at the site of destruction. This leads to a preference of mobile facilities or to establish facilities on the storage sites.

Based on these results and conclusions the second phase was planned

2nd phase project
The aim of this project is to find the best option for the destruction of the mines. Following the experience of the 1st project the second is also performed with STCU as contract partner.
Destruction methods chosen, not necessarily must be standard methods of demilitarisation companies. Although former weapon specialists of Ukraine are performing the project, the destruction of stockpiled PFM-1 mines is not considered as a mainly military issue. It is a typical technical problem like treating special types of hazardous materials or waste. Destruction therefore will be considered on the

basis of EU environmental technologies which have been for a long time a topic of EU policies and framework programmes. Methods developed are today state of the art for industrial applications. A general strategy consists to avoid all kind of back-end solutions. Only in case those solutions are much more costly and not available – for a limited time frame back end solutions can be applied.
Slide 19 shows what has to be considered for searching practical technical solutions.

General considerations for destruction options/EU environmental policy
A simple disposal option for the mines is not possible because
1. Disposal is not a destruction method (Ottawa convention)
2. Shallow ground burial would also not be possible due to the environmental hazards of the mines.

A geologic disposal could be considered under certain circumstances ensuring that accessibility cannot be forced – but there is the risk of explosions, which could lead to fracturing the geological barrier and ground water contamination.

Contamination of air – water and soil must be avoided. (The European Water Directive; furthermore there exists a very strong emphasis of many EU countries for a European Soil Directive.)
This means that OP/OB (Open Pit destruction of the mines or Open Burning) cannot take place. The release of contaminants into the atmosphere generates soil contamination, and ground water would be most likely affected after a certain time. Decontamination of the site, site rehabilitation is much more costly then the use of a technology of confinement.
Often OP/OB are methods used because they allow a quick solution. Follow up costs will appear much later and have to be financed by someone else. (Slide 20)

During the first phase of the project a preliminary assessment of destruction options has been made (slide 23). It shows traditional technologies not high ranking. Main reasons are the difficulties of a discontinuous treatment of off gases (peaks of reaction products by explosions), a wide variety of contaminants (The simulation model of Prof. Trusov considers some 120 substances), and the need of secondary waste treatment.

Slide 22 indicates the material flow of an explosion chamber. This standard destruction method practically can be adapted to all environmental standards. The method consists in transferring open pit destruction in a confined environment. To ensure detonation, additional charges of explosives must be applied, increasing the demand of off gas treatment capacity. Reaction of the explosive is incomplete so the waste will be contaminated demanding further treatment before it can be disposed off. (Shallow ground burial, waste dumping site).
Slide 21 shows a general flow sheet for the destruction by thermal treatment.

Reducing emissions by off gas treatment can be done to comply with the demands of regulations. Costs of off-gas cleaning depend on the requirements of regulations. The lower the concentrations in releases to the environment are set, the more expensive the treatment of releases. Usually beyond a certain limit of release concentrations, costs of treatment rise exponentially for one specific technology showing its limits and the need for new technologies.

In case of further reduction of release rates, old technologies are no more competitive and must be substituted by new ones.

The project aims also to look into this issue. It is not planned to develop technologies never used before (a question of costs and time) but to test technologies which are for other issues standard technology.

It is possible that at the end the decision will be made to use a traditional ammunition destruction technique. To ensure that the destruction method will be chosen in a transparent way, and to show that there is good reason to use one method or to select one bid, this project also develops guidelines for the technical evaluation. These guidelines will be based on EU environmental policy objectives (slide 25).

Time schedule starting destruction

Slide 26 shows the planned time schedule for the steps leading to the destruction of the mines.
Phase 2nd project will end by July, tender procedure could be finished by September, evaluation of bids by November. If there are no administrative delays starting of destruction should be possible by springtime 2005.