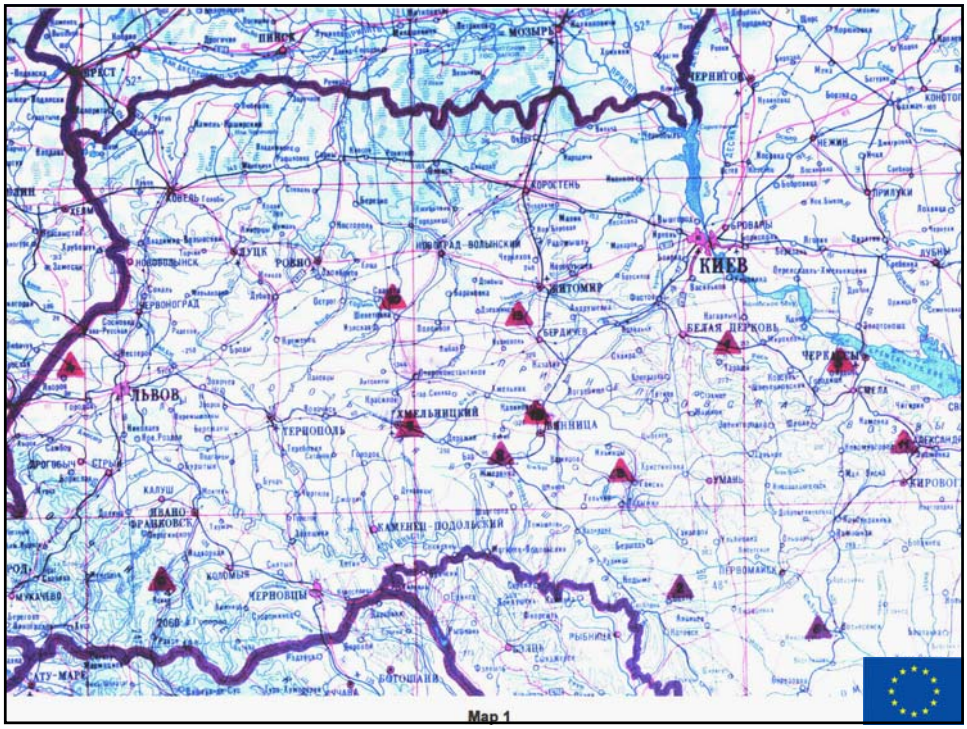
EC Project For The Destruction Of PFM-1 Stockpiles In Ukraine

European Commission

Geneva 0204
P. Krejsa

Stockpiled APM

13 sites approx. 6 Mio. mines



Map 1

Open questions 2001-2002

define a research project

based on strong cooperation with Ukrainian institutes

Aims:

- **Condition of the mines**
- **Risk assessment**

Condition of the mines
Risk assessment

Effect of an explosion of APM stockpile

STCU – Science and Technology Center Ukraine

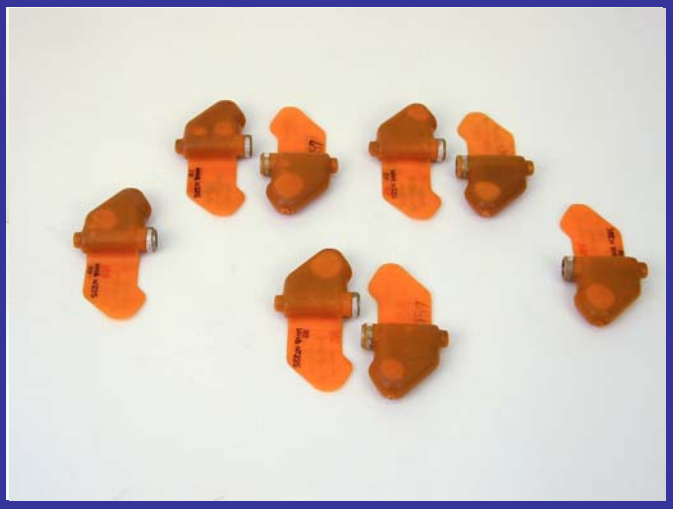
Intergovernmental organisation
Established in 1993
Canada, European Union, Ukraine, United States of America..

Develops, approves, finances, and monitors science and technology projects for peaceful purposes.

The program offers **weapons scientists from CIS states** that are Parties to the STCU Agreement the opportunity to redirect their talents to **peaceful activities**.

To fill the gaps of knowledge concerning the PFM-1and find the most reasonable way of destruction

Assembly of mine ammunition



PFM-1 Canister

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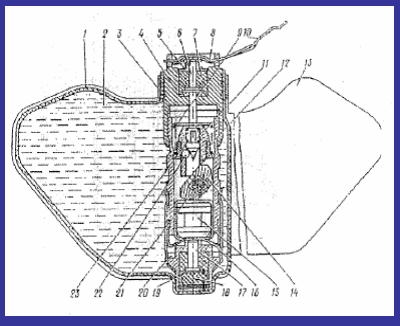
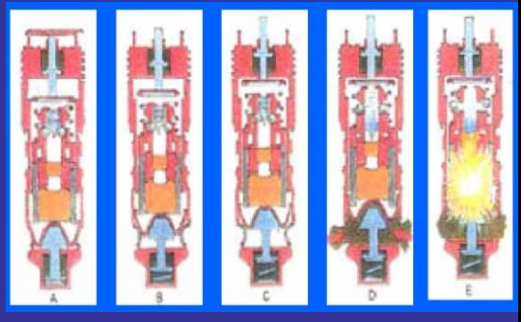
PFM-1 (-1s) AMMUNITIONS DISASSEMBLING OPERATIONS LIST

9M27K3 WAR HEAD

Ser	Operation	Level of hazard
1.	Unsealed and package locks unlocking	Safe
2.	Removal of package box cap	Safe
3.	Removal of coupling elements	Safe
4.	Extraction of ammunition out of package box	Unsafe
5.	Ammunition condition check	Unsafe
6.	Unscrewed of nose plug	Very dangerous
7.	Unscrewed of bottom plug	Very dangerous
8.	Unscrewed of explosive bolts	Very dangerous
9.	Removal of nose cone	Very dangerous
10.	Unscrewed of tighten nut	Very dangerous
11.	Unscrewed of bottom	Very dangerous
12.	Extraction of ejecting charge	Very dangerous
13.	Extraction of frame with clips out of ammunition body	Very dangerous
14.	Separation of clips from frame	Very dangerous
15.	Installation of clips at elevator	Unsafe
16.	Remove of clips from elevator and install to shoot device	Very dangerous
17.	Extraction of clips debris after shooting	Safe

Anti-Personnel Mine PFM-1 / ПФМ-1





Mass, g	80
Explosive charge mass, g	40
Length, mm	120
Width, mm	65
Thickness, mm	20

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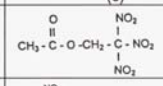
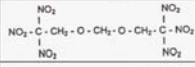
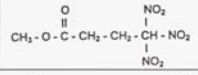
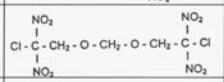
VS-6D CHEMICAL COMPOSITION

VS-6D CHEMICAL COMPOSITION (four components autectic alloy)

SER	COMPOUND	MOLECULARE STRUCTURE	NAME	%of composition per year of manufacturing				
(a)	(b)	(c)	(d)	1978	1981	1983	1987	1989
1	Substance ATS according to OST V84-1499-77		trinitroethyl ether acetic acid	21	22	21	21	21
2	Substance K		bistrinitroethyldimethoxymethane	7	7	8	7	8
3	MTEK		methyl ether trinitrobutyric acid	21	21	21	22	21
4	Substance KhK		bischlordinitroethyldimethoxymethane	50	50	50	50	50
5	Retarder DOS according to GOST 8728-88	$C_{26}H_{50}O_4$	dioctylsebacinate	2,2	2,2	2,1	2,2	2,1

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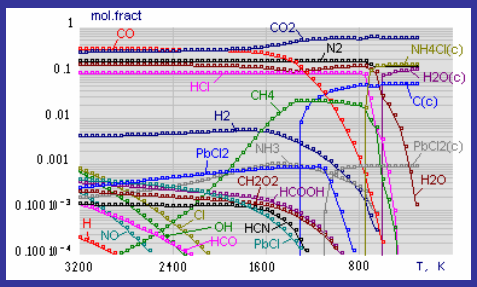
Types of ammunition, year of production, amount of mines

PFM-1
PFM-1s
Engineering Force KSF-1 (-1s)

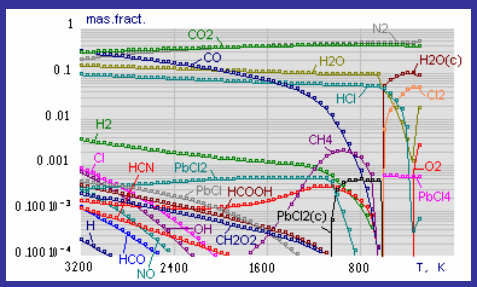
Year of prod	1983	1984	1985	1986	1987	1988	1989	Total ammo at site	Total mines at site
Name of site									
Olshanitsa	128	1392	220		640			2380	171360
Ольшаніца					2740		3500	6240	399360
Balta		1392	1000	588	812			3792	273024
Балта								0	0
Gaysin	1888			1460	6600			9948	716256
Гайсин					600			600	38400
Yavoriv								0	0
Яворів						500		500	32000
Total at year	2016	2784	1220	2048	8052	0	0	16120	1160640
	0	0	0	0	3340	500	3500	7340	469760
									1630400

Prof. B.Trusov, Bauman Moscow State Technical University

Products of thermal decomposition



Products of thermal decomposition of explosive (mine PFM-1) during cooling at proportional reduction of pressure from 1000 MPa up to 0.1 MPa



Products of thermal decomposition of explosive (mine PFM-1) during cooling at proportional reduction of pressure from 1000 MPa up to 0.1 Mpa and at proportional adding of air from 0 up to 100 %

Calculations have been made with code <Terra>. Calculations for 15 substances in solid phase and 148 in gas phase

POLLUTANTS COMPOSITION AFTER OPEN BURNING OR OPEN DETONATION

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CHEMICAL FORMULA	MOLE/KG
O_2	0,5
H_2	0,5
H_2O	6
Cl_2	$2,6*10^{-4}$
HCl	1,6
CO	3,9
N_2	3,3
$COCl_2$	$3,8*10^{-6}$
CO_2	5,67
NO	0,98
CH_2O	1,36
HNO_2	$3,1*10^{-6}$
NH_2	$3,2*10^{-6}$
Cl	1,0
OH	0,08
CH_3-NH-CH_3	$1,25*10^{-5}$
C_6H_5-NH_2	$5,5*10^{-6}$
Unidentified toxic substance (LCt_{50}=0,1 mg/l*min)	12,72
TOTAL	37,61
TOTAL GAS RELEASE	842,46 l/kg

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POTENTIAL OF DAMAGE CAUSED BY UNDESIRED EXPLOSION of PFM-1 AMMUNITIONS MILITARY SITES

Olshanitsa - Kiev reg.

	pollution zone characteristics		
air stability level	Range, km	Square, sq. km	Population inside of zone
Inversion	5,5	2,45	1000
Isotherm	2,2	0,455	200
Convection	1,3	0,312	125

	IMPACT MEN		
air stability level	Fatal	Hard injury	Light injury
Inversion	350	400	250
Isotherm	70	80	50
Convection	44	50	31

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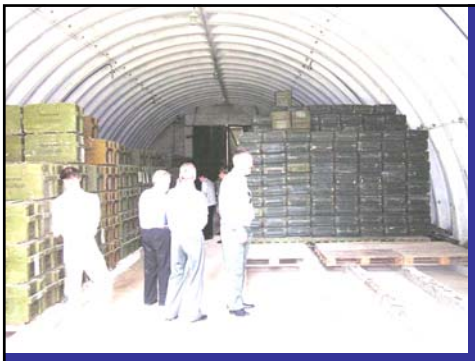
Impact of explosion

Ser	Name of site	Radius of explosion impact, m	
		shock wave	fragmentation
1	Olshanitsa - Kiev reg.	396	680
2	Balta - Odessa reg.	310	470
3	Gaysin - Vinnitsa reg.	434	780
4	Yavoriv - Lviv reg.	152	160
5	Dubievka - Cherkassy reg.	269	380
6	Voznesensk – Mikolayev reg.	190	225
7	Grechany - Khmelnitsky	393	670
8	Ludovka - Vinnitsa reg.	329	515
9	Dilyatin - Ivano-Frankovsk reg.	171	195
10	Tsvitokha - Slavuta Khmelnitsky reg.	586	1225
11	Znamyanka - Kirovograd reg.	392	667
12	Kalinivka - Vinnitsa reg.	422	750
13	Chudniv - Gitomir reg.	173	195



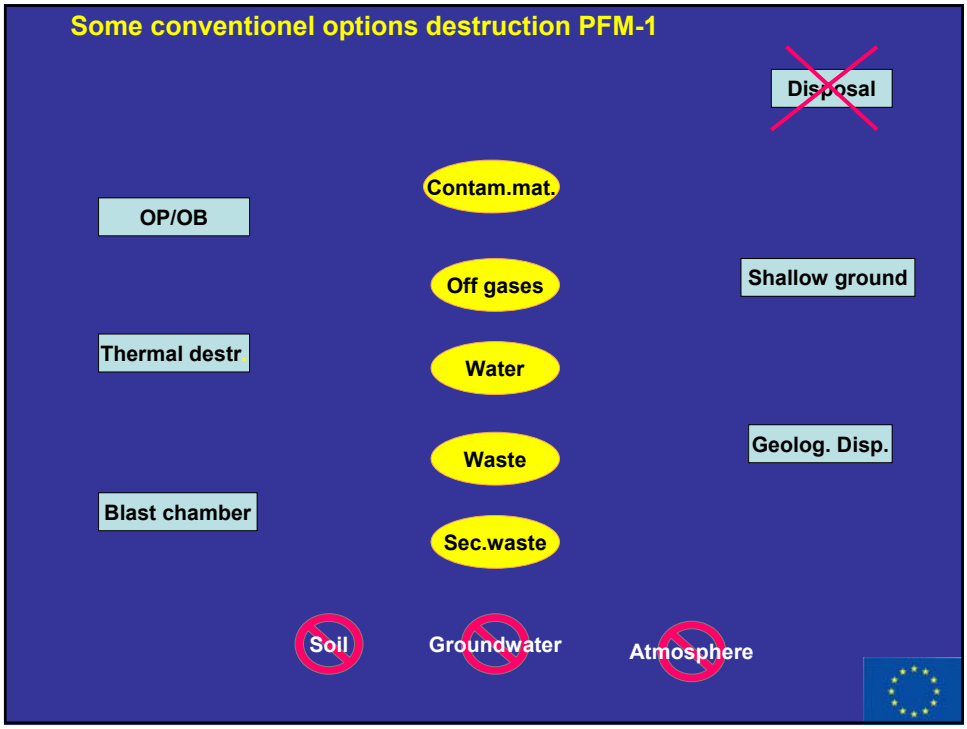
STCU 1st project report

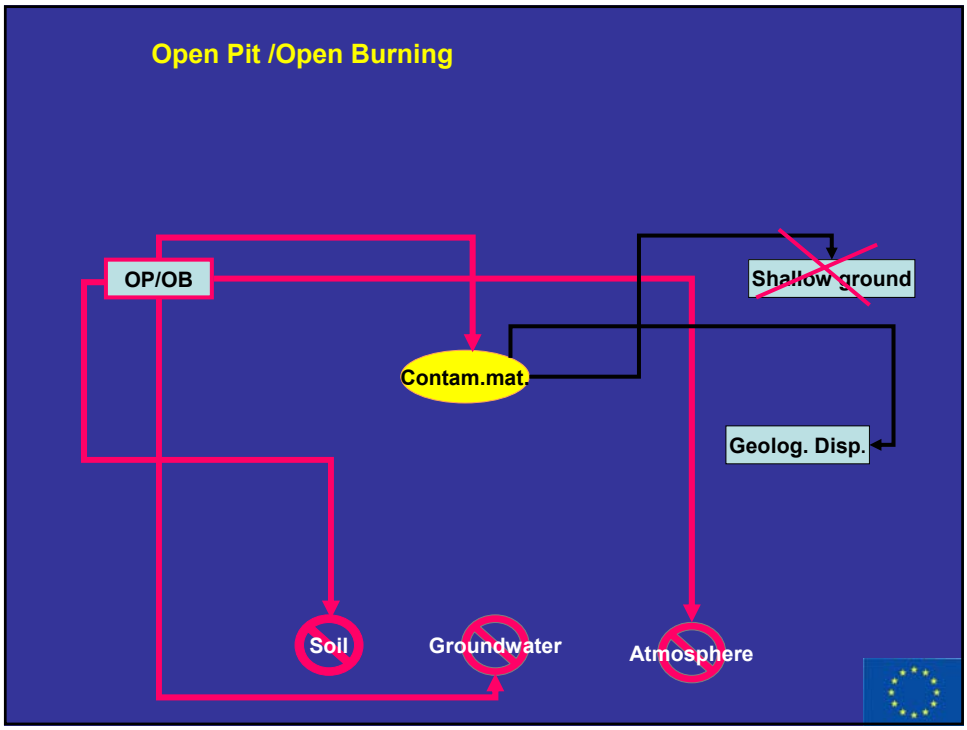
Condition of mines : good
Risk assessment: triggered from outside/population density/ CIP

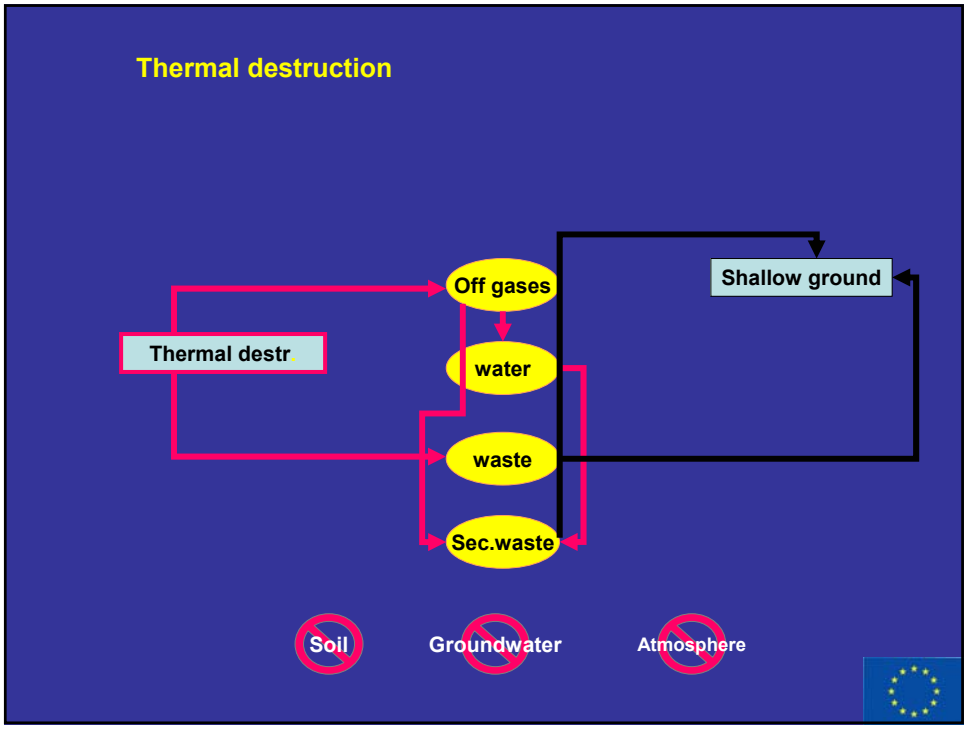
DG Research / STCU 2nd Project

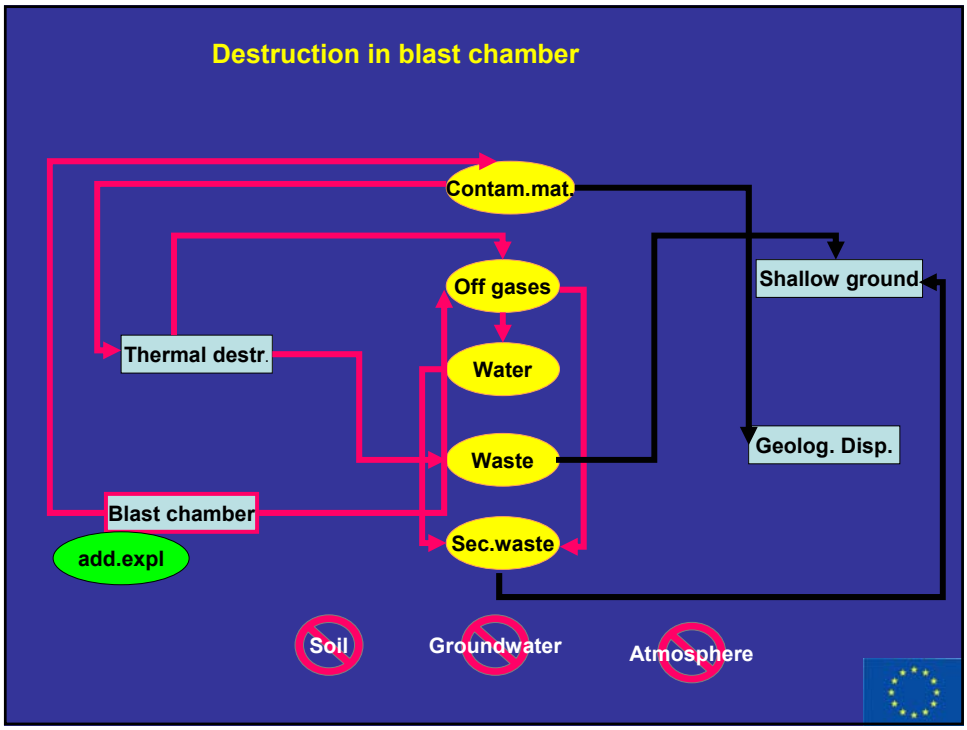
Duration 6 months
Beginning February

- Method of destruction
- Evaluation guidelines


Some conventionel options destruction PFM-1
Disposal
Contam.mat.
OP/OB
Off gases
Shallow ground
Thermal destr.
Water
Waste
Geolog. Disp.
Blast chamber
Sec.waste
Soil
Groundwater
Atmosphere


Open Pit /Open Burning
OP/OB
Shallow ground
Contam.mat.
Geolog. Disp.
Soil
Groundwater
Atmosphere


Thermal destruction
Off gases
Shallow ground
Thermal destr.
water
waste
Sec.waste
Soil
Groundwater
Atmosphere


Destruction in blast chamber
Contam.mat.
Off gases
Shallow ground
Thermal destr.
Water
Waste
Geolog. Disp.
Blast chamber
add.expl
Sec.waste
Soil
Groundwater
Atmosphere

Assessment of destruction methods

	max value	expl.cham.	therm.dest	MSO	Ox.Liqu.	cementation	supercr.fluid
experience with PFM1	100	0	0	0	0	100	0
on site	100	0	100	100	100	100	100
easy handling	100	100	0	0	50	80	50
no transport	100	0	100	100	100	100	100
no disassembling	100	100	0	0	50	100	50
no addit. charges	100	0	100	100	100	100	100
no after burner	100	0	0	100	100	100	100
no cyclon	100	0	0	100	100	100	100
no scrubber	100	0	0	100	100	100	70
no second. Waste	100	0	0	0	0	100	100
no waste treatment	100	0	100	100	50	100	100
max. recycling	100	50	50	50	50	100	50
no technical risk	100	70	100	40	40	100	40
env. acceptab.	100	100	100	100	100	100	100
	1400	420	650	890	940	1380	1060
			in case of mobile ex.ch. +200				

Methods to be tested

MSO – Molten Salt Oxidation

Supercritical fluids

Oxidation in the liquid phase

Cementation

Problem of dismantling

Evaluation criteria

- Availability of method
- Experience with method
- Safety of processes involved
- Environmental impact
- Waste quality and treatment
- Energy and material consumption
- Cost / benefit

Next steps

Finalising 2nd project Decision about method	July 2004
Tender procedure	September 2004
Evaluation of bids	November 2004
Contracts	January 2005
Starting destruction	Spring 2005