Ukraine Strategic Arms Elimination Program

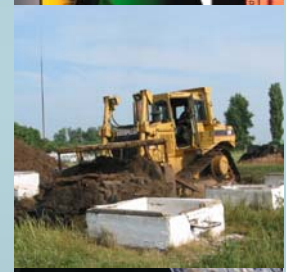
Liquid Missile Propellant and Storage Facilities Elimination Project

COOPERATIVE THREAT REDUCTION
АМЕРИКА - УКРАЇНА

Risk Management at Former Military Sites

Environmental Aspects of the Liubashevka Rocket Fuel Storage Site Elimination






PETRO NAKHABA

All-Ukrainian Public Organization
"Chysta Khvylya"

Deputy Head

Kyiv, Ukraine

NATO/CCMS Pilot Study Meeting on Prevention and Remediation in Selected Industrial Sectors

Ottawa, Ontario, Canada

12-16 June 2005

PROJECT DESCRIPTION

Provide

the equipment and services

required to demilitarize

8

Liquid missile fuel storage facilities by neutralizing and dismantling the infrastructure required to support the Strategic Nuclear Forces of Ukraine

PROJECT DESCRIPTION

Phase I, initiated in January 2001

- Repair railway spurs into four sites. Repair and certify 15 tank cars.
- Conduct physical and environmental surveys and assessments of each site. Develop an initial project plan for Phase II
- Certification & repair of Ukrainian mobile incinerators

Completed in October 2002

PROJECT DESCRIPTION

Phase II, initiated in October 2002

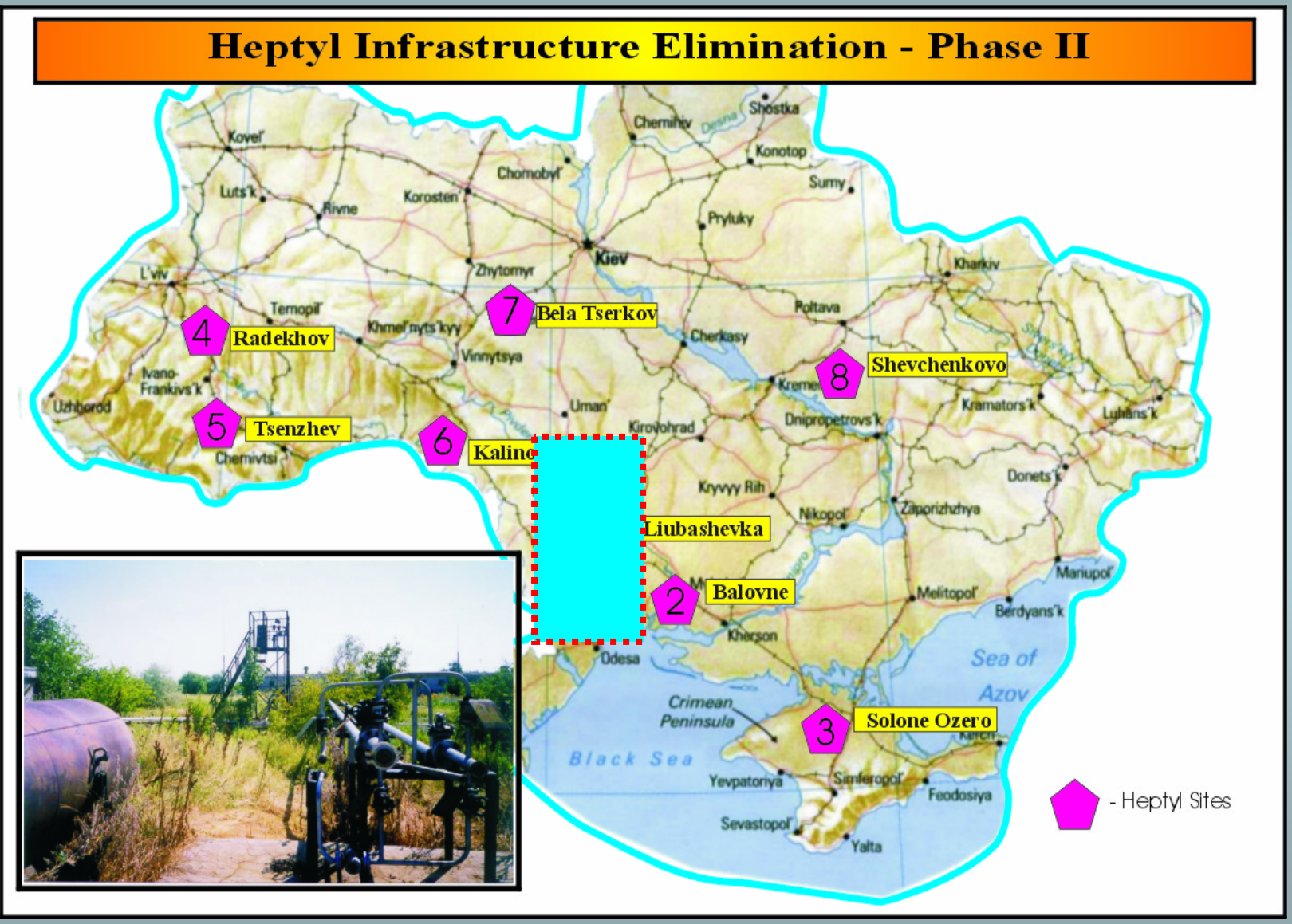
- Neutralization, decontamination, disassembly, removal, and elimination of the fuel storage tanks, fuel handling equipment and support facilities.
- Technical restoration and post work environmental analysis at the eight sites

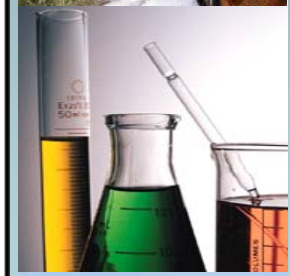
Completed at two sites:
Liubashevka
and Balovne in 2004

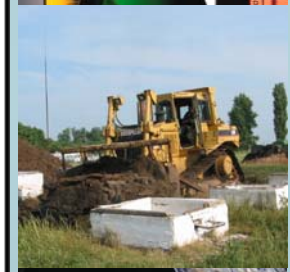
MAIN OBJECTIVES OF ENVIRONMENTAL MONITORING

- To ensure worker health and safety
- To prevent accidental hazardous spills due to neutralization and dismantlement activities
- To verify that the site has not been additionally contaminated during the course of demilitarization activities

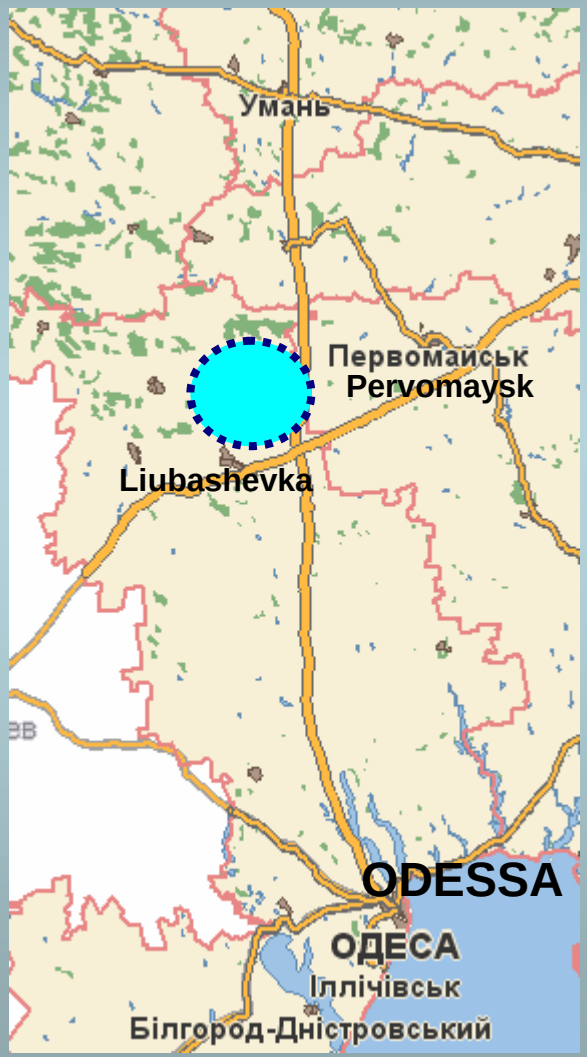
HEPTYL SITES IN UKRAINE





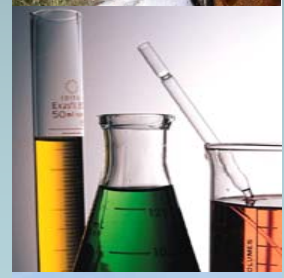


LIUBASHEVKA - BRIEF SITE DESCRIPTION



- The Liubashevka RFSS is located in Odessa Region approximately 50 km Southwest of Pervomaysk
- The territory of the storage area is covered with grass and some fruit trees
- The nearest population centers are the facility residential area located East of the facility 1.5 km away and the town of Liubashevka itself, which is located south of the facility 2.2 km away
- There is a drinking water well at the facility residential area that is 120 m in depth

LIUBASHEVKA - BRIEF SITE DESCRIPTION

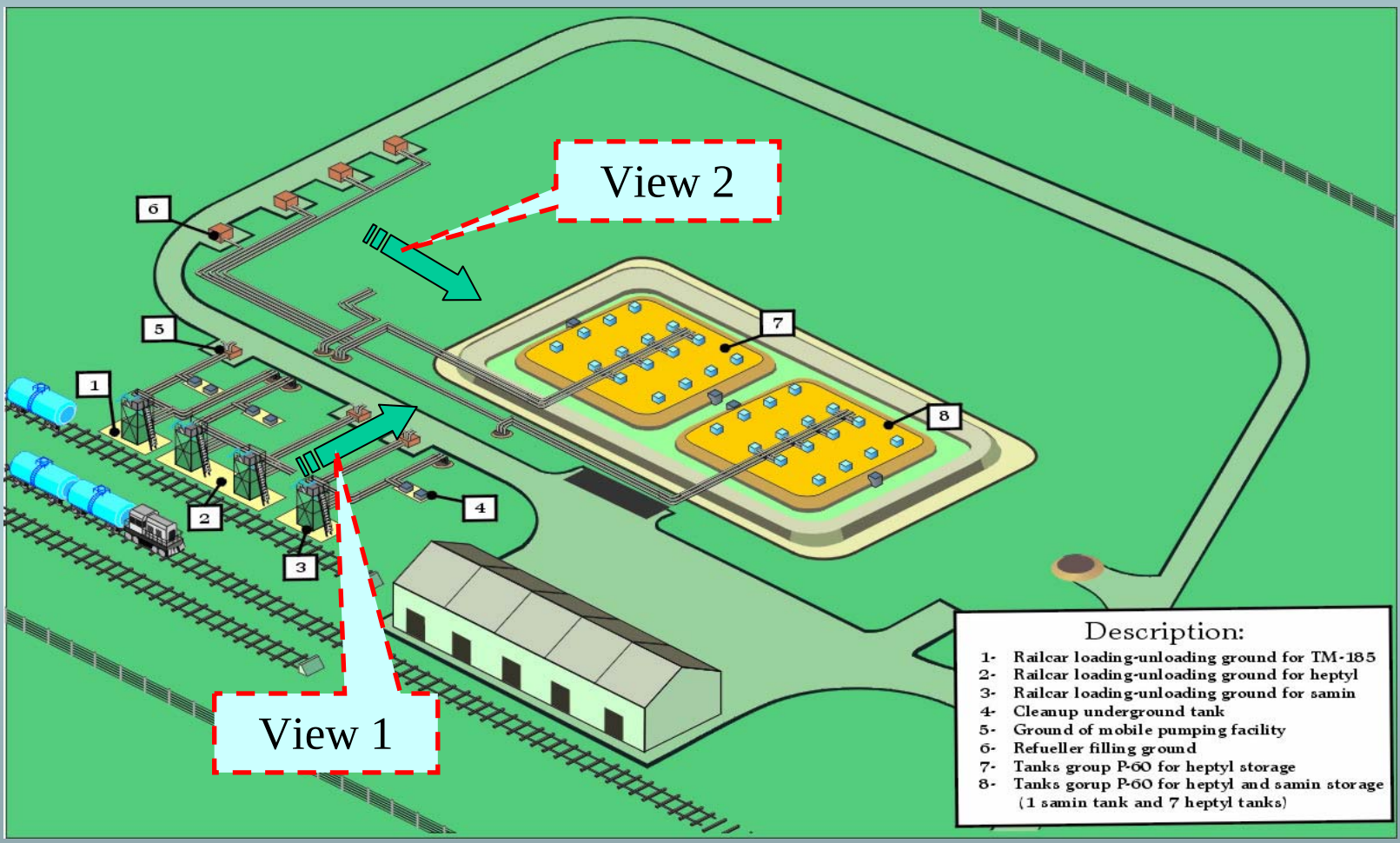


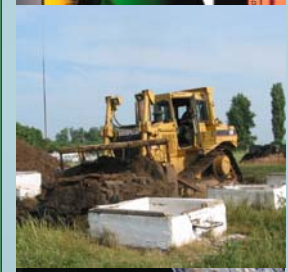
Liubashevka RFSS served for receiving, storage, and supply of propellants (Heptyl and Samin) required for fueling ICBM and cruise missiles. Site infrastructure consisted of the following:

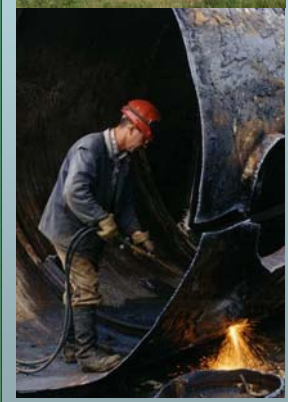
- One group of 8 underground R-60 Heptyl storage tanks
- One group of 8 underground R-60 Samin tanks

  Note: in March 2003, the MOD informed that 7 of them were used to store Heptyl
- Three underground cleaning tanks R-25
- Dispensing and loading pipelines (approximately 2000 m) connecting tanks with other facilities
- Four loading and unloading facilities for railcars, with sets of dispensing pumps, sumps, vessels, and pipelines
- Four loading facilities, with pipes and valves to dispense Heptyl and Samin into the special fuel trucks
- Three connection installations

LIUBASHEVKA
INITIAL STATUS







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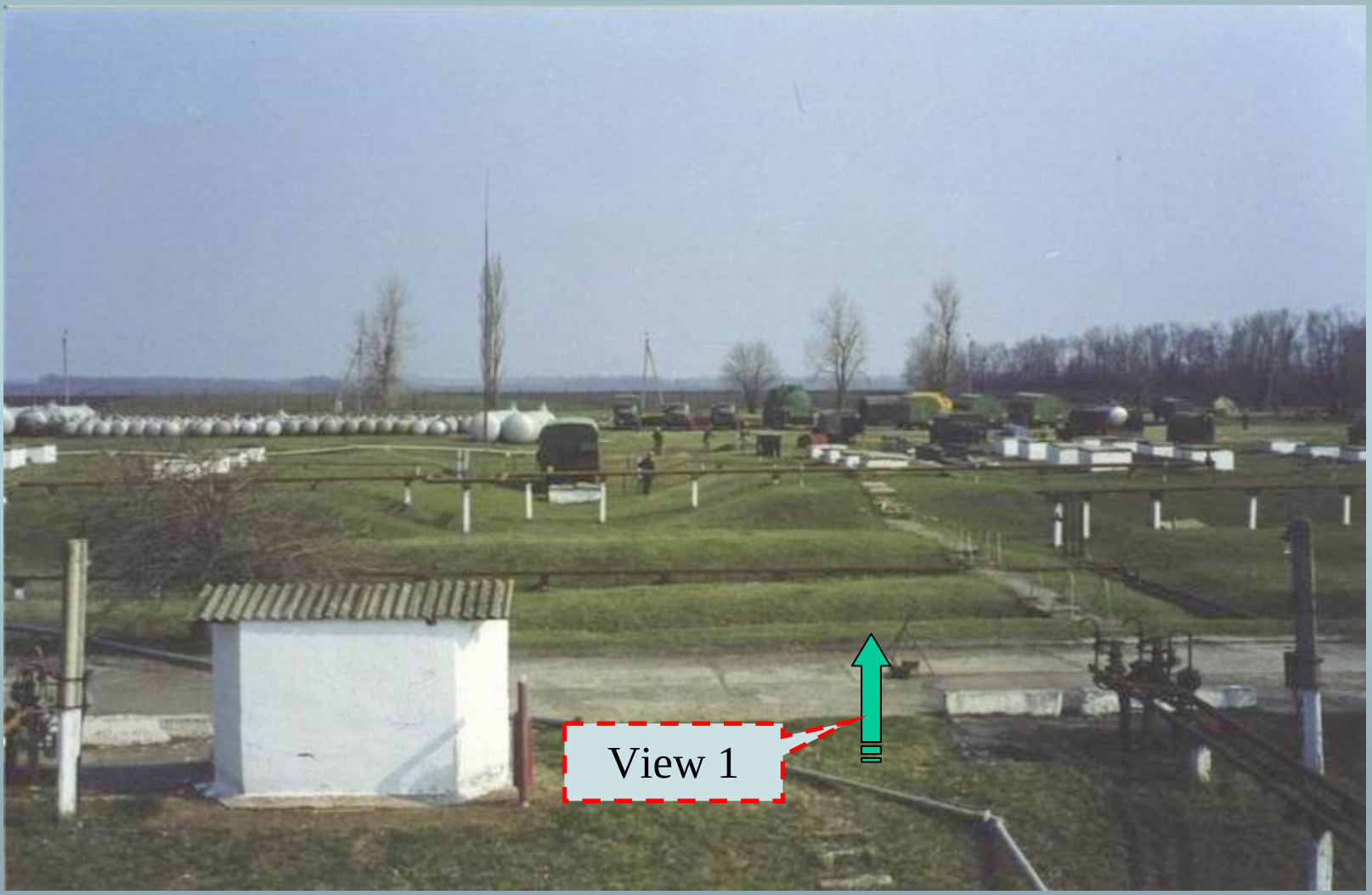

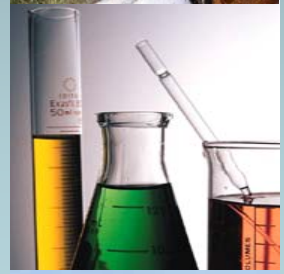

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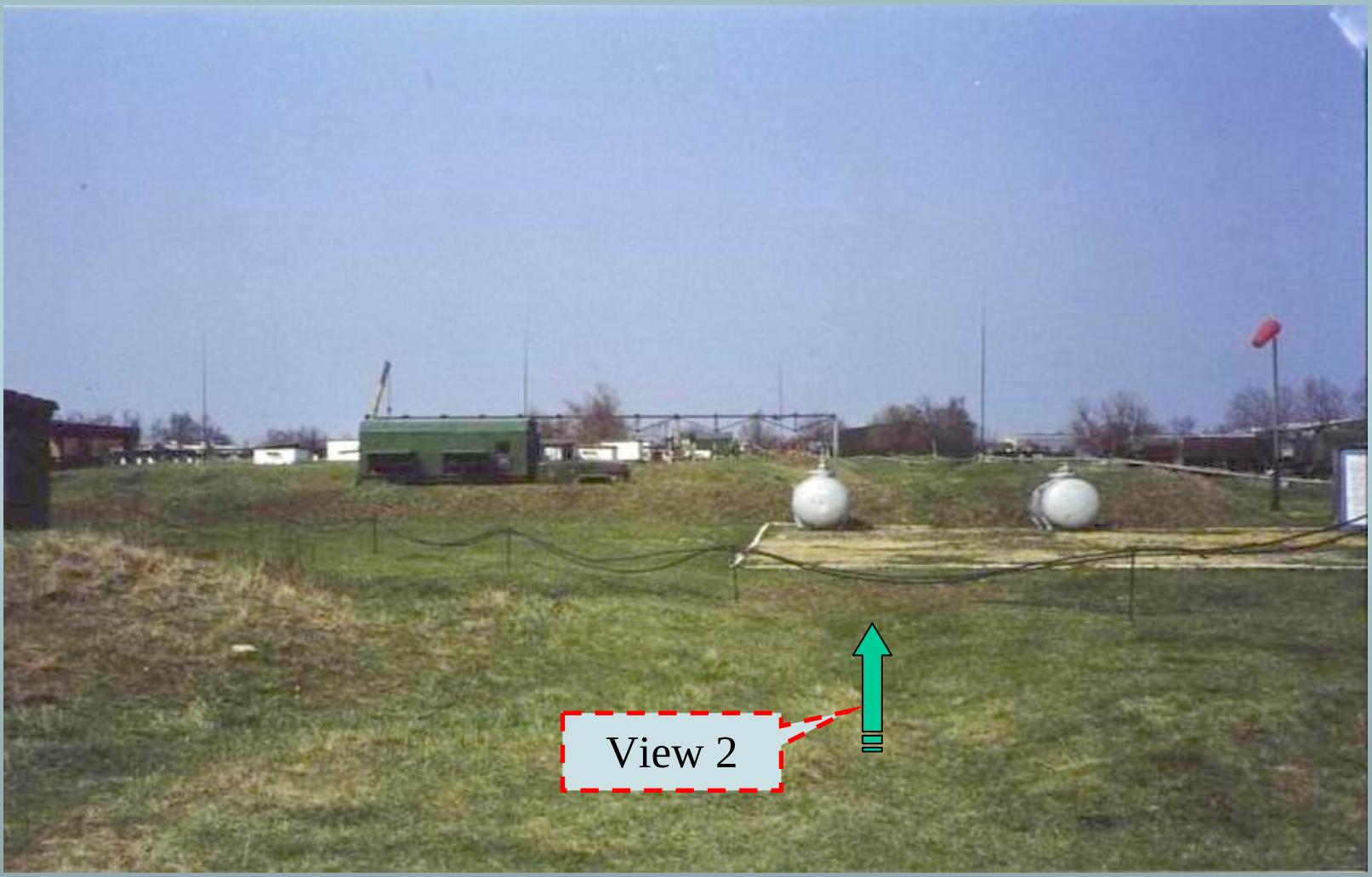
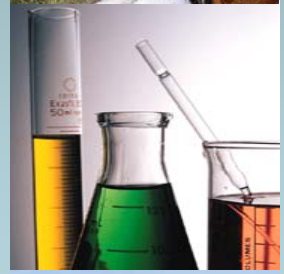




OVERVIEW OF SCOPE OF WORK

- Development of Design Documentation and Environmental Impact Assessment (OVOS) approved by the appropriate Ukrainian authorities
- Development of a Work Execution Plan (WEP) based on the Design Documentation and OVOS
- Environmental Survey
- Neutralization of all the infrastructure elements and incineration of Heptyl and Samin wastewater and vapors
- Infrastructure component dismantlement
- Site restoration

OVERVIEW OF SCOPE OF WORK

Subcontract requirements were developed with

SPECIAL ATTENTION

to ensuring the safety of personnel and minimizing the environmental hazards associated with the work

OVERVIEW OF SCOPE OF WORK

The Phase II Environmental Survey included the three following stages:

- Additional Environmental Testing made necessary by the Ukrainian MOD statement that R-60 Tank Block #1 was temporarily utilized for Heptyl storage

- Environmental Monitoring and verification testing for all elimination activities

- Post-Dismantlement Environmental Survey

SAMPLING METHODOLOGY AND ASSOCIATED EQUIPMENT

- The Phase II Environmental Survey was performed in accordance with the UML-ELI-43 and MOES-ELI-RFSS Procedures and applicable Ukrainian norms and standards

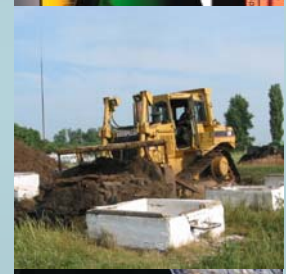
- The work area air, liquid waste, soil, sand, scrapes, and scrap sampling and testing were completed by the field analytical laboratory equipped with HP-1050 and VARIAN Liquid and HP-6890 Gas Chromatographs

SAMPLING METHODOLOGY AND ASSOCIATED EQUIPMENT

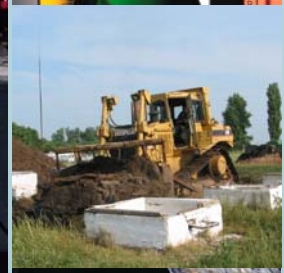
- Post-Dismantlement soil and water sample analysis was performed using similar equipment at the laboratory in the City of Kharkiv

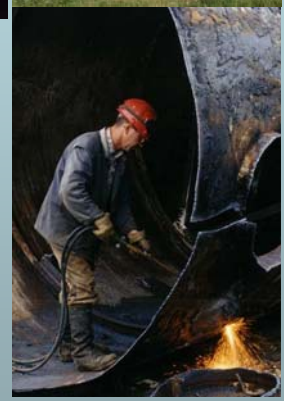
- All the equipment mentioned has gone through metrological attestation and received all necessary certificates

- The Phase IIEnvironmental Survey was conducted using the same procedures, techniques, and equipment documented in Phase I



SAMPLING METHODOLOGY AND ASSOCIATED EQUIPMENT





ADDITIONAL ENVIRONMENTAL SURVEY

Soil samples were taken from the tank blocks in order:

- To determine the level of Heptyl contamination in the previously-identified “Samin” Block #1 and
- To contour the areas of soil excessively contaminated with Heptyl and Samin

ADDITIONAL ENVIRONMENTAL SURVEY

Item #	Sampling Location	Contaminant Content					
		UDMH		NDMA		DMA	Xylidine
		mg/kg	I_{MAC}	mg/kg	I_{MAC}	mg/kg	mg/kg
12	square12*, point 1*	0.080	4.00	-	-	-	-
13	square 13*, point 2*	0.300	15.00	-	-	-	-
14	square 11*, point 3*	-	-	-	-	0.31	-
15	square 12*, point 4*	-	-	0.190	19.00	0.14	-
16	square 13*, point 5*	0.440	22.00	0.035	3.50	0.52	-
17	square 12, point 6*	0.030	1.50	-	-	-	-
18	square 12, point 7*	0.036	1.80	0.043	4.30	0.38	-
19	square 13, point 8*	0.300	15.00	0.200	20.00	0.36	-
20	square 11, point 9*	0.042	2.10	-	-	0.69	-
21	square12, point 10*	-	-	0.013	1.30	0.34	-
22	square 13, point 11*	0.096	4.80	0.065	6.50	0.46	-
23	square13, point12*	0.058	2.90	-	-	-	-
MAC		0.02		0.01		N/A	0.5

ADDITIONAL ENVIRONMENTAL SURVEY

Figure 1. R-60 Tank Block #2 (UDMH)

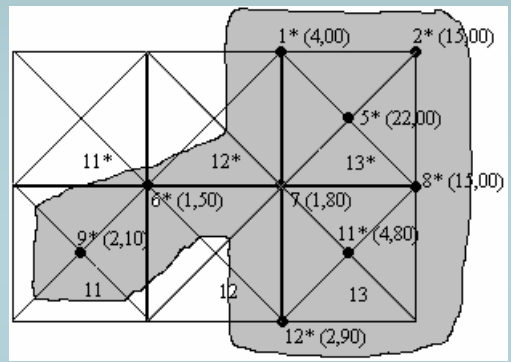
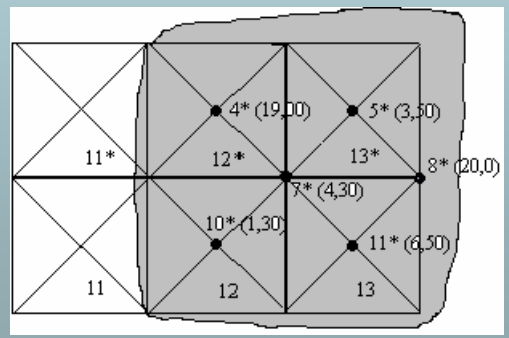


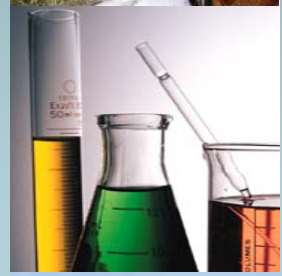
Figure 2. R-60 Tank Block #2 (NDMA)



ADDITIONAL ENVIRONMENTAL SURVEY

- In summary, based on the results of contouring, it was necessary to strip the contaminated soil layer to a depth of 30 cm, with the overall volume of contaminated soil **450 m^3**

- The stripped soil was stockpiled and passed to the MOD for neutralization at the area for temporary storage of contaminated soil. It was placed on and covered with a polyethylene sheet



ADDITIONAL ENVIRONMENTAL SURVEY

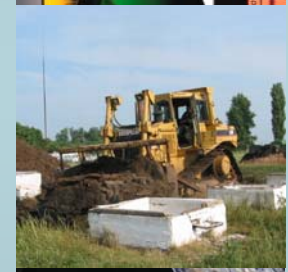
Marker for Topsoil Area Excessively Contaminated With Heptyl

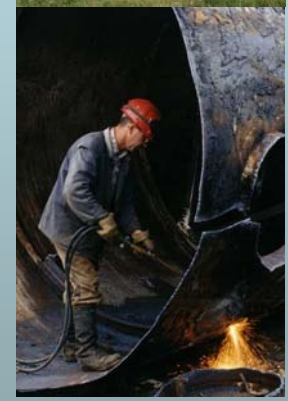
NEUTRALIZATION AND INCINERATION

Neutralization work activities included:

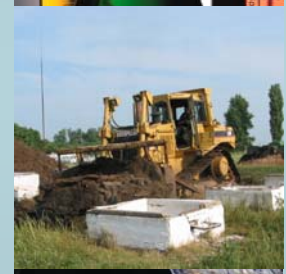
- Check on tank structure integrity
- Preparation for neutralization
- Neutralization
- Post-neutralization solid waste (sludge) disposition, and
- Wastewater and vapor incineration

NEUTRALIZATION AND INCINERATION





NEUTRALIZATION AND INCINERATION



Environmental monitoring covered UDMH, Triethylamine, and Xylidine sampling and analysis and included:

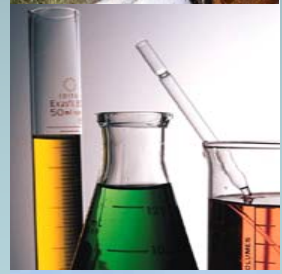
- Daily air sampling in the down-wind work area and at a 50 m radius from the incinerator location
- Determination of the air contamination level in pipelines and tanks during the neutralization process. The air in each tank was then analyzed at least three times: at 2, 24, and 72 hours after completion of the neutralization cycle
- Determination of contaminant concentration in the wastewater mobile tank when necessary
- Determination of the contamination level of tank solid waste (sludge) resulting from tank cleaning

LIQUID WASTE AND VAPOR INCINERATION

Specialized MOD incinerator units were used for incineration of liquid waste and vapors under the following conditions:

- 11G427 (2 each) – for incineration of vapors and liquid waste generated after neutralization of Heptyl tanks and pipelines. The concentration of UDMH in wastewater did not exceed 5%; in chemical neutralization solutions – 1%
- 11G426 (1 each) – for incineration of wastewater and chemical neutralization solutions generated after neutralization of samin tanks and pipelines. Concentration of Xylidine in both wastewater and chemical neutralization solutions did not exceed 1%
- 11G94 (3 each) – for incineration of Heptyl and Samin vapors only

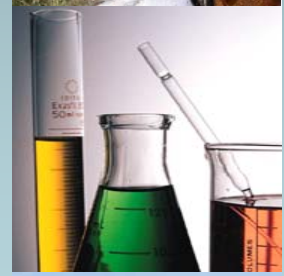
LIQUID WASTE AND VAPOR INCINERATION

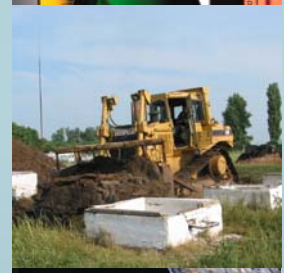


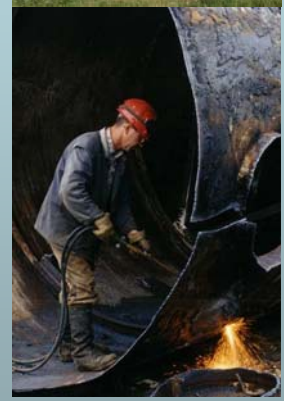
DISMANTLEMENT AND SITE RESTORATION

The dismantlement of the Liubashevka RFSS structures accompanied by :

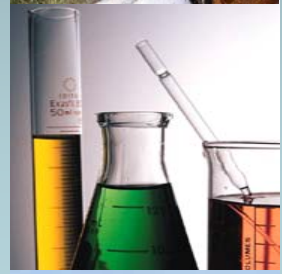
- Removal of underground tanks and associated infrastructure
- Elimination of foundations and sumps
- Steel salvage
- Debris and solid wastes burial
- Removal and placement of contaminated soil, and
- Site restoration





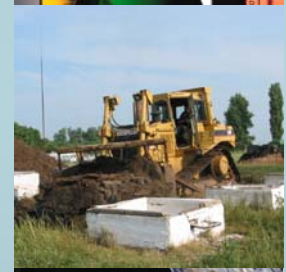


DISMANTLEMENT AND SITE RESTORATION



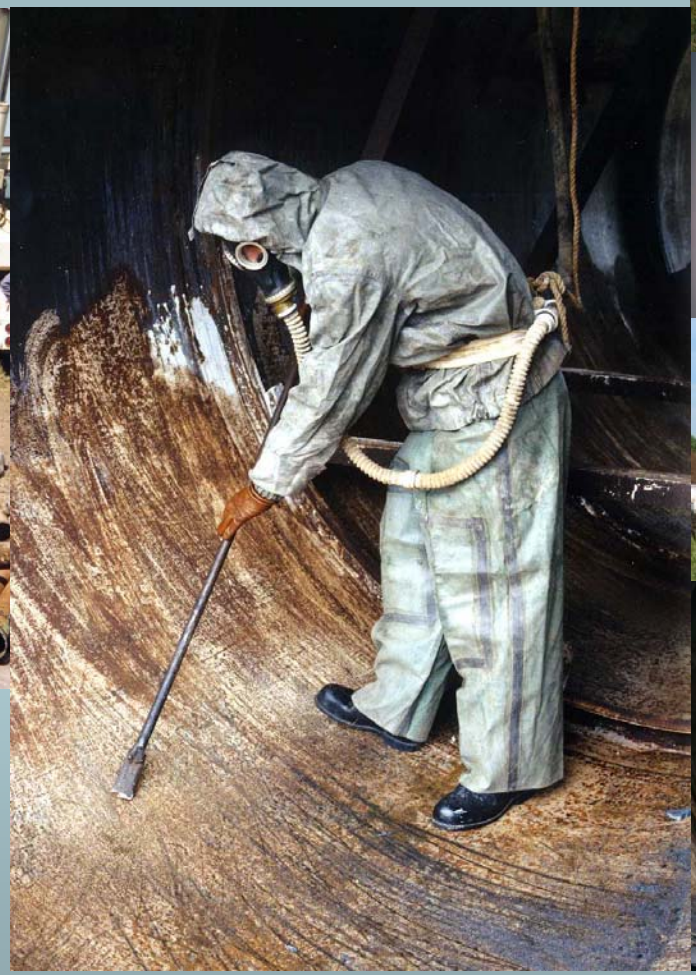
Removal of underground tanks and associated infrastructure

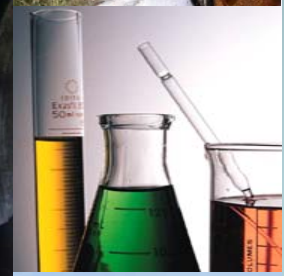
DISMANTLEMENT AND SITE RESTORATION

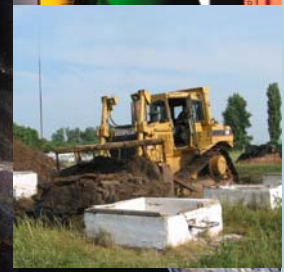


Elimination of foundations and sumps

DISMANTLEMENT AND SITE RESTORATION



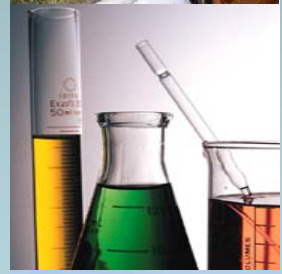




Steel salvage

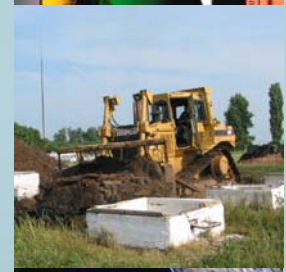
DISMANTLEMENT AND SITE RESTORATION

Steel salvage



DISMANTLEMENT AND SITE RESTORATION

Debris and solid wastes burial

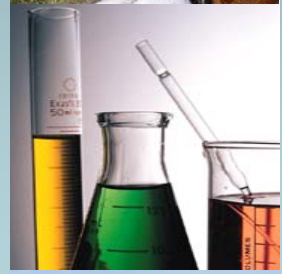


DISMANTLEMENT AND SITE RESTORATION

Debris and solid wastes burial

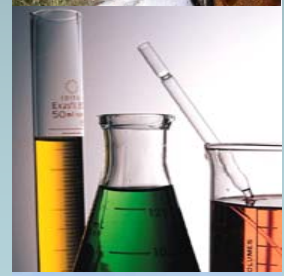
DISMANTLEMENT AND SITE RESTORATION

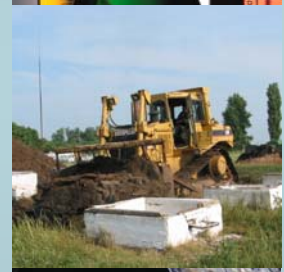
Removal and placement of contaminated soil

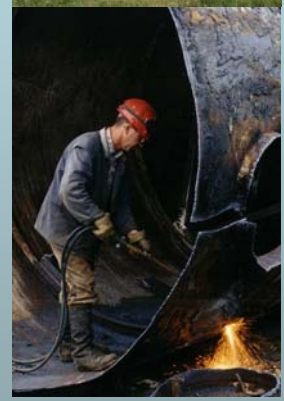


DISMANTLEMENT AND SITE RESTORATION

Site Restoration







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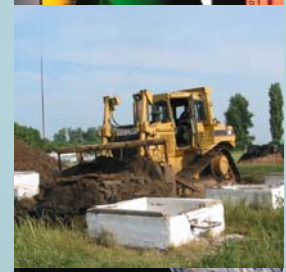


Site Restoration

DISMANTLEMENT AND SITE RESTORATION

Environmental monitoring and verification testing during this stage was focused on prevention of mixing contaminated and common soil, and additional sampling and testing of disturbed soil, tank sump sand, scrap, and debris

ON-SITE AIR MONITORING

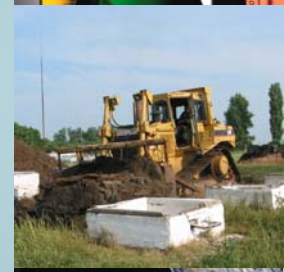
In order to continuously assess the level of air contamination in the work area and to provide, when necessary, recommendations on the use of protective equipment, monitoring posts were erected near all potentially hazardous sources (e.g., incineration zone, tank blocks, and associated infrastructure and pipelines)

ON-SITE AIR MONITORING

Air sampling at the R-60 Heptyl Tank Block

ON-SITE AIR MONITORING

Air Monitoring Post Equipment



ON-SITE AIR MONITORING

Maximum Registered Contaminant Concentrations in Air in the Work Area

Date	Type of dismantlement activities	Concentration, mg/m^3				
		UDMH	NDMA	Xylidine	TEA	NOx
		MAC				
		0.1	0.01	3.0	10.0	2.0
2 June 2003	Dispensing-unloading facilities; R-60 Heptyl tanks pipelines and valves	0.024	0	0.05	0.12	0.5
3 June 2003		0.074	0.003	0.064	0.23	0.5
4 June 2003	Dispensing-unloading facilities; R-60 Heptyl/Samin tank pipelines and valves	0.37	0.003	0.3	0.64	0.5
5 June 2003		0.29	0	0.05	0.1	0
6 June 2003		0.23	0.003	0.05	0.1	0.5
9 June 2003		0.14	0.003	0.05	0.1	0.5
10 June 2003		0.023	0	0.05	0.1	0
11 June 2003		0.1	0.003	0.05	0.1	0.5
12 June 2003		0.08	0.003	0.05	0.1	0.5
13 June 2003		0.023	0.003	0.05	0.1	0.5
17 June 2003		0.05	0.003	0.05	0.1	0.5

ON-SITE AIR MONITORING

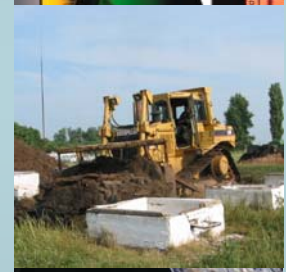
Maximum Registered Contaminant Concentrations in Air Outside Work Area

Date	Concentration, mg/m³					
	50 m Down-Wind Zone			Sanitary Protective Zone		
	UDMH	Xylidine	TEA	UDMH	Xylidine	TEA
	MAC					
	0.03	0.9	3.0	0.001	0.002	0.14
19 May 2003	0.012	0.04	0.09	0	0	0
20 May 2003	0.012	0.04	0.08	0	0	0
	0.016	0.05	0.1	0	0	0
21 May 2003	0.011	0.05	0.09	0	0	0
	0.016	0.05	0.53	0	0	0
	0.016	0	0.15	0	0	0
22 May 2003	0.016	0.05	0.1	0	0	0

SAMPLING AND TESTING DURING R-60 TANK REMOVAL

- Prior to R-60 tank removal, soil covering the tanks was temporarily stockpiled beside the tank blocks in piles numbered one through six and then analyzed for UDMH and NDMA

SAMPLING AND TESTING DURING R-60 TANK REMOVAL



SAMPLING AND TESTING DURING R-60 TANK REMOVAL

Pile #1 Soil Analysis Results Prior to Decontamination

Bore pit #	Layer, m	UDMH		NDMA	
		mg/kg	I_{MAC}	mg/kg	I_{MAC}
1	0-0.3	0	0	0.18	18.0
	0.5-0.7	0	0	0.23	23.0
	1.1-1.3	0.038	1.90	0.30	30.0
2	0-0.3	0.026	1.30	0.17	17.0
	0.5-0.7	0	0	0.03	3.0
	1.1-1.3	0.10	0.50	0.03	3.0
2a	0-0.3	0.008	0.40	0.33	33.0
	0.5-0.7	0.175	8.75	0.23	23.0
	1.1-1.3	0	0	0.49	49.0
3	0-0.3	0.206	10.30	0.16	16.0
	0.5-0.7	0.081	4.05	0.41	41.0
	1.1-1.3	0.037	1.85	0.13	13.0
3a	0-0.3	0.085	4.25	0.53	53.0
	0.5-0.7	0.011	0.55	0.34	34.0
	1.1-1.3	0	0	0.43	43.0

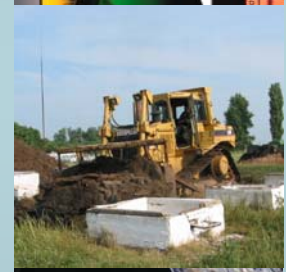
SAMPLING AND TESTING DURING R-60 TANK REMOVAL

- Upon the MOD representative's initiative, it was decided to decontaminate this soil with 10%-solution of DTS-GK, analyze it again to verify that neutralization was successful, and then use it for backfilling the pit. To this end, contaminated soil was placed into the 20x25x2 m pit (about 300 m^3) and was neutralized in two layers of 30 cm with DTS-GK by MOD, using standard military procedures.

PRE-EXISTING HEPTYL SPILLS

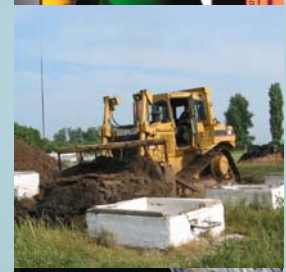
- Two special cases were documented during the R-60 #G2 and #G4 tank removal process. At the bottom of the pans of these tanks, wet sand seemed to be heavily contaminated with spilled liquid with a strong Heptyl odor

PRE-EXISTING HEPTYL SPILLS



R-60 #G2

PRE-EXISTING HEPTYL SPILLS



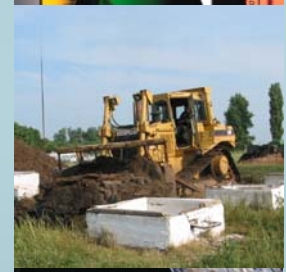
R-60 #G4

PRE-EXISTING HEPTYL SPILLS

R-60 #G2 and #G4 Pans Liquid Sample Results

Date	Tank pan #	Percentage of UDMH in liquid, %
16 July 2003	G2	2.76
18 July 2003	G4	42.9
	MAC Not Applicable for liquid test	






PRE-EXISTING HEPTYL SPILLS

- Further technical inspection of the R-60 #G2 and #G4 tanks revealed that they had no holes. It is believed that these Heptyl spills resulted from improper practices at Liubashevka RFSS during the operational period
- In accordance with Design Documentation, Sump containment sand (6 m^3) was neutralized by MOD with DTS-GK and placed in the contaminated soil temporary storage area.
- Tank pans were neutralized, dried, and cut into 1 x 1 m pieces

PRE-RESTORATION SAMPLING AND TESTING

- Prior to final site restoration, sampling and testing was performed using the field laboratory

- It was concluded that the level of contamination in all combined samples is within the established limits and there are no obstacles to the start of final site restoration

PRE-RESTORATION SAMPLING AND TESTING

Pile #4, #5 and #6 Soil Analysis Results

Area #/ Square #	Layer, m	UDMH		NDMA	
		mg/kg	I_{MAC}	mg/kg	I_{MAC}
V/1	0-0.3	0.009	0.45	0	0
	0.3-0.6	0.008	0.40	0	0
V/2	0-0.3	0	0	0	0
	0.3-0.6	0	0	0	0
VI/1	0-0.3	0.01	0.50	0	0
	0.3-0.6	0.011	0.55	0	0
VI/2	0-0.3	0.007	0.35	0	0
	0.3-0.6	0.008	0.40	0	0
VI/3	0-0.3	0.005	0.25	0	0
	0.3-0.6	0.009	0.45	0	0
VI/4	0-0.3	0.005	0.25	0	0
	0.3-0.6	0.005	0.25	0	0
MAC		**0.02**		**0.01**	

POST-DISMANTLEMENT ENVIRONMENTAL SURVEY

- The main goal of the post-dismantlement environmental survey was to provide objective data on the environmental status of the Liubashevka RFSS after completion of all dismantlement activities

POST-DISMANTLEMENT ENVIRONMENTAL SURVEY

The field team activities included:

- Meteorological monitoring
- Sampling
- Drilling boreholes
- Sample collection
- Transportation of samples

POST-DISMANTLEMENT ENVIRONMENTAL SURVEY

- The off-site water sampling locations were selected according to applicable Ukrainian standards within a 2-km zone around the Liubashevka RFSS. Chemical analysis of all samples was performed at the KRC ME laboratory facility in Kharkiv.

POST-DISMANTLEMENT ENVIRONMENTAL SURVEY

The following types of samples were analyzed within the framework of the post-dismantlement environmental survey:

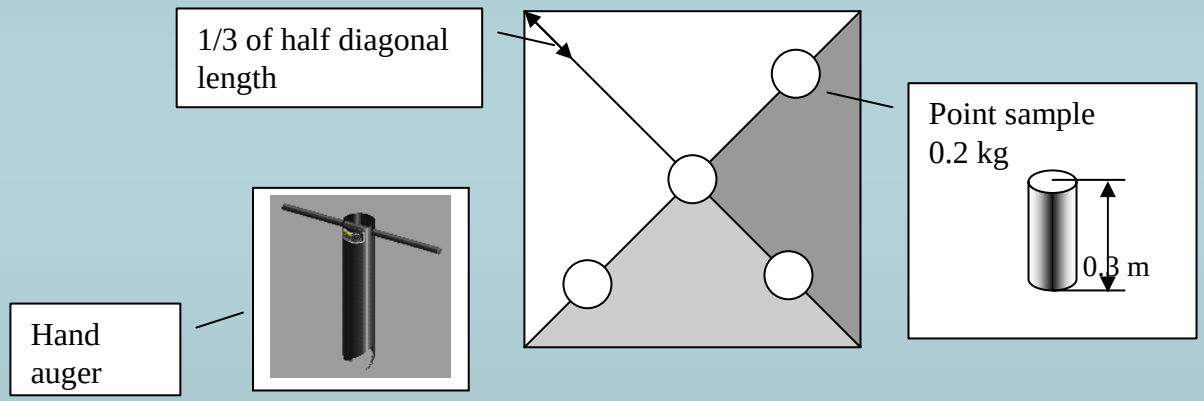
- Topsoil
- Soil from boreholes
- Underground water
- Surface water from natural water bodies within a 2-km zone
- Vegetation

POST-DISMANTLEMENT ENVIRONMENTAL SURVEY

Soil Sampling

- The 1 kg combined samples, taken in topsoil and consisting of five 0.2-kg point samples each, were collected from each sampling square (10 x 10 m; 20 x 20 m; 40 x 50 m) using the “envelope sampling methodology”.
- Each point sample was taken using a hand auger from a depth 0 to 0.3 m.

POST-DISMANTLEMENT ENVIRONMENTAL SURVEY



"Envelope Sampling Methodology"

POST-DISMANTLEMENT ENVIRONMENTAL SURVEY

Soil Sampling

- In order to assess the rate of vertical migration of contaminants, the soil samples were also collected from boreholes which were drilled with a “Big Beaver” portable earth drill up to 4.0 m depth each

POST-DISMANTLEMENT ENVIRONMENTAL SURVEY

Portable Earth Drill “Big Beaver”

POST-DISMANTLEMENT ENVIRONMENTAL SURVEY

Soil Sampling

- To obtain background information, three “reference” soil samples were collected in potentially clean areas from non-disturbed sites located 0.5 km away from Liubashevka RFSS

- Each soil sample was placed into a 1 L glass jar that was immediately sealed to prevent the sample’s contact with atmospheric air

POST-DISMANTLEMENT ENVIRONMENTAL SURVEY

Topsoil Analysis Results

Sampling Square #	UDMH		NDMA	DMA	
	mg/kg	I_{MAC}	mg/kg	mg/kg	I_{BG}
2	0	0	0	0	0
6	-	-	0	0	0
7	-	-	0	0	0
11	0	0	-	0	0
11*	-	-	-	0	0
12	0	0	0	0.015	1.36
12*	0.002	0.1	0	0	0
13	0.006	0.3	0	0.015	1.36
13*	0.008	0.4	0	0.018	1.64
Control sample #1	0	0	0	0	0
Control sample #2	0	0	0	**0.011**	**1.00**
Control sample #3	0	0	0	0.009	0.82
MAC	**0.02**		**0.01**	**N/A**	
BG	**-**		**-**	**0.011**	

POST-DISMANTLEMENT ENVIRONMENTAL SURVEY

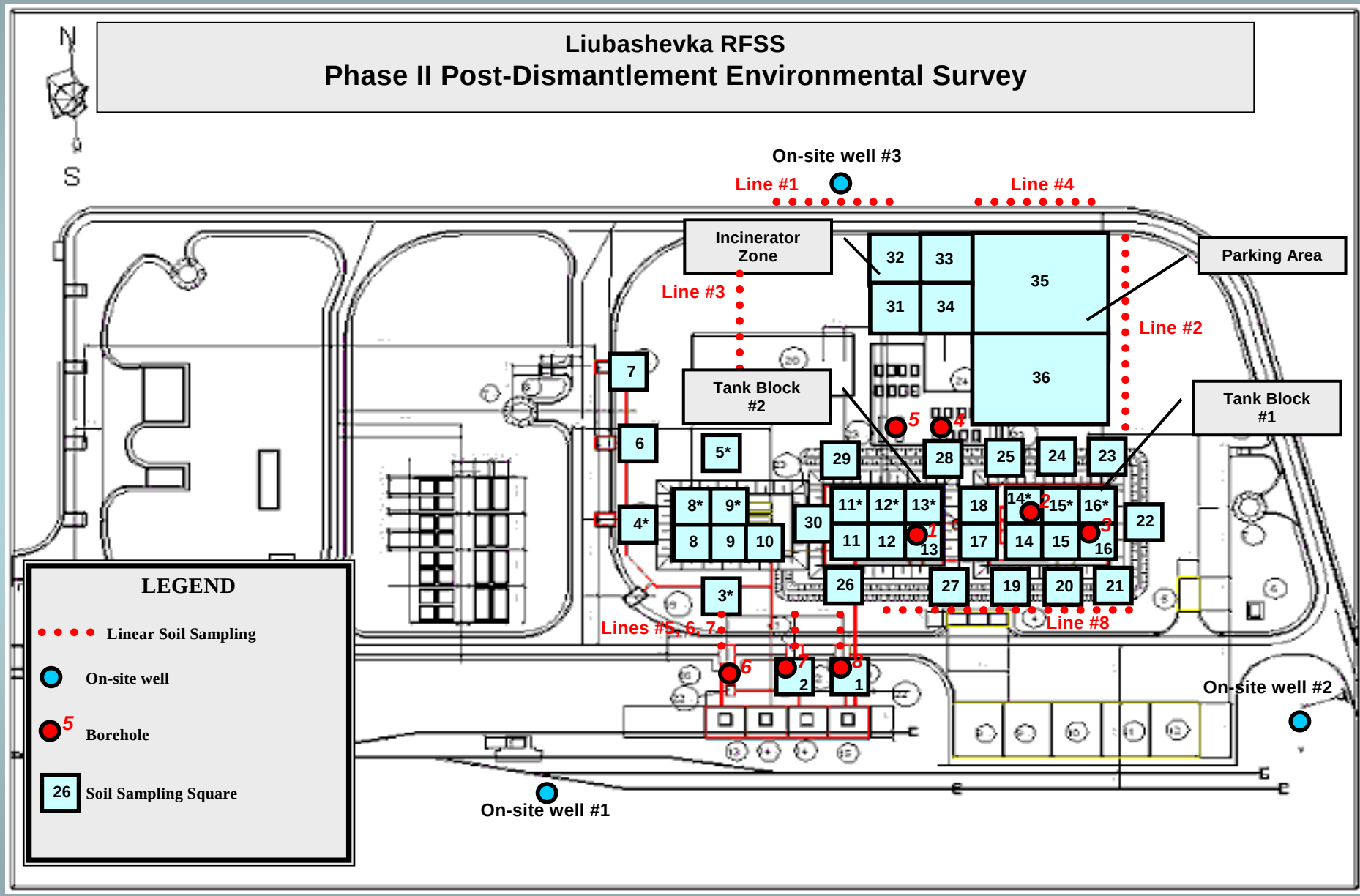
Topsoil Analysis Results

Sampling Square #	Formaldehyde		Nitrates		Nitrites	
	mg/kg	I_{MAC}	mg/kg	I_{MAC}	mg/kg	I_{BG}
13	0	0	0	0	1.05	0.99
Control sample #1	2.65	0.38	0	0	0.75	0.71
Control sample #2	2.81	0.4	0	0	**1.06**	**1.00**
Control sample #3	1.5	0.21	0	0	0.88	0.83
MAC	**7.0**		**130**		**N/A**	
BG	**-**		**-**		**1.06**	

POST-DISMANTLEMENT ENVIRONMENTAL SURVEY

Soil Testing Results

- Topsoil analysis results for Heptyl-related contaminants showed that UDMH was detected in some sampling squares at 0.1 to 0.4 MAC.
- DMA was detected at background levels (0.009 to 0.018 mg/kg).
- NDMA was not detected.
- Concentration of formaldehyde was found to be 0.14 to 0.57 MAC (approximately background concentration)
- Nitrites were also detected in concentrations comparable to background data (0.36 to 2.11 mg/kg)


Liubashevka RFSS
Phase II Post-Dismantlement Environmental Survey
N
S
On-site well #3
Line #1
Line #4
Incinerator Zone
Parking Area
Line #3
Line #2
Tank Block #2
Tank Block #1
32
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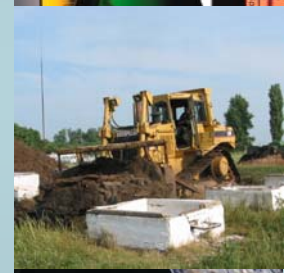
16
22
26
27
19
20
21
3*
Lines #5, 6, 7
Line #8
On-site well #2
On-site well #1
LEGEND
Linear Soil Sampling
On-site well
Borehole
Soil Sampling Square
26

POST-DISMANTLEMENT ENVIRONMENTAL SURVEY

Water Sampling

- Water samples were collected from seven water sources which were also tested during Phase I

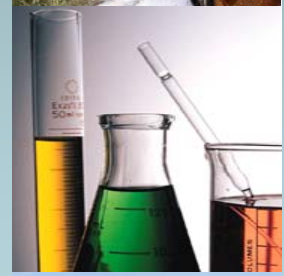


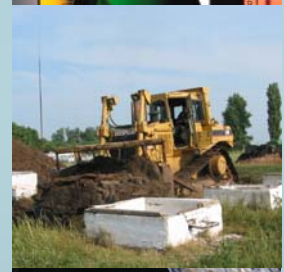



POST-DISMANTLEMENT ENVIRONMENTAL SURVEY

Source #	Source description	Coordinates		Remarks
		Azimuth, °	Distance from the center of the site, km	
1	“Water well”	340	0.95	120 m depth
2	“Stream”	155	0.45	
3	“Syrovsky Yar” Pond	330	0.9	
4	On-site well #1	Locations indicated on see Attachments 4, 5, and 6		5.2 m water table
5	On-site well #2			5.8 m water table
6	On-site well #3			6.2 m water table
7	Military Unit drinking water well	90	0.58	10.0 m water table

Features of Water Sources





POST-DISMANTLEMENT ENVIRONMENTAL SURVEY

Summary of Water Analysis Results
(maximum values detected for all water bodies)

Contaminant	Content		
	MAC	mg/L	I_{MAC}
UDMH	0.02	0	0
NDMA	0.01	0	0
DMA	0.1	0	0
Formaldehyde	0.05	0	0
Nitrates	45	27.3	0.6
Nitrites	3.3	0.09	0.03
Xylidine	0.5	0	0
TEA	2.0	0	0
DEA	0.02	0	0

POST-DISMANTLEMENT ENVIRONMENTAL SURVEY

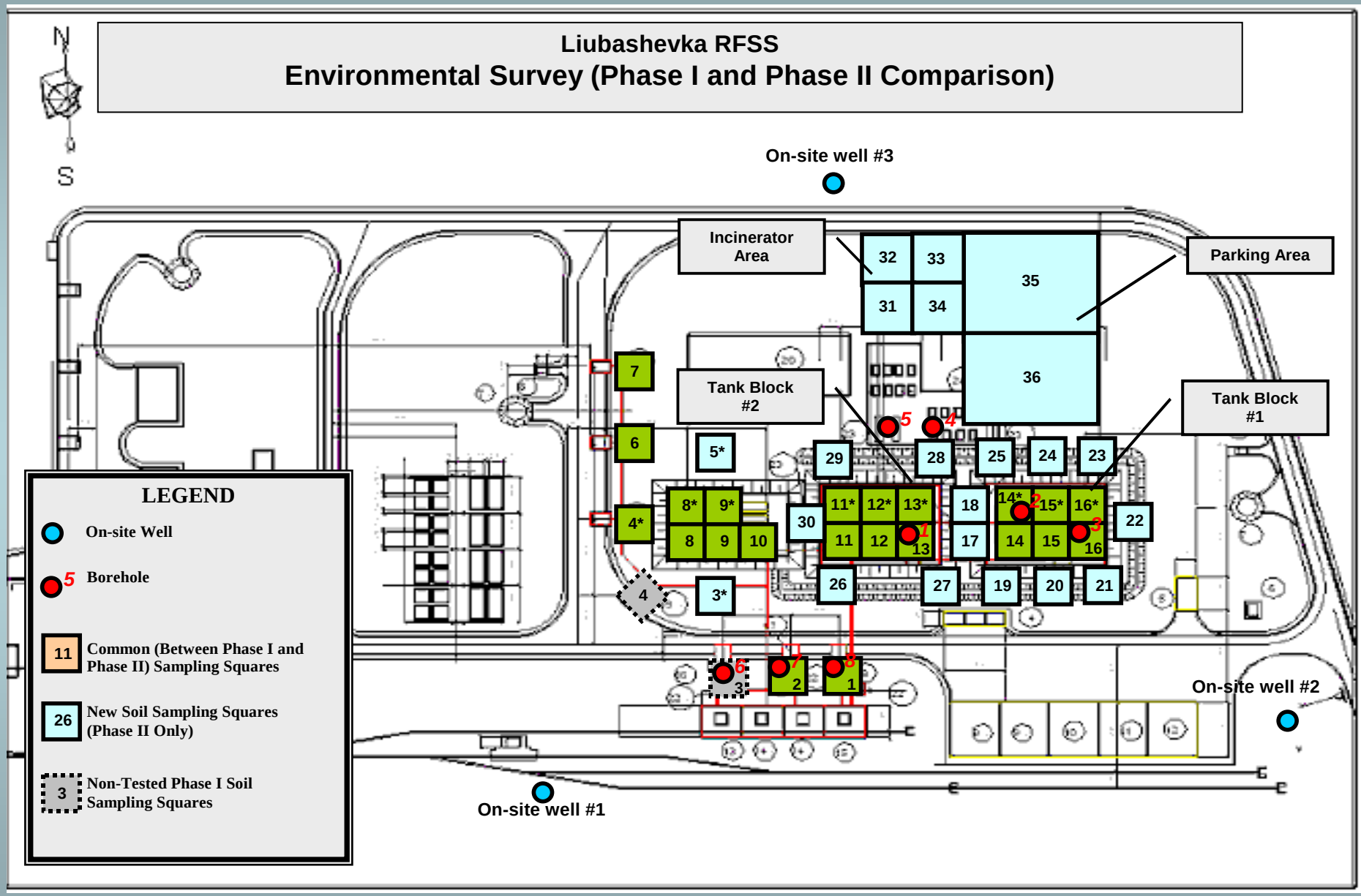
Vegetation Sampling

- Grass sampling was performed near R-60 tank blocks #1 and #2 and at the boundary of the Sanitary Protective Zone in accordance with standard procedures using garden scissors. No UDMH or NDMA were detected during vegetation sample testing

COMPARATIVE ANALYSIS OF THE PHASE I AND II SURVEY RESULTS

PHASE I	PHASE II
Goals	
To characterize and document location, quantity, type, level, and extent of existing contamination.	
To document the existing state of the environment prior to the commencement of any on-site physical activities.	To monitor and document the existing state of the environment during the dismantlement activities. To protect worker's health and safety. To document the state of the environment after completion of neutralization and dismantlement activities. To verify that the site has not been additionally contaminated in the course of demilitarization activities, in part by comparing "pre-" and "post-" test results in the exact same test locations.

Liubashevka RFSS
Environmental Survey (Phase I and Phase II Comparison)



COMPARATIVE ANALYSIS OF THE PHASE I AND II SURVEY RESULTS

Topsoil Testing Results

Sampling Square #	UDMH, mg/kg		NDMA, mg/kg		DMA, mg/kg	
	Phase I	Phase II	Phase I	Phase II	Phase I	Phase II
2	0.064	0	0.033	0	0.083	0
6	0.003	0	0.011	0	0.337	0
7	0.003	0	0.021	0	0.076	0
11	0.051	0	0	0	0.065	0
11*	0.016	0	0	0	0.395	0
12	0.024	0	0.023	0	0.259	0.015
12*	0.019	0.002	0.012	0	0.102	0
13	0.25		0.013	0	1.89	0.015
13*	8.29	0.008	0.053	0	2.158	0.018
Control sample #1	0	0	0	0.006	0	0
Control sample #2	0	0	0	0	0.03	0.011
Control sample #3	0	0	0	0	0.018	0.009
MAC	**0.02**		**0.01**		**N/A**	

COMPARATIVE ANALYSIS OF THE PHASE I AND II SURVEY RESULTS

Topsoil Testing Results

Sampling Square #	Formaldehyde, mg/kg		Nitrates, mg/kg		Nitrites, mg/kg	
	Phase I	Phase II	Phase I	Phase II	Phase I	Phase II
2	1.92	1.43	0	0	1.08	1.41
6	3.34	1.5	0	0	2.22	0.84
7	3.38	1.36	0	0	1.57	1.88
11	2.81	1.38	10.02	0	1.36	1.14
11*	2.05	1.1	0	0	1.45	0.42
12	2.36	0.98	0	0	1.02	0.04
12*	2.1	0.5	0	0	1.37	1.63
13	2.29	2.05	0	0	1.21	1.89
13*	1.77	1.54	0	0	2.59	1.52
Control sample #1	2.63	2.65	0	0	0.99	0.75
Control sample #2	3.41	2.81	0	0	0.84	1.06
Control sample #3	2.92	1.5	0	0	1.21	0.88
MAC	**7.0**		**130.0**		**N/A**	

COMPARATIVE ANALYSIS OF THE PHASE I AND II SURVEY RESULTS

Water Sampling and Testing

PHASE I	PHASE II
Water sampling and testing were performed in order to assess the existing level of contamination of surface and underground water prior to physical work commencement	Water sampling and testing were performed to assess the environmental impact of demilitarization activities on surface and underground water
Water Sources <u>On-site</u> On-Site Wells #1, #2, #3 <u>Off-site</u> “Water well” “Stream” “Syrovsky Yar” Pond Military Unit drinking water well	
<u>Water testing results showed that no contamination of surface and groundwater with rocket fuel components was detected</u>	

CONCLUSIONS

- All necessary measures were undertaken to ensure worker health and safety and to prevent any additional contamination of the site during demilitarization activities
- The results of air analysis show that in some cases, especially at the time when R-60 Heptyl tanks were still open, the concentration of UDMH exceeded the MAC established for work zones. The maximum concentration of UDMH associated with dismantlement of pipelines and fittings, 2.16 mg/m^3 or 21.6 MAC, was documented on 21 May 2003. In all such cases, access to work places was limited to only directly involved personnel and the use of protective equipment by each worker was mandatory

CONCLUSIONS

- No air contamination was detected at the down wind boundary of the Sanitary Protective Zone
- There was no impact on atmospheric air around the Liubashevka RFSS resulting from demilitarization activities
- In order to verify the allowable concentration of incoming incineration wastewater, each batch was analyzed, and if needed, was diluted with clean water to the appropriate concentration

CONCLUSIONS

- Contaminated topsoil discovered during the Phase I Environmental Survey and an additional pre-dismantlement site assessment was removed and immediately stockpiled in the temporary contaminated soil storage area built by the subcontractor per Ukrainian standards. Stockpiles were constructed to limit contaminant migration. Other soil from greater depths was neutralized by MOD and used as backfill
- Site restoration was completed in accordance with the WEP. The final grading of Liubashevka RFSS was completed using only topsoil with RFC concentration well below MAC

CONCLUSIONS

- The comparison of Phase I and Phase II Environmental Survey results shows that elimination of all RFC sources (e.g. tanks, pipelines, installations), containerization of heavily contaminated soil and sump containment sand (with topsoil, compacted clay and polyethylene sheets), and neutralization of contaminated soil by MOD significantly improved environmental conditions at Liubashevka RFSS
- During the course of dismantlement, incineration, and site restoration activities, no accidental spills or emissions occurred

CONCLUSIONS

- Based on the Final Environmental Report prepared by the independent environmental observer and approved by the Ministry of Environment and Natural Resources of Ukraine and the independent verification report prepared by STC “Sensor”, the Liubashevka Rocket Fuel Storage Site has not been additionally contaminated due to demilitarization activities

ABBREVIATIONS AND SYMBOLS

DEA	Diethylamine
DMA	Dimethylamine
I_{BG}	Data given as a ratio to background concentration
I_{MAC}	Data given as a ratio to MAC
Liubashevka RFSS	Liubashevka Rocket Fuel Storage Site
MAC	Maximum Allowable Concentration
MAC_{DD}	Maximum *Acceptable* Concentration (temporarily accepted standards for Rocket Fuel Storage Sites established by Design Documentation)
MOD	Ministry of Defense
MOES-ELI-RFSS	Methodological Recommendations for Environmental Survey at Rocket Fuel Storage Sites
NDMA	Nitrosodimethylamine
NOx	Nitrogen oxide
OVOS	Environmental Impact Assessment
RFC	Rocket Fuel Component
TEA	Triethylamine
TM-185	Rocket fuel similar to kerosene
TPH	Total Petroleum Hydrocarbons
UDMH	Heptyl
UML-ELI-43	Unified Procedure for Environmental Survey at Military Sites
WEP	Work Execution Plan
-	No test was performed (applies for all tables)
0	Contaminant was not detected (applies for all tables)