



State Nuclear Regulatory Committee of Ukraine



Licensing experience of heap and stope (block) leaching of uranium ore in Ukraine

Riazantsev Viktor - Head of Department of
Radiation Technologies Safety of SNRCU,
in cooperation with
**State adventure "Eastern ore mining and
processing enterprise"**.

IAEA TM on Low Grade Uranium Ore, 29 - 31 March 2010

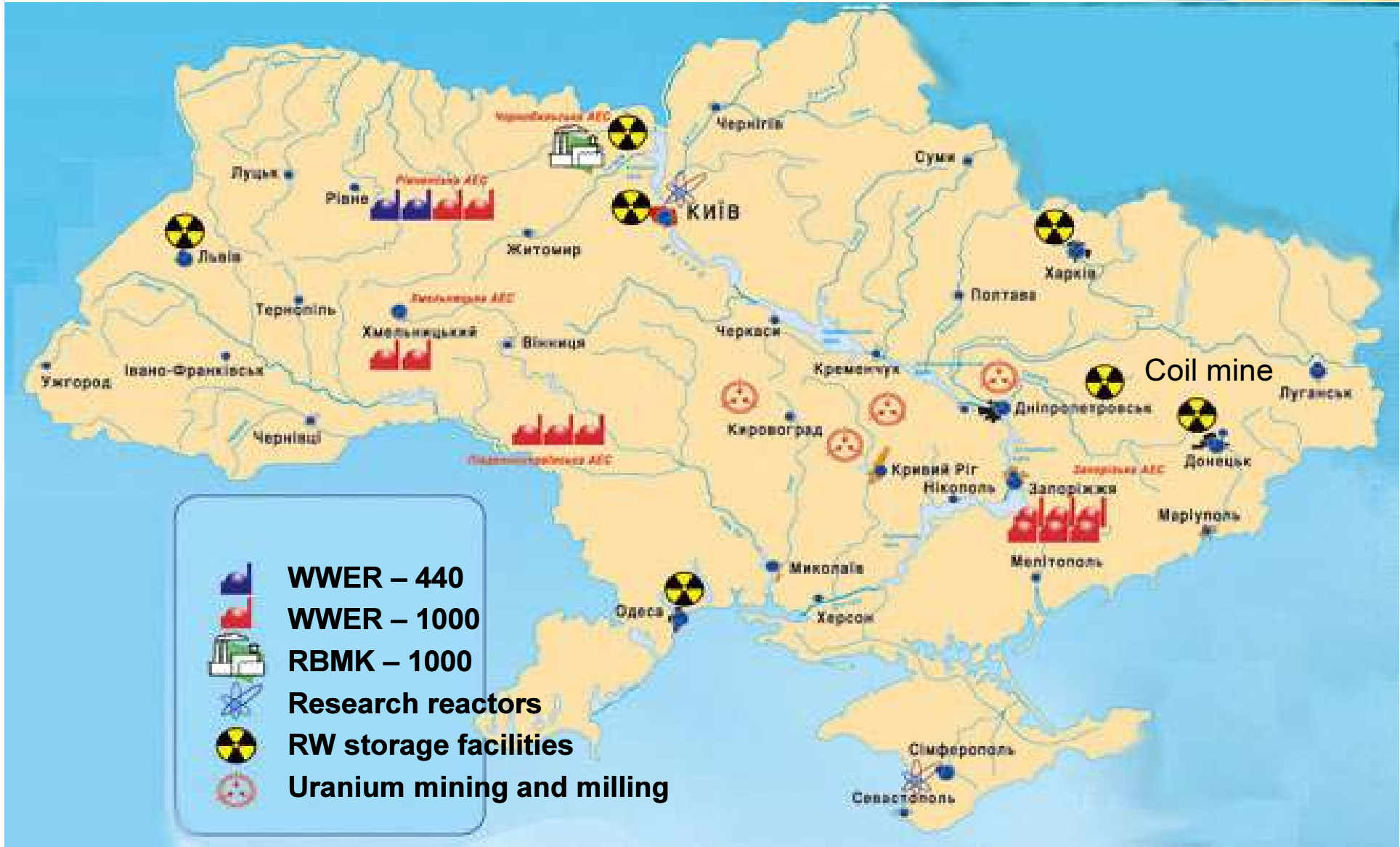


Contents

- License procedure for uranium ore recovery activity.
- Heap leaching on Smolino mine.
- Reprocessing of rock debris on Smolino mine (“Altait”).
- Stope (block) leaching on Ingulsky mine.



Nuclear Applications in Ukraine

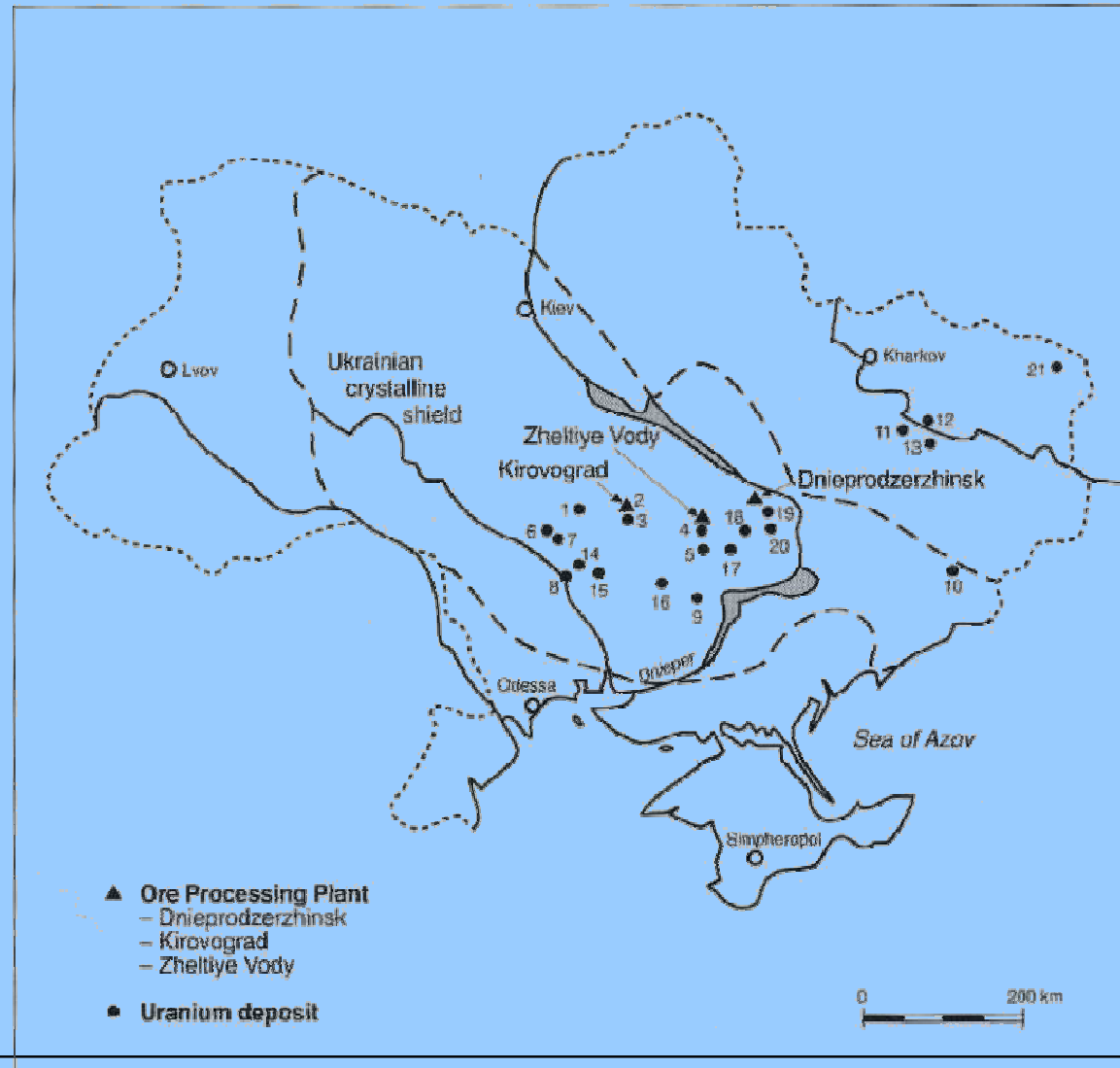




Uranium ore deposits and uranium processing operations in Ukraine (NEA 2002)



1. Vatutinskoye,
2. Severinskoye,
3. Michurinskoye,
4. Zheltorechenskoye,
5. Pervomayskoye,
6. Lozovatskoye,
7. Kalinovskoye,
8. Yuzhnoye,
9. Nikolokozelskoye,
10. Nikolayevskoye,
11. Berekskoye,
12. Krasnooskolskoye,
13. Adamovskoye,
14. Sadovokonstantinov,
15. Bratskoye,
16. Safonovskoye,
17. Devladovskoye,
18. Novogurievskoye,
19. Surskoye,
20. Chervonoyarskoye,
21. Markovskoye.





Legislation structure in Ukraine



- Constitution of Ukraine;
- International Conventions and Law of Ukraine;
- Government decree;
- Regulatory body safety requirements in nuclear energy use: SNRCU, Ministry of health, Ministry of environmental protection;
- Interdepartmental guide, standards, rules:
Radiation Safety Standards of Ukraine (NRBU-97)", Basic Health and Safety Rules of Radiation Safety of Ukraine (OSPU-2005)
- etc.



Main Ukrainian nuclear laws

- About the use of nuclear energy and radiation safety (1995)
- About mining and processing of uranium ores (1997)
- About protection of humans from the influence of ionizing radiation (1998)
- About licensing in the field of nuclear energy use (2001)



About the use of nuclear energy and radiation safety (1995)



is fundamental in the nuclear legislation of Ukraine. It establishes the priority of human and environmental safety, the rights and duties of citizens in the field of nuclear energy use, regulates the activity related to operating nuclear installations and sources of ionizing radiation, also establishes legal frameworks of international obligations of Ukraine regarding the use of nuclear energy.



About mining and processing of uranium ores (1997)

regulates the legal relations in mining and processing of uranium ores and the use of processing products as raw material for receiving nuclear material, determines the features of the activity of uranium facilities, protection of personnel, population and the environment from exposure to ionizing radiation, and also aspects of social protection of personnel of uranium facilities and population due to influence of ionizing radiation.



About protection of humans from the influence of ionizing radiation (1998)



- ☰ focuses on the protection of life, health and property of people from the negative influence of ionizing radiation which results from practical activity or in case of a radiation accident, by implementation of warning and rescuing measures and compensation of damage.



About licensing in the field of nuclear energy use (2001)



- ☰ determines legal and organizational principles of licensing in the field of the use of nuclear energy, and also general points of regulating public relations which arise during its realization.



Activities on processing of uranium ores include:



- Designing.
- Siting.
- Construction.
- Commissioning.
- Operation.
- Reconstruction.
- Decommissioning by:
 - Temporal stopping (preservation).
 - Re-profiling.
 - Close out.



Uranium ore processing



According to Government decree # 1782
“About the licensing procedure of separate
types of activity in the field of nuclear energy
use”

- ☞ The State Nuclear Regulatory Committee of Ukraine (SNRCU) is the specially authorized state body on licensing in uranium ore processing.
- ☞ The licensing procedure of activity in uranium ore processing is established.



Activity on processing of uranium ores:



- must be carried out in accordance with the requirements of regulatory guide on nuclear and radiation safety “Conditions and rules of conducting activity on uranium ores processing” (2001). Now in revision...



Main documents that an applicant must provide for the receipt of a license on uranium ore processing are:



- a report on the safety analysis of activities in uranium ore processing (requirements to this report are laid down in the regulatory guide “Requirements to the report on safety analysis of conducting activities in U ore processing”, (NP 306.5.03/2.045-2001);
- conclusions of the State expertise on nuclear and radiation safety of the U ore processing project;
- a program of U ore processing waste management;
- a program of quality assurance, developed in accordance with ISO 9000 standards.



НОРМИ ТА ПРАВИЛА З ЯДЕРНОЇ ТА РАДІАЦІЙНОЇ БЕЗПЕКИ

УМОВИ ТА ПРАВИЛА
ПРОВАДЖЕННЯ ДІЯЛЬНОСТІ З ПЕРЕРОБКИ УРАНОВИХ РУД

НП 306.4.03/2.044-2001

ВИМОГИ ДО ЗВІТУ ПРО АНАЛІЗ БЕЗПЕКИ ПРОВАДЖЕННЯ
ДІЯЛЬНОСТІ З ПЕРЕРОБКИ УРАНОВИХ РУД

НП 306.5.03/2.045-2001

Видається окремо

КИЇВ
МІНІСТЕРСТВО ЕКОЛОГІЇ ТА ПРИРОДНИХ РЕСУРСІВ УКРАЇНИ
2001



Міністерство охорони здоров'я України

б. Радіаційна гігієна

Основні санітарні правила
забезпечення радіаційної безпеки
України

ДЕРЖАВНІ САНІТАРНІ ПРАВИЛА
6.177-2005-09-02

ВИДАННЯ ОФІЦІЙНЕ



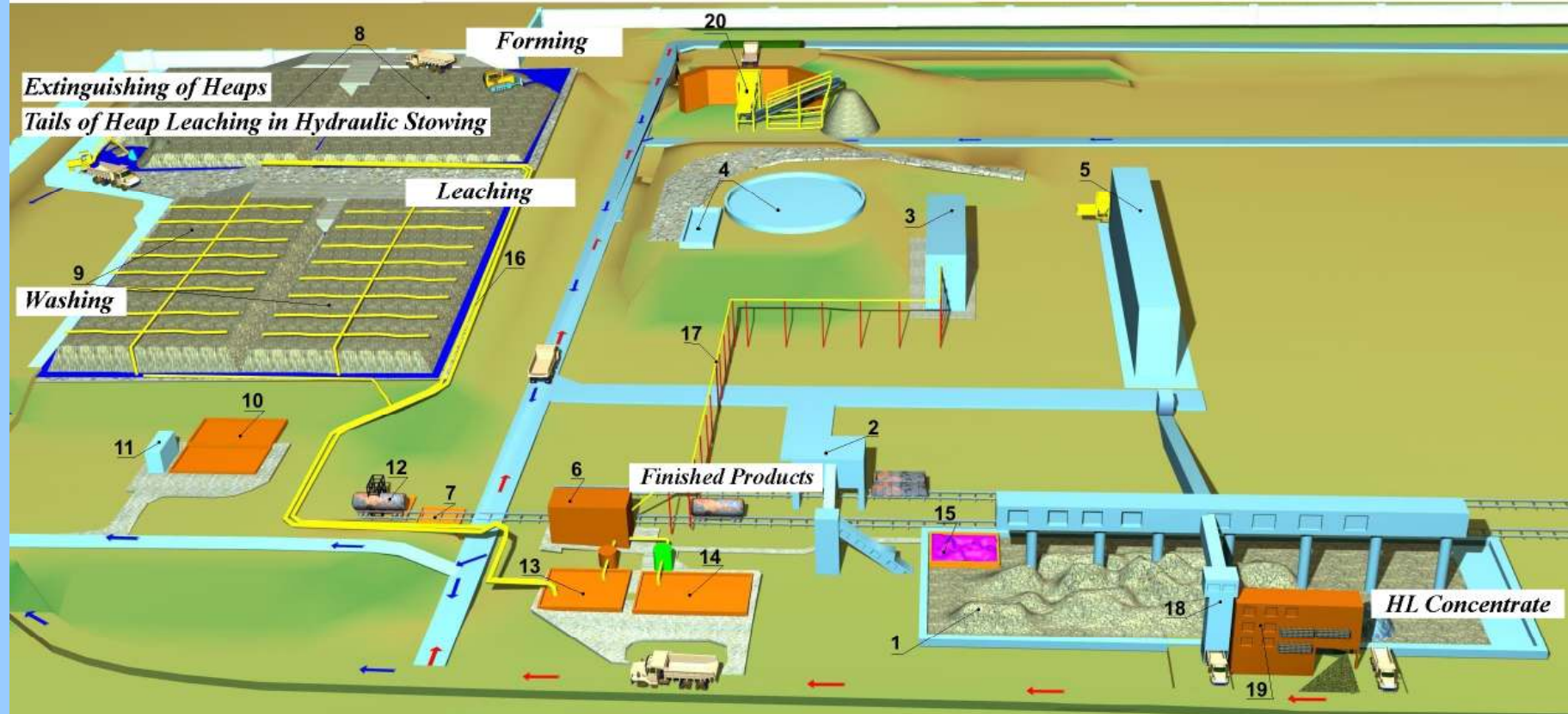
Heap leaching on Smolino mine



The Smolinskaya Mine

Ground of Industrial Development of Heap Leaching Technology

- 1 - Open Ore Store;
- 2 - Building of Railway Carriage Transfer;
- 3 - Technological Corps of Water Treatment;
- 4 - Cone-thickener with Dewatering Box of RSP;
- 5 - Radiometric Sorting Plant (RSP);



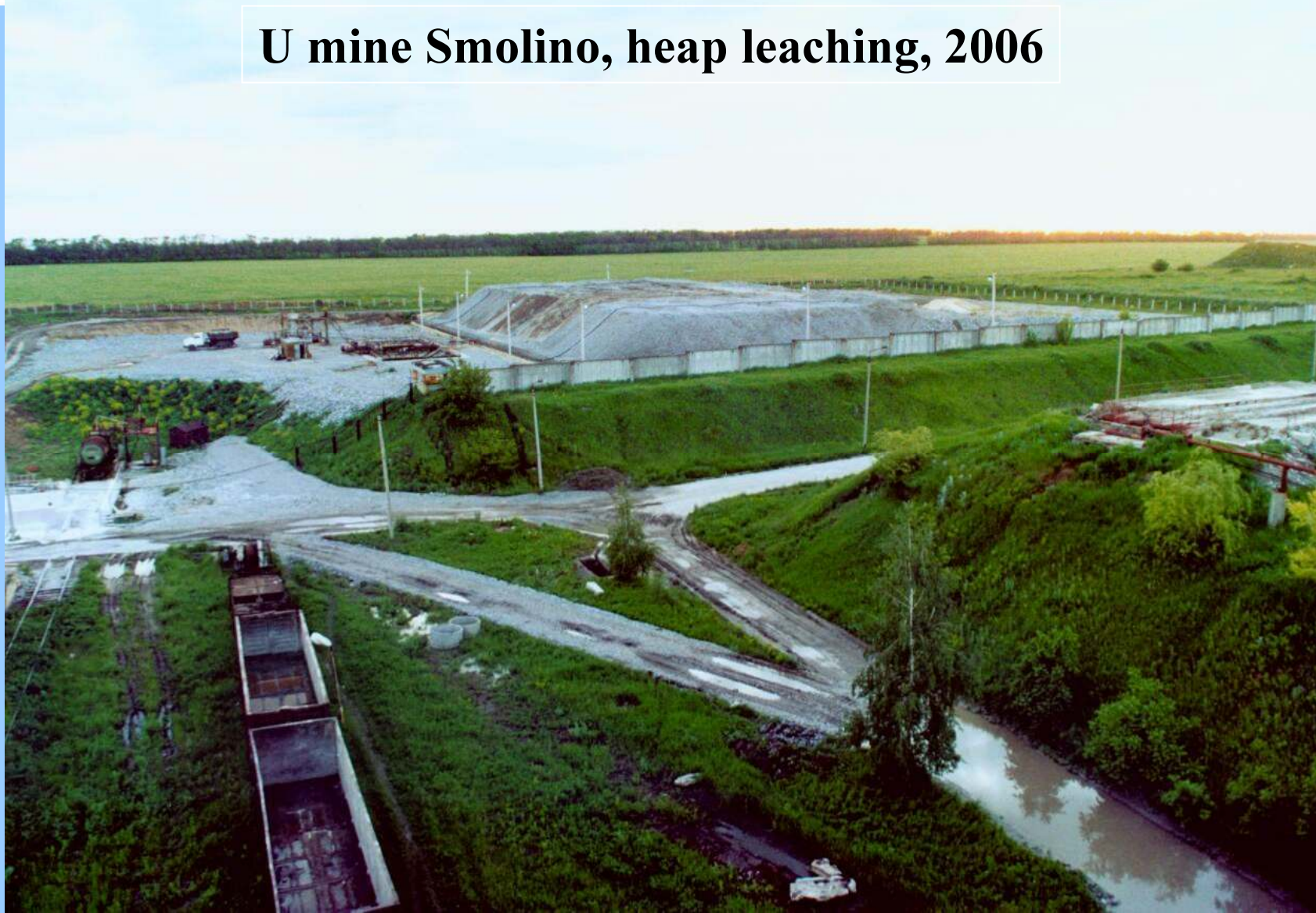
- 6 - Technological Corps of Water Treatment of HL;
- 7 - Lime Discharge & Storing Unit;
- 8 - Ground № 1 of HL Technology;
- 9 - Ground № 2 of HL Technology;
- 10 - Well № 3 of Washout Waters;

- 11 - Pump Station of Washout Waters;
- 12 - Acid Acceptance & Issuance Unit;
- 13 - Well № 2 of Productive Solutions;
- 14 - Settling well № 4;
- 15 - Manganese Dioxide Storing Ground;

- 16 - Terrestrial Track of Technological Pipeline System;
- 17 - Technological Overpass;
- 18 - Tail Sorting Plant of RSP;
- 19 - Tail Bin of RSP;
- 20 - Crushing Unit;



U mine Smolino, heap leaching, 2006



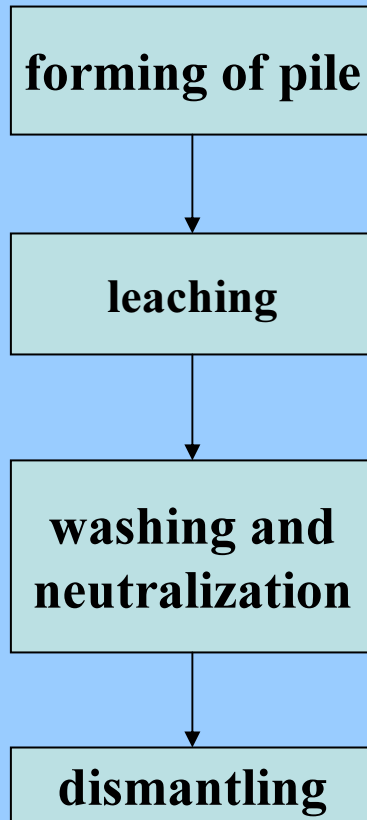
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Heap leaching technology



Technological stages:



Material of the leaching ore pile, after washing and neutralization, is used, as the hardening stowage, for fillup of mine block cavity

Time of leaching of one pile by volume of 30 000 tons, middle height - 6 m - is 3 months.

Basic technological operation on U leaching from pile is the process of its irrigation, which is characterized by the following parameters :

- The density of irrigation - is 25 l/m² per hour.
- The mode (type) of irrigation - is periodic, infiltration-capillary.
- Concentration of acid in circulatory solution – 10-50 g/l, sulfates – to 50 g/l.
- At such mode, time of contact of portion of working solution with an ore in the body of pile makes 24-40 hours.
- Middle concentration of uranium in products solutions - 140 mg/l.



Heap leaching technology (experimental)



- Result: 30 000 t (ore – approx. 0,08%) - 18 t (U)



Reprocessing of rock debris on Smolino mine (“Altait”).



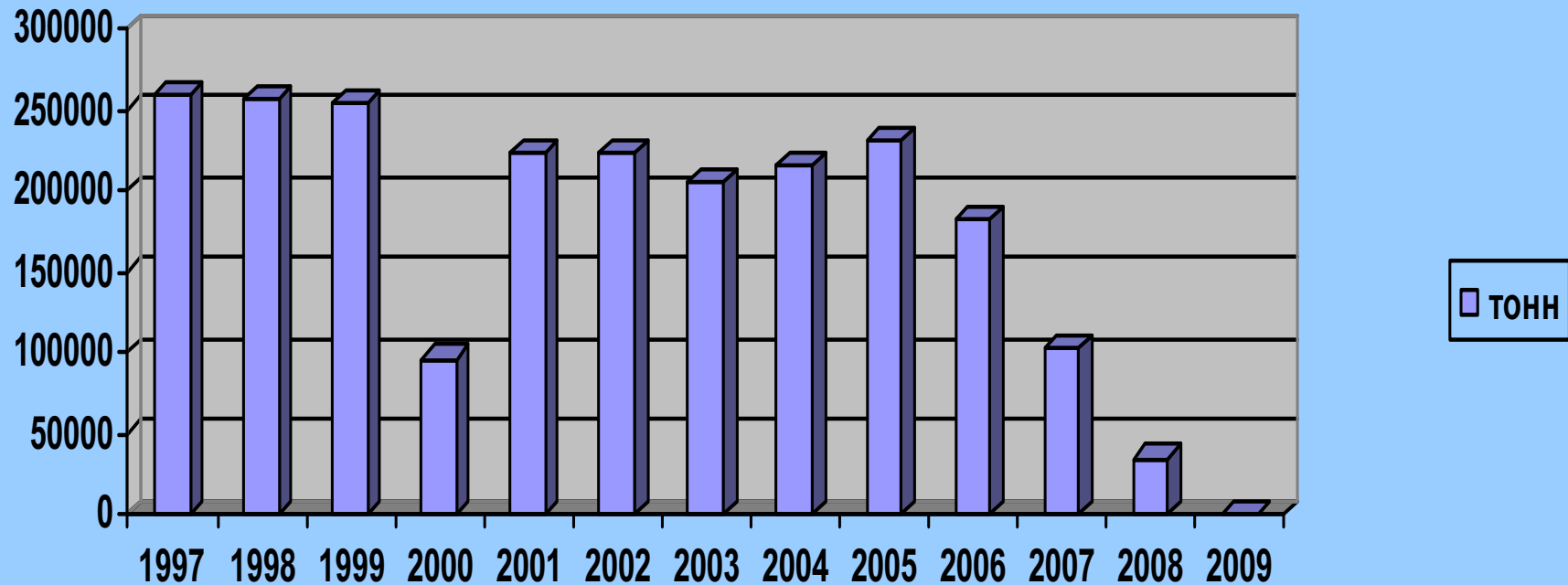
During operation of Smolino mine (from 1976) about 5 600 000 tons of waste rock and waste of radiometry grading of uranium ore is accumulated on mine site (800 000 t of U-ore per year).



U mine Smolino, 2007



Reprocessing of rock debris on Smolino mine (“Altait”)



The dynamics of annual accumulation of waste rock in the dump of the Smolino mine
(total amount 5 600 000 t).





“ALTAIT”





“ALTAIT”



Quality of atmospheric air on the dump and the «Altait complex» sites:

- Equivalent equilibrium volume activity of radon-222 on a dump – 52,26 Bq/m³.
- Equivalent equilibrium volume activity of radon-220 (toron) on a dump – 2,43 Bq/m³.
- Exposure radiation dose rate of gamma-radiation on a dump – 176 μR/h.
- Exposure radiation dose rate of gamma-radiation in the distance 10 m from a dump – 47 μR/h.
- Exposure radiation dose rate of gamma-radiation in the distance 20 m from a dump – 31 μR/h.
- Average content of uranium in the dump - 0,022%.
- Average content of uranium in the dust of dump - 0,014%, and thorium – 0,0038%.



“ALTAIT” operation in 2009



Result:

Total quantity of waste rock extracted from a dump in 2009 - 753 000 t (U 0,019% average).

Waste of ore pretreatment - into debris pile - 35 200 t (U < 0,01%).

ALTAIT (machine class):

Directed to heap leaching – 36 900 t (U 0,035%).

Directed to Hydrometallurgical Plant - 102 700 t (U 0,047%).

Received the “machine class” - 266 600 t (U 0,023%)

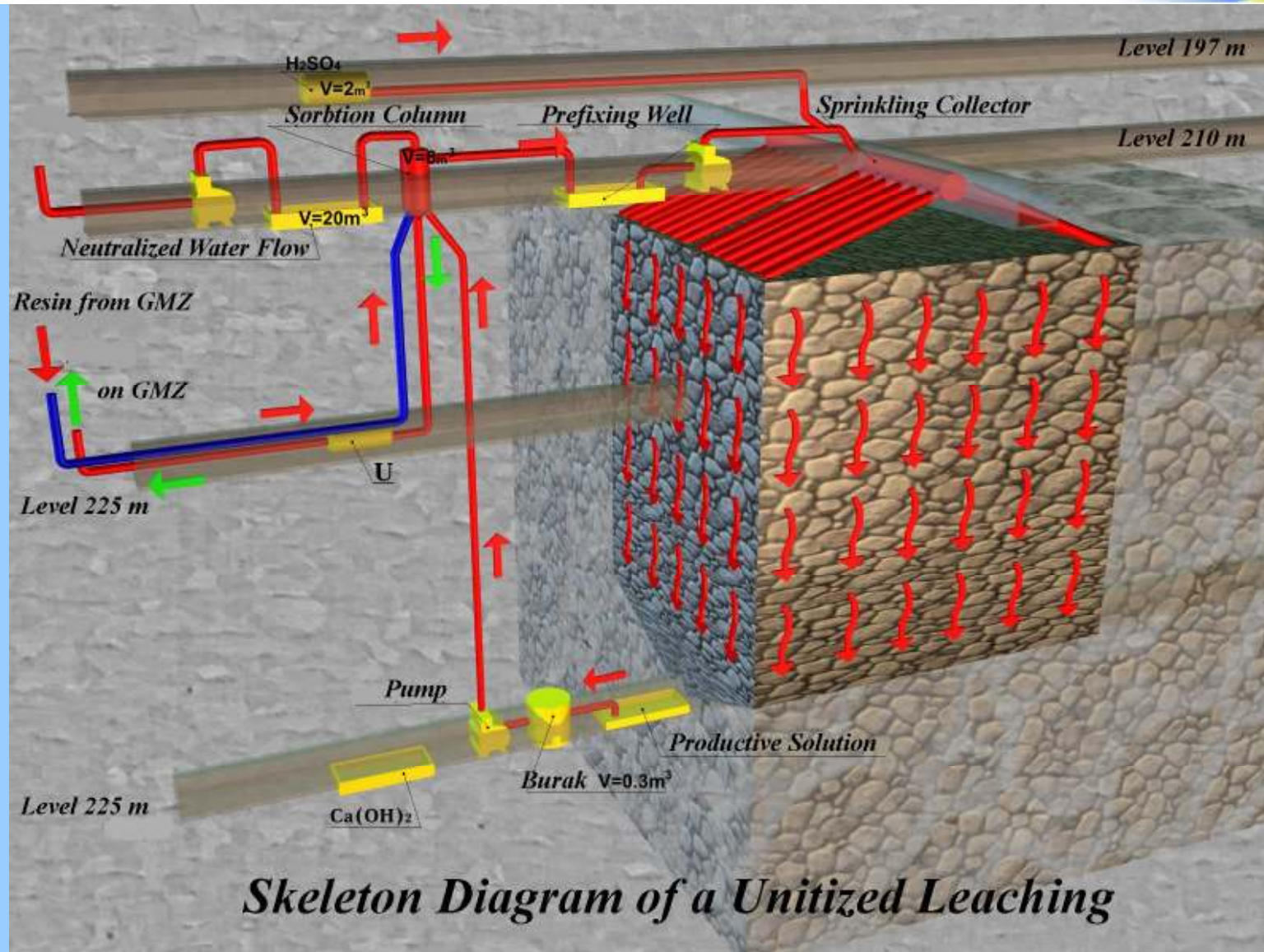
- recovery again.

Directed to the tails – 211 600 t (U < 0,009%).

Volume of waste rock decrease to 3 time.



Stope (block) leaching on Ingulsky mine





Stope (block) leaching on Ingulsky mine



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Stope (block) leaching on Ingulsky mine





Stope (block) leaching on Ingulsky mine



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Stope (block) leaching on Ingulsky mine



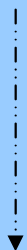
Block body – preparation,
explosive rupture

Main technological
stages:

acidation of ore in blocks



leaching of uranium
from an ore



- Acidation of ore in blocks is carried out by solution of sulphuric acid (concentration of acid 50 g/l). Solution flow - 57 m³/h. Irrigation flow – 34 l/m² per hour.
- The system of irrigation are the network of the bored irrigation wells with 2.5 x 2 m polyethylene tubes d 16 mm.
- The acidation period continues is approximately 2 months to achievement of average U contents in productive solution 150 mg/l. The process of U leaching and sorption starts after achievement of the indicated concentration.
- Leaching is carried out by solution of sulphuric acid (15 g/l). The density of irrigation is the same, as at acidation of ore in a block. Ending of leaching process is set by stopping of concentration increasing in solution circulatory through a block.



Stope (block) leaching on Ingulsky mine



(cont.)

Main technological stages:

U sorption from the productive solutions by ion-exchange resin AMP

washing of the leaching blocks by mine water

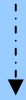
- Duration of period of leaching and sorption continues approximately 9 months.
- Sorption of uranium is conducted on ion-exchange resin AMP in the sorption column. Capacity of AMP - 30 kg/m³. Height of working layer of AMP is 4 m. Rate of productive solution movement is 30 m/h.
- U saturated AMP (4,3 m³/day) unloads from the column and is sent to GMP (Yellow Water City) for the further processing.
- After stopping of leaching process for the decline of sulphuric acid content in ore material his washing is carried out. Washing is carried out on the leaching scheme (without addition of acid). Solutions, passing through an ore in blocks, wash her, acidity of solutions decreased, and in a sorption column uranium are fixed additionally. Under reaching pH= 3-4, solutions through the sorption column flow into neutralization sump, after that washing of the leaching ore by mine water begins



Stope (block) leaching on Ingulsky mine (cont.)



Main technological stages:



neutralization of
washing waters
on mine water
treatment complex

- Neutralization is carried out by lime milk.
- After neutralization washing water with a PH 7-7,5 by pump sent to mine water treatment installation.
- Time of washing of the leached ore blocks will make 48 days at productivity of pump 63 m³/h and during 15 h/day. General volume of the washing waters – 45 500 m³.
- Duration of washing and neutralization process and discharge of washing waters on mine water treatment installation will make approximately about 2 months.



Stope (block) leaching (experimental)

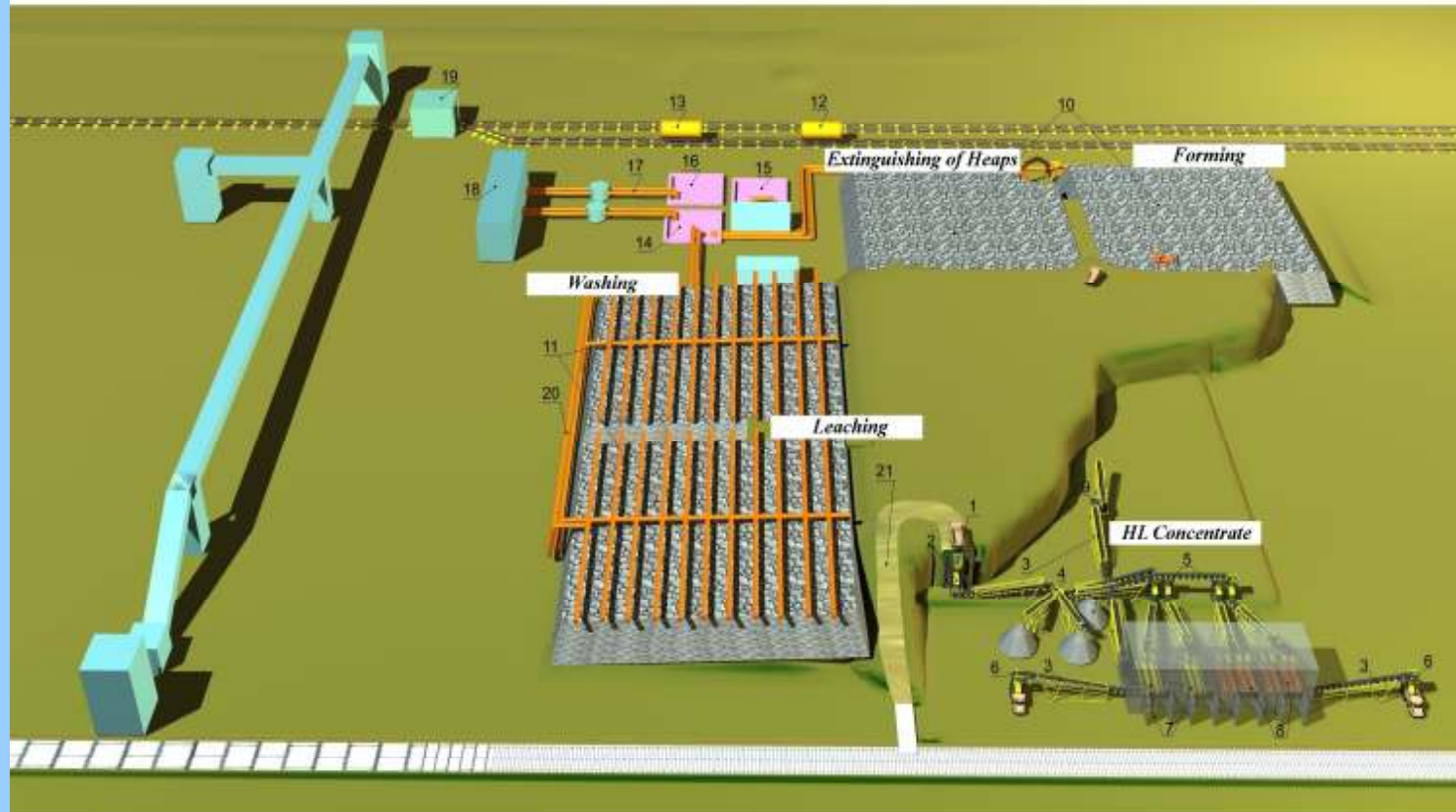
- Ore block – 8-10 thousand t, 0,06% - 4 t U.
- In preparation – 100 000 t U ore.



Future activity (in preparation)

The Ingul'skaya Mine

New technology – Pile Grading & Heap Leaching



1 - Loading Storage;

2 - Jaw Crushing;

3 - Conveyer;

4 - Unbalance Elbow Screens;

5 - Live Storage with Feeding;

6 - Issuance with Storage & Feeding Unit;

7 - Separators "Abad" of Department No. 1

8 - Separators "Mineral" of Department No. 2;

9 - Mobile Crushing & Screening Unit;

10 - Ground No. 1 of HL Technology;

11 - Ground No. 2 of HL Technology;

12 - Acid Acceptance & Issuance Unit;

13 - Finished Products;

14 - Well of Productive Solution

15 - Well of Washout Waters;

16 - Dewatering box;

17 - Technological Pipeline System;

18 - Technological Corps;

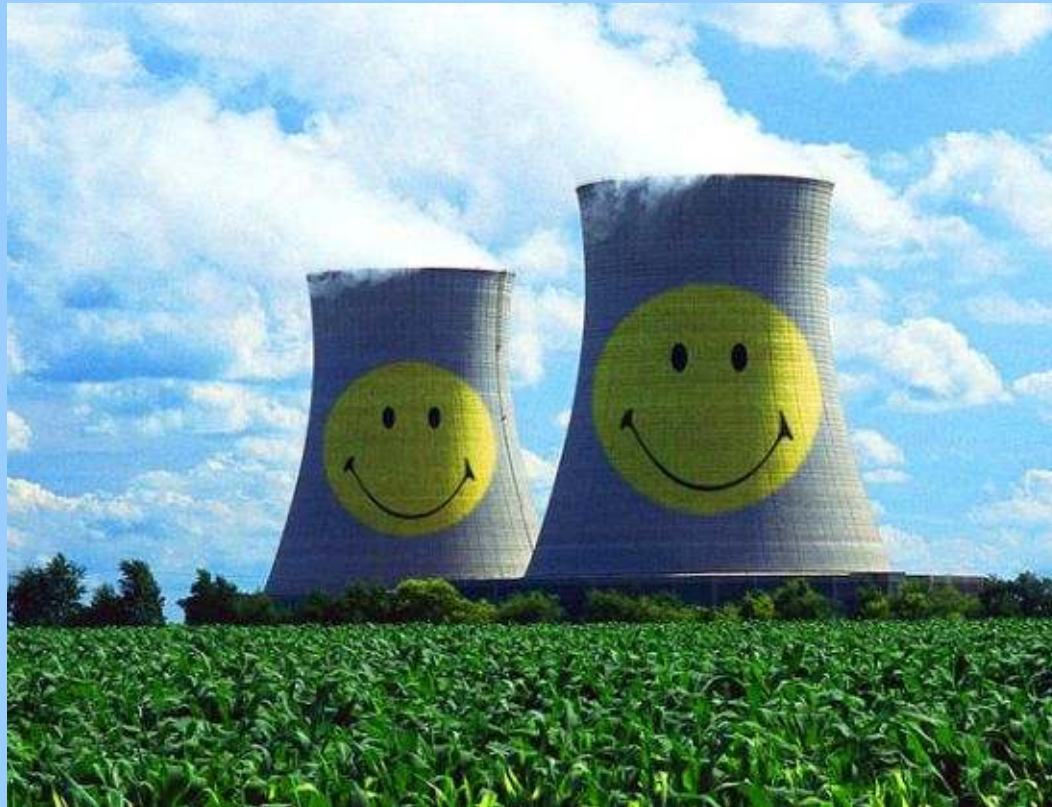
19 - Weighing Station;

20 - Integral Track of Technological Pipeline System;

21 - Loading Ramp.



Thank you for your attention!



If you have any questions or you need additional information, please contact:

tel: + (380 44) 254 3451, fax: + (380 44) 254 3311

e-mail: riazantsev@hq.snrc.gov.ua