



National Research Center “Kurchatov Institute”

POSSIBILITIES AND PERSPECTIVES OF TDLS APPLICATION IN NUCLEAR INDUSTRY

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General scheme of nuclear fuel cycle

Mining, milling, leaching



Production of concentrates



Production of UF₆



Enrichment



Fuel fabrication



Nuclear power plants



Depleted UF₆



Depleted UF₆ reprocessing



Spent fuel reprocessing



Mining, milling, leaching

Leaching – production of different solvents of uranium.

There are two main scheme of leaching

Solution in acids H_2SO_4 , HNO_3

Solution in ammonia carbonate $(\text{NH}_4)_2\text{CO}_3$

Third method – usage of bacteria (*Thiobacillus ferrooxidans*)
is under investigations

Gaseous pollutants – SO_2 , NO_x , NH_3



Production of concentrates (yellow cakes)

Extraction and re-extraction of uranium compounds from solutions using different resins.

Production of yellow cakes.

Yellow cake – mixture of different compounds with uranium content from 50% to 80-90%

First it was name of concentrate of ammonia polyuranate – $(\text{NH}_4)_2\text{U}_2\text{O}_7$.

In dependence on process it can be also other

main component $(\text{NH}_4)_4\text{UO}_2(\text{CO}_3)_3$ – ammonia tryuranilcarbonate.

During extraction and re-extraction processes it is possible evaporation of organic solvents.

There are no reliable data on organic pollutions during drying process of yellow cake. Besides that organic solvents have wide band molecular spectra.

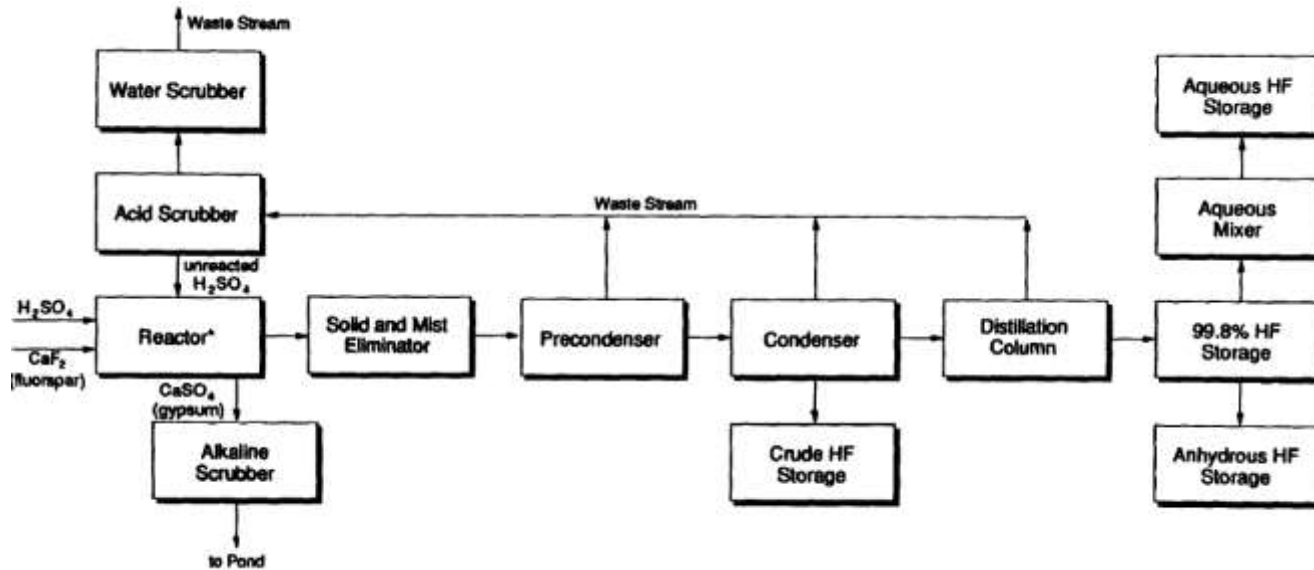


Production of uranium hexafluoride

First it is necessary to produce HF and F₂



Electrolysis of melts $\text{KF} \cdot 2\text{HF}$ produce F₂



Gaseous pollutants – SO₂, HF, PF₃, SiF₄ and several others from CaF₂



Production of uranium hexafluoride

Multistep process including at least double step refining

Solution of yellow cake in HNO_3 :

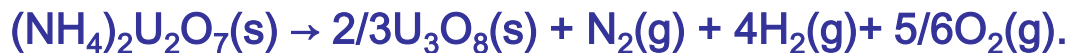


First step refining extraction by tributylphosphate in kerosene – $(\text{C}_4\text{H}_9)_3\text{PO}_4$).

Precipitation of ammonia diuranate, chemical denitration:



Drying and decomposition of ammonia diuranate



Fluorination, production of UF_4 :



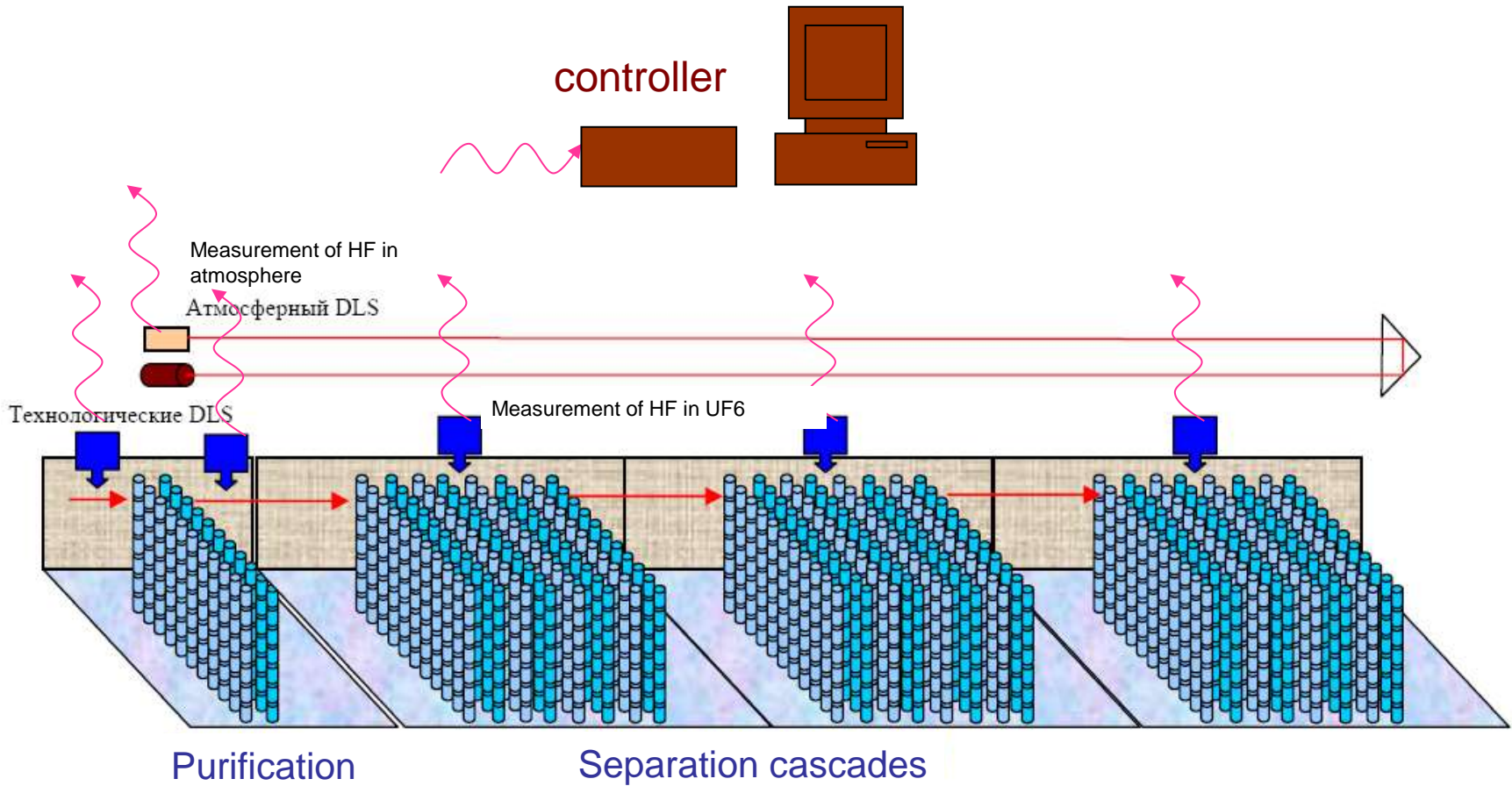
Fluorination UF_4 :



Gaseous pollutions – HF , NH_3 , NO_x , UF_6 , organics



Enrichment of uranium hexafluoride





Depleted uranium hexafluoride

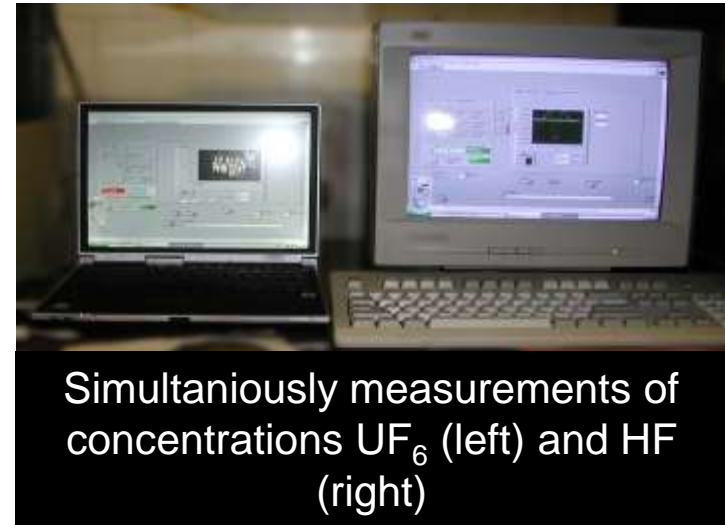
New storages



Old storage



Depleted uranium hexafluoride



lasers

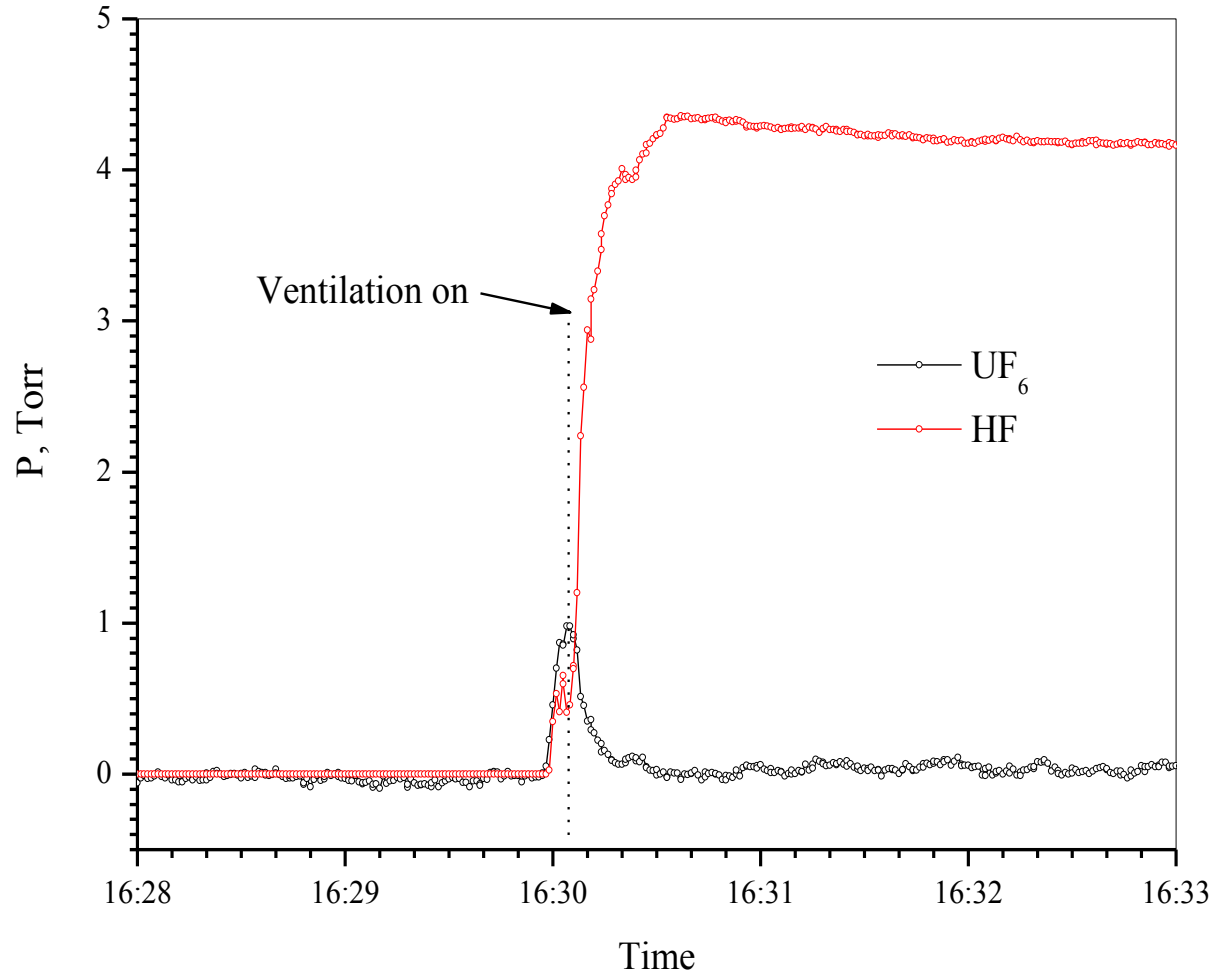


detectors

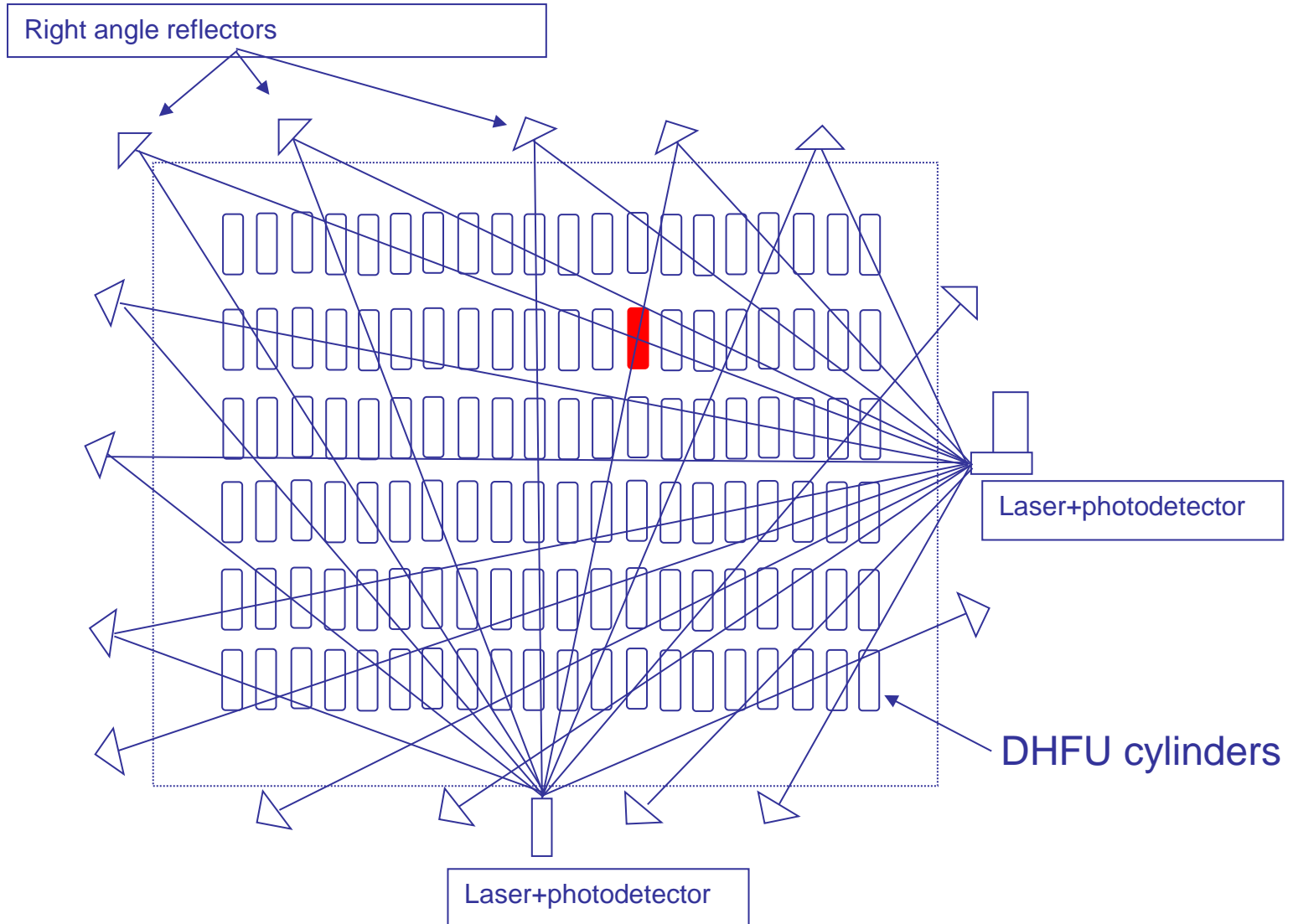




Depleted uranium hexafluoride

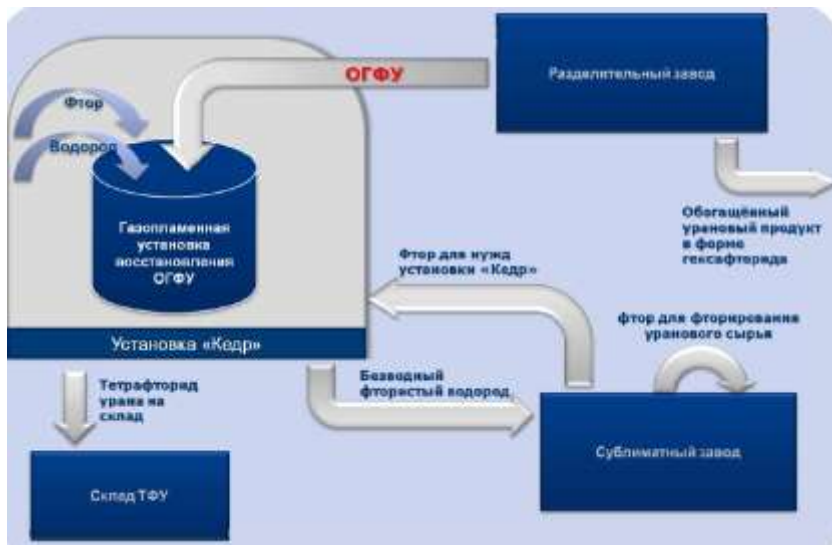


Depleted uranium hexafluoride

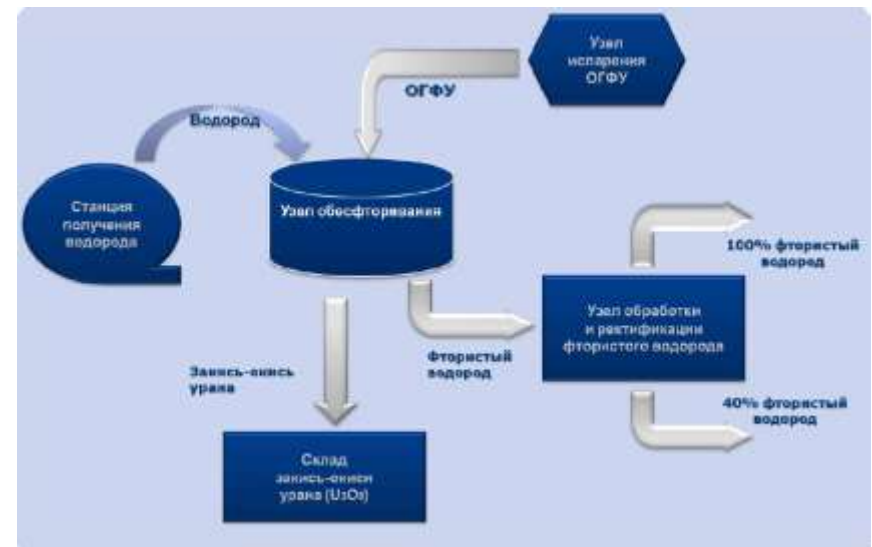




Depleted UF₆ reprocessing



Production of UF₄



Production of U₃O₈



Fuel fabrication



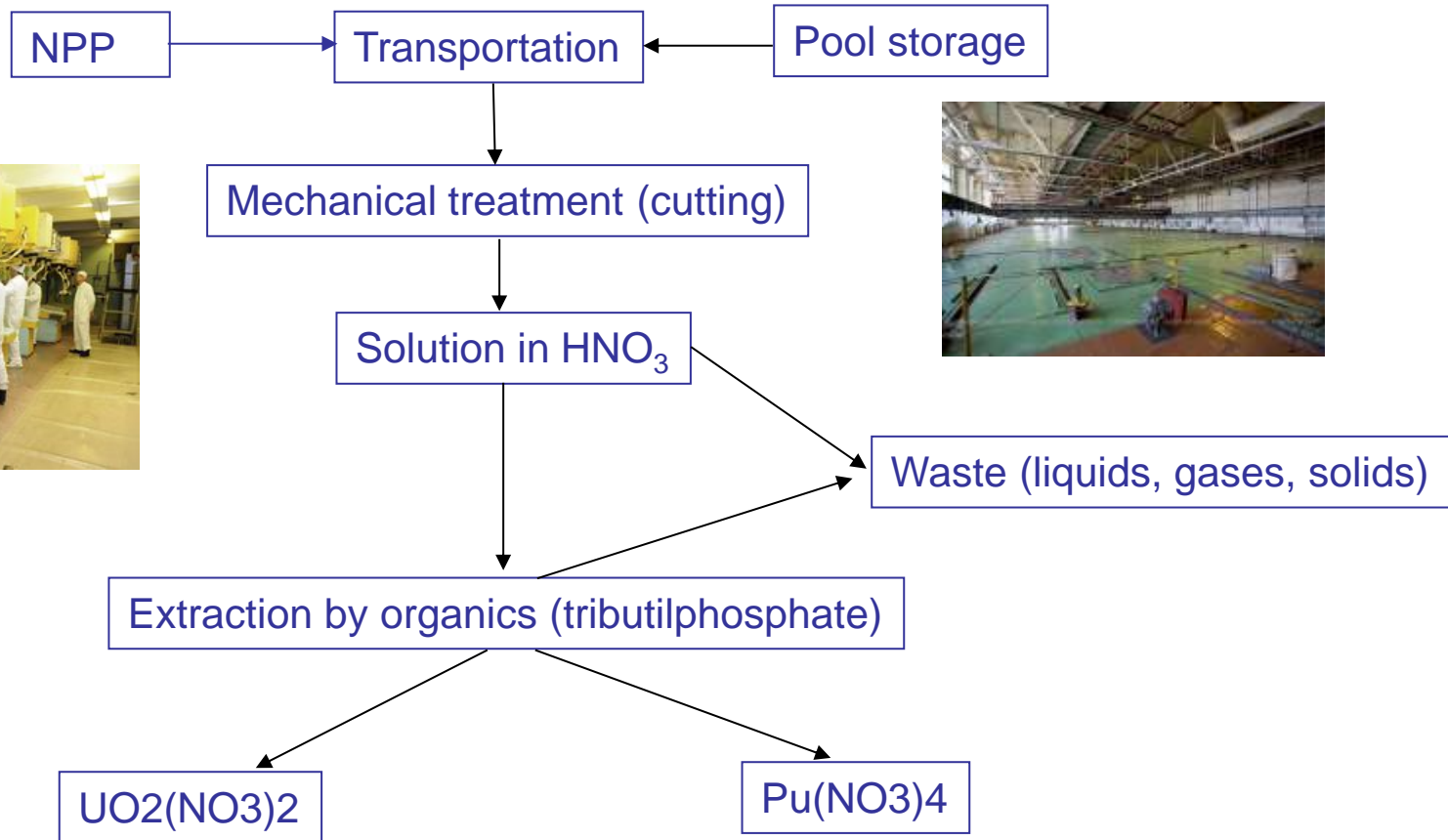


Nuclear power plants





Spent fuel reprocessing



NO_x , $^{14}\text{CO}_2$, HDO, HTO, I₂, Xe, Kr, aerosols



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Thank you for your attention