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Nuclear Fuel Cycle, KD2430

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Nuclear Fuel Cycle, KD2430

- A merge of the courses Nuclear Chemistry (KD2080) and Nuclear Fuel Cycle (KD2290)

⇒ The old Nuclear Fuel Cycle is expanded with some Nuclear Chemistry

- https://www.kth.se/social/course/KD2430/

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Nuclear Energy in the World 2010*

Country	TWh	% e	Reactors
USA	807.1	19.6	104
France	410.1	74.1	58
Japan	280.3	29.2	51
Russia	159.4	17.1	33
South Korea	141.9	32.2	21
Germany	133	28.4	9
Canada	85.5	15.1	17
Ukraine	83.95	48.1	15
China	71	1.8	15
Spain	59.3	20.1	8
United Kingdom	56.9	15.7	18
Sweden	55.7	38.1	10
Belgium	45.7	51.2	7
Czech Republic	26.4	33.2	6
Switzerland	25.3	38	5

Country	TWh	% e	Reactors
Finland	21.9	28.4	4
India	20.5	2.9	20
Hungary	14.7	42.1	4
Bulgaria	14.2	33.1	2
Brazil	13.9	3.1	2
Slovakia	13.5	51.8	4
South Africa	12.9	5.2	2
Romania	10.7	19.5	2
Argentina	6.7	5.9	2
Mexico	5.6	3.6	2
Slovenia	5.4	37.3	1
Netherlands	3.75	3.4	1
Pakistan	2.6	2.6	3
Armenia	2.3	39.4	1
WORLD	**2 590**	**13,8**	**428[ii]**

[ii] Including Taiwan's 6 reactors

*According to World Nuclear Association, www.world-nuclear.org

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Planned reactors January 2012*

Country	Today	Under constr	Planned
China	15	26	51
Russia	33	9	14
India	20	6	17
South Korea	21	5	6
Canada	17	3	3
Japan	51	2	10
Slovakia	4	2	0
USA	104	1	7
Argentina	2	1	2
France	58	1	1
Pakistan	3	1	1
Finland	4	1	0
Brazil	2	1	0
Poland	0	0	6
United Kingdom	18	0	4
Turkey	0	0	4

Country	Today	Under constr	Planned
UAE	0	0	4
Vietnam	0	0	4
Ukraine	15	0	2
Czech Republic	6	0	2
Bulgaria	2	0	2
Romania	2	0	2
Iran	1	0	2
Bangladesh	0	0	2
Belarus	0	0	2
Indonesia	0	0	2
Kazakhstan	0	0	2
Armenia	1	0	1
Egypt	0	0	1
Jordan	0	0	1
Lithuania	0	0	1
WORLD	**428**	**61**	**158**

*According to World Nuclear Association, www.world-nuclear.org

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Proposed reactors January 2011*

Country	Proposed
China	120
India	40
Russia	30
USA	27
Saudi Arabia	16
Ukraine	11
UAE	10
Italy	10
United Kingdom	9
Vietnam	6
South Africa	6
Japan	5
Thailand	5

Country	Proposed
Brazil	4
Turkey	4
Belarus	4
Chile	4
Canada	3
Switzerland	3
Pakistan	2
Finland	2
Bangladesh	2
Kazakhstan	2
Hungary	2
Mexico	2
Malaysia	2

Country	Proposed
Slovakia	1
Argentina	1
France	1
Czech Republic	1
Romania	1
Indonesia	1
Egypt	1
Slovenia	1
Netherlands	1
Israel	1
North Korea	1
WORLD	**343**

Reactors today: **434**

Reactors under construction, planned and proposed: **61 + 156 + 343 = 560**

*According to World Nuclear Association, www.world-nuclear.org

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L2&3: Fundamental Nuclear Chemistry

- Why are some isotopes radioactive?
- How do they decay?
- Different kinds of radiation
- Kinetics of radioactive decay

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L4: Interaction of Ionizing Radiation with Matter

- How do different radiation types interact with matter?
- Radiation Protection

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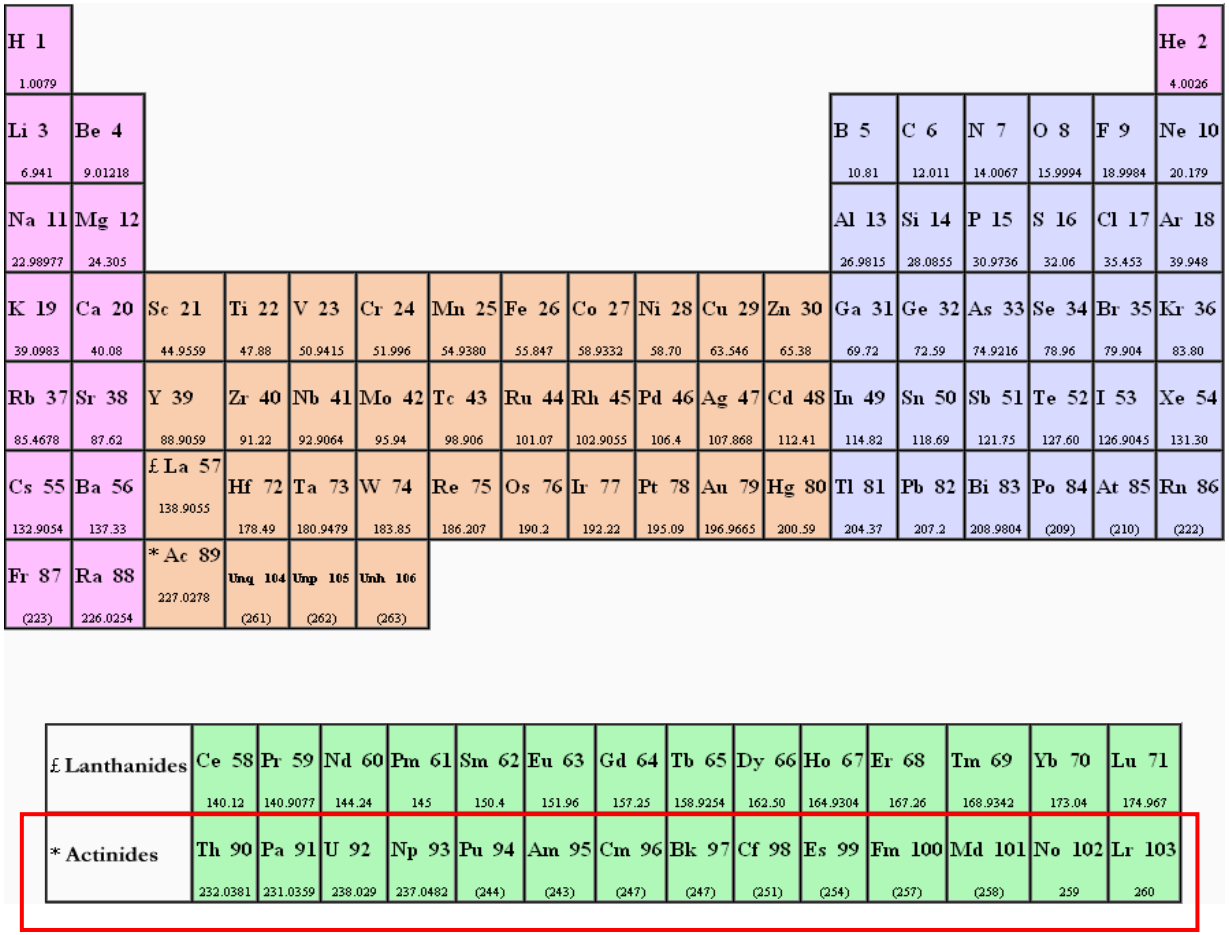
L5: Detection of Ionizing Radiation Radiochemistry

- Instruments for detecting ionizing radiation are presented
- Radiochemistry: the use of radioactive isotopes to follow different processes

L6: The Chemistry of the Actinides

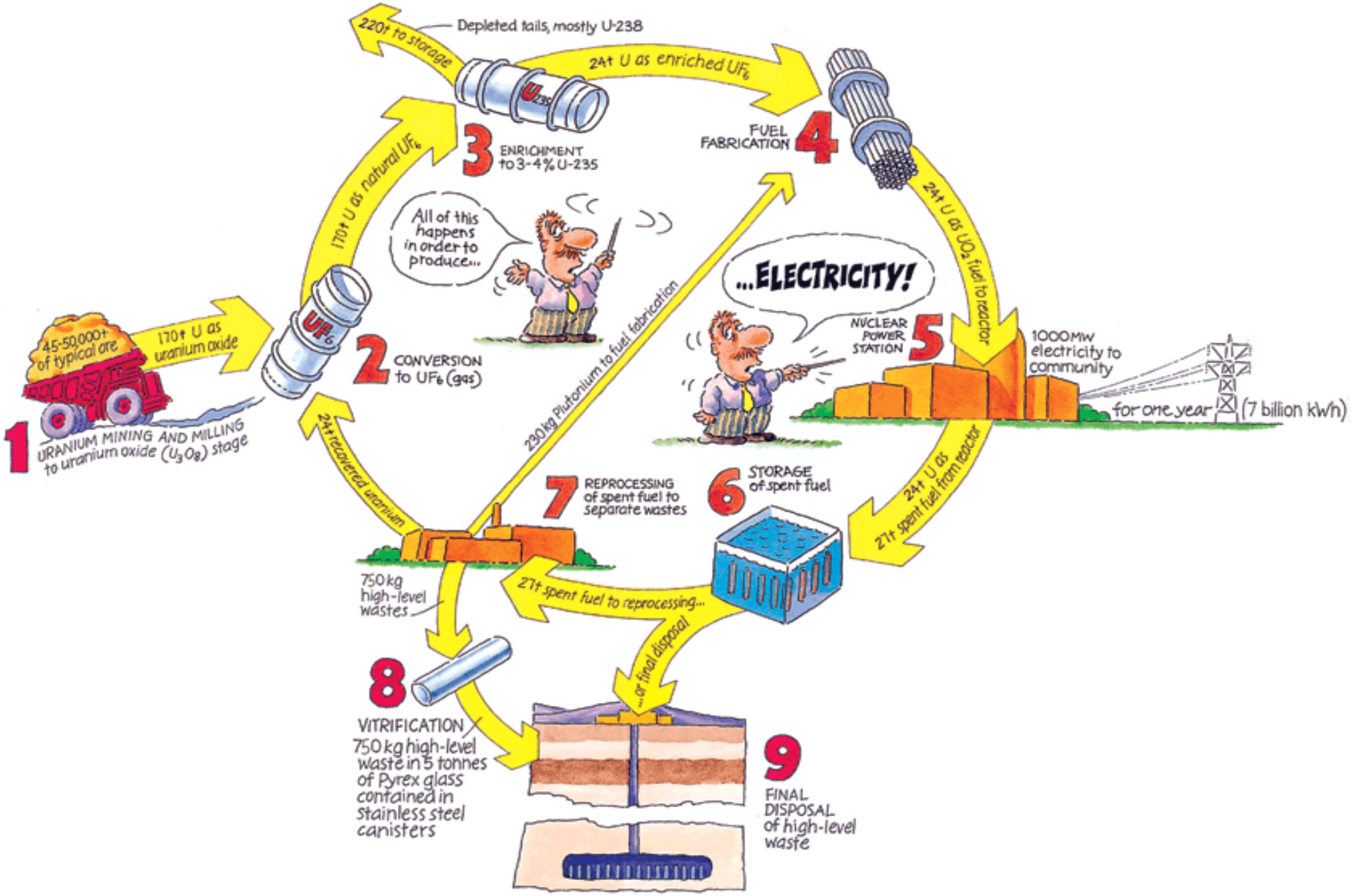
In periodic table Atomic number 89-103

Ac, Th, Pa, U, Np, Pu, Am, Cm, Bk, Cf, Es, Fm, Md, No, Lr



No stable isotopes and very radioactive

L7: Mining to fuel production



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L8 & 9: Reactor Concepts, Reactor Chemistry

- Different types of Nuclear Reactors are presented
- The Chemistry of a Nuclear Reactor

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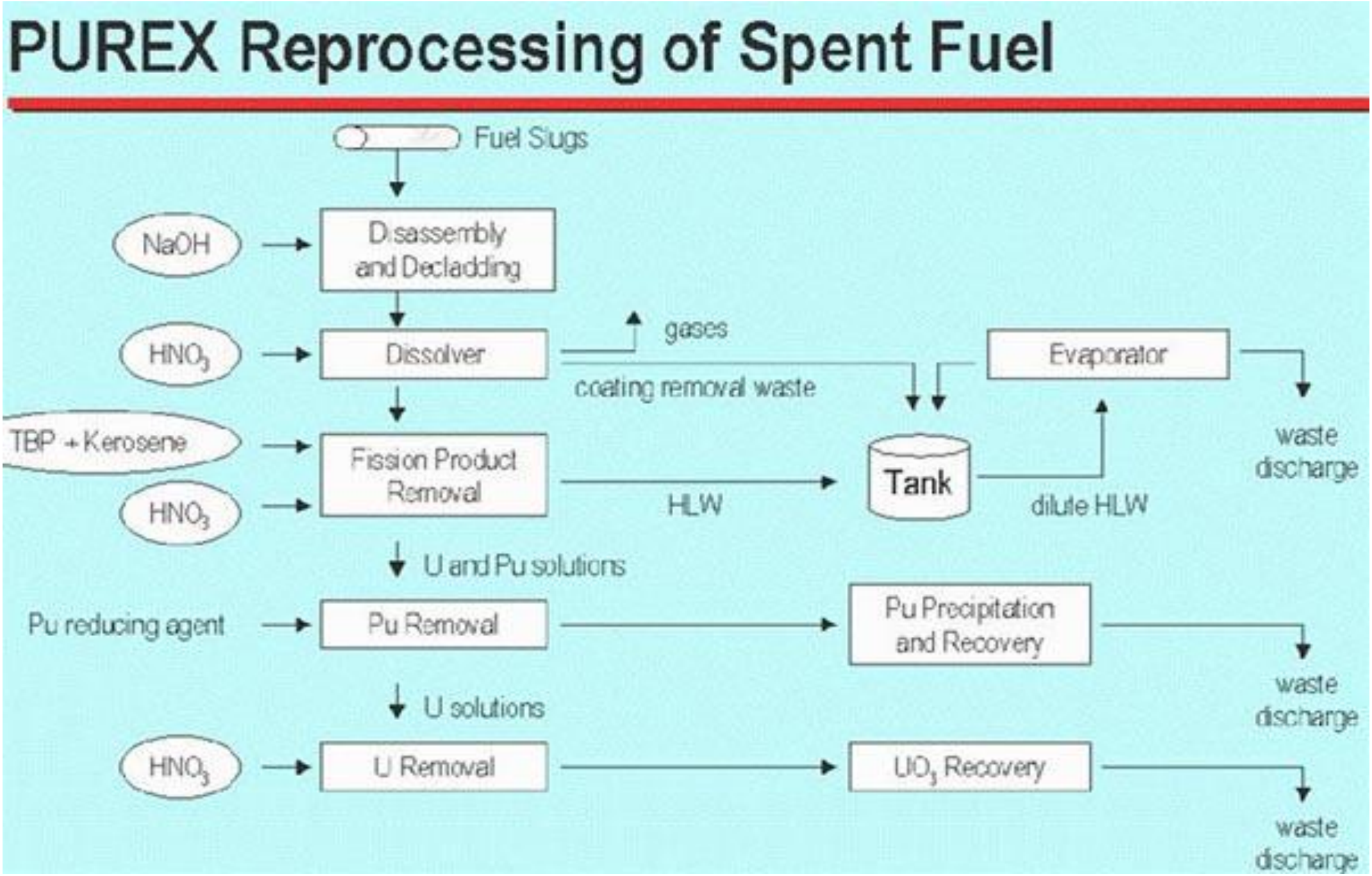
L10: The History of Nuclear Power

- The Manhattan Project, Oak Ridge, Hanford, Majak
- Accidents; 3 Mile Island, Chernobyl, Sellafield, Fukushima, etc.
- Environmental consequences, sanitation…



Handling of nuclear waste

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L12: KBS-3, Geological Storage

- How is the waste planned to be handled in
  a) Sweden (=KBS-3)
  b) Other countries

- Different kinds of planned geological storages are presented

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Lab: Detectors for Ionizing Radiation

- Groups of 2-3 students
- Book time with Mats (after L5)
- Different detectors are presented. The principle on how they work, advantages and drawbacks, handling

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Project

- Groups of 2-3 students
- Written report and oral presentation
- At the oral presentation another group will act as opponent

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Field trip

- One day excursion.

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Schedule

Date & time	Place	Lecturer	Activity	Reading
17/1, 10-11	L43	MJ+SW	L1: Introduction	
18/1 13-15	Lib	MJ	L2: Fundamental Nuclear Chemistry, Part 1	Chapter 1-5
19/1 13-15	Lib	MJ	L3: Fundamental Nuclear Chemistry, Part 2	Chapter 1-5
23/1 15-17	E34	MJ	L4: Interaction of Ionizing Radiation with Matter	Chapter 6-7.3 & 18
25/1 13-15	Lib	MJ	L5: Detection of Ionizing Radiation, Radiochemistry	Chapter 8-9
31/1 13-15	Lib	MJ	WS1: Workshop (calculation assignment)	
7/2 10-12	Lib	SW	L6: The Chemistry of the Actinides	
10/2 13-15	Lib	SW	L7: Mining, Enrichment, Fuel Fabrication	
14/2 10-12	Lib	MJ	L8: Reactor Concepts	
17/2 13-15	Lib	MJ	L9: Reactor Chemistry	
21/2 10-12	Lib	MJ+SW	L10: The History of Nuclear Power	
24/2 13-15	Lib	SW	L11: Concepts for Fuel Management	
28/2 13-15	Lib	MJ+SW	L12: KBS-3, Geological Storage	
2/3 13-15	Lib	MJ	WS2: Workshop (calculation assignment)	

Project presentation and field trip will be scheduled later
Lab will be scheduled individually for each group.