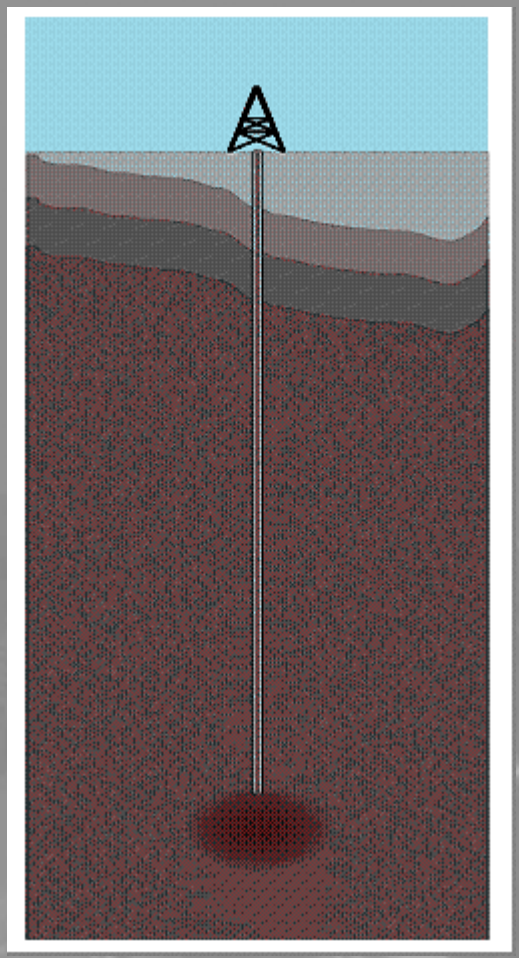
Committee on the Peaceful Uses
of Outer Space
Fiftieth session
11 June 2007

YUZHNOYE

design office

YUZHNOYE

Problem Statement



Exploration of the peaceful nuclear power engineering is under intensive development and propagation throughout the world. Analysis of the world experience revealed that a safe handling of the radioactive waste is among

the three key problems of the nuclear-power engineering along with its safety and economic indices.

With that a main trend of the technical policy in the field of handling of the radioactive waste of nuclear-power stations is to develop the up-to-date infrastructure, which will make possible to provide a safe collection, primary and deep waste reclamation up to the condition suitable for transfer of the radioactive waste to specialized enterprises for a long-term storage or final waste burial.

YUZHNOYE

Comparative characteristics of fuel consumption and environmental contamination by HPS and NPS

Name	HPS	NPS
Electricity generated	28 bill. kW/hour	28 bill. kW/hour
Atmospheric oxygen consumed	26 mill. t	-
Emissions into environment:		
-oxides of carbon	29 mill. t	-
-oxides of nitrogen	310 mill. t	-
-oxides of sulfur	620 thou. t	-
-ash	6,4 mill. t	-
Long-live radioactive nuclides	40 Curie	2 Curie
Dose rate in location area	45-80 μR/hr	10-14 μR/hr

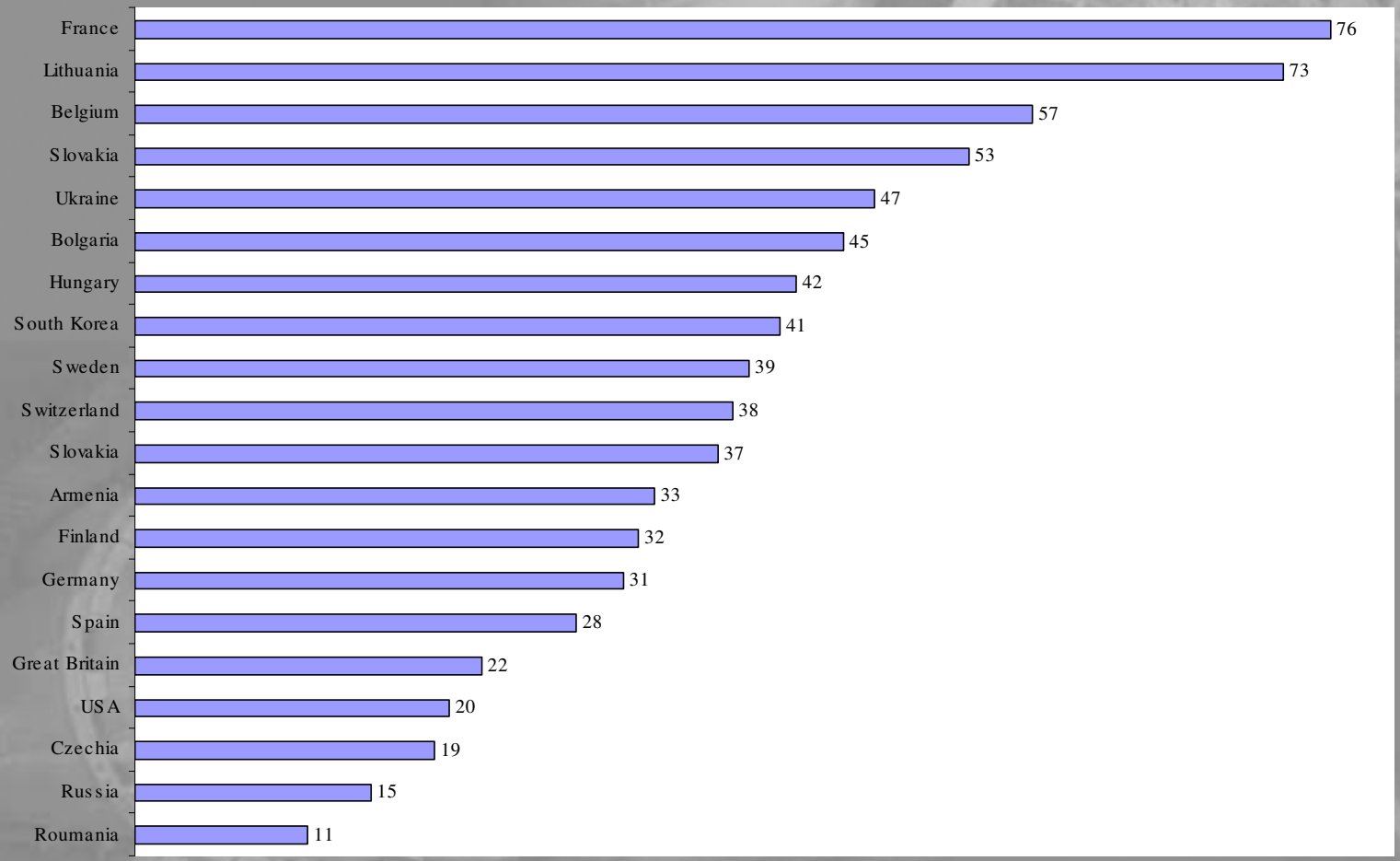
YUZHNOYE

Daily concentrations of HPS emissions into environment, μg/m³

Distance from tube	Sulfurous gas	Hydrogen sulphide	Oxide of nitrogen	Oxide of carbon	Ash
1 km	6,02	0,002	1,950	7,20	1,20
3 km	1,47	0,008	1,300	16,0	3,40
5 km	1,22	0,008	0,050	13,3	1,20
7 km	1,12	0,030	1,300	13,0	2,40
15 km	0,22	0,002	0,030	4,00	0,27
Limiting permissible concentration	0,50	0,008	0,085	3,00	0,50

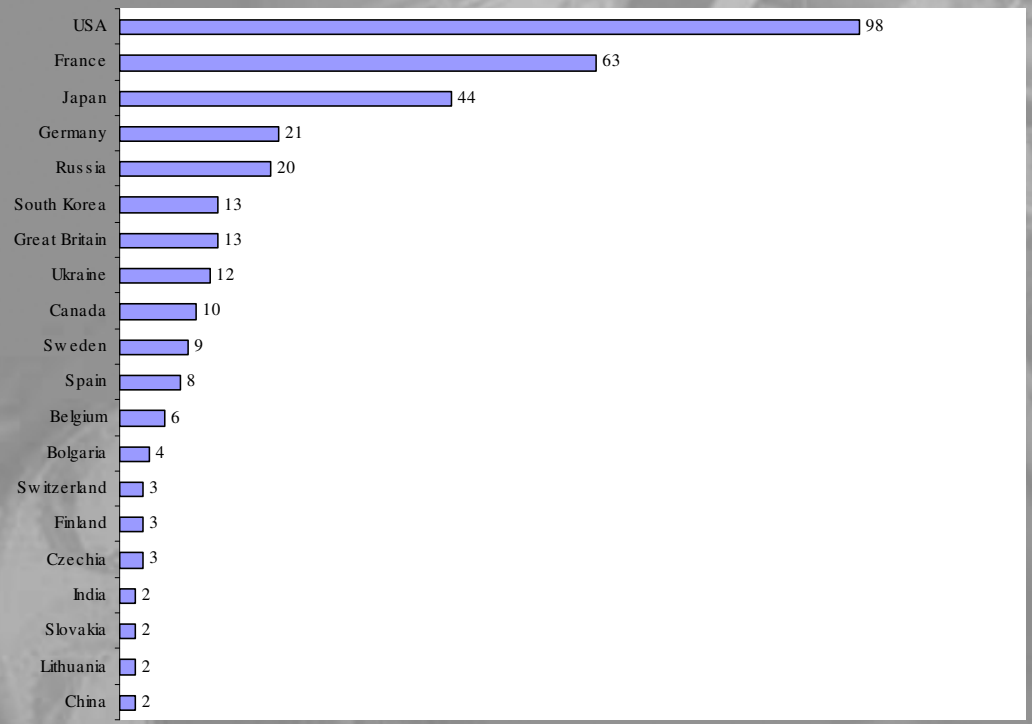
YUZHNOYE

Fraction of nuclear-power stations in the total power engineering in countries (%)



YUZHNOYE

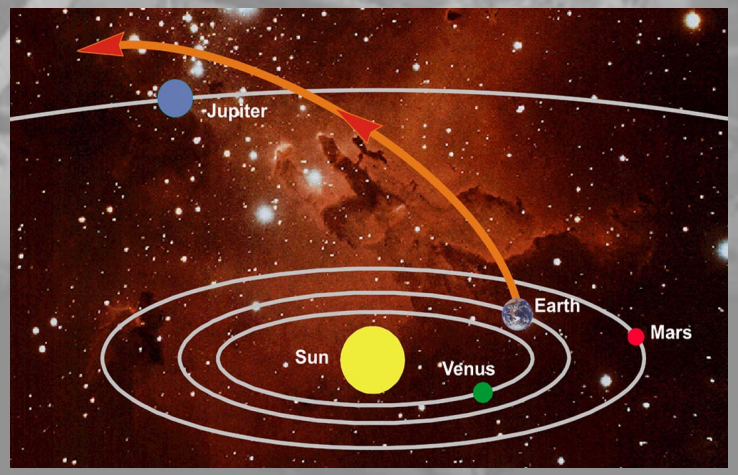
Total capacity of nuclear-power stations in countries, GW



YUZHNOYE

Suggested Approach

For LRW removal in space the following sequence of operations could be implemented:



- The LV deploys special waste orbital removal stage (with LRW) into reference circular orbit around the Earth.

- An orbital upper stage system provides injection into orbit of burial with the help of its own propulsion system.

YUZHNOYE

Suggested Approach

- The "long-life high activity" (with half-life period of hundreds of thousands of years) waste (LRW) might be stored in space. This will allow to forever free the Earth's biosphere from the most harmful part of highly radioactive waste.
- While waste with rather small half-life period (SHLP) will still be subject to vitrification and packing in special containers for geological burial, accumulation of LRW will stop in future geological repositories.

The problem of RW removal into space by means of LV systems requires joint efforts of experts from nuclear industry and the ones in the field of space industry:

- LRW after processing at radiochemical plants is separated from waste with small half-life period;
- Then, the LRW should be placed in capsules to be transported and inserted in containers for LV removal (containers of rocket removal).

YUZHNOYE

The reclamation process of DNF, coming from NPS is the evident future of all states, which develop the nuclear power engineering. Such «closing» of a handling cycle with nuclear fuel (HCNF) is economically feasible according to a number of reasons:

Economical:

- The requirements on natural uranium are reduced substantially (by 1/6 part) both at the expense of a return of 235-th isotope of uranium which did not burn in a reactor, and as a result of the formation of new nuclear fuel - plutonium
- 1 gram of plutonium is approximately equivalent to 1 ton of petroleum as a source of heat energy

Others:

- Reprocessed DNF can be used for production of TVELs
- Closing HCNF reduces the danger of the nuclear fuel distribution due to a «burning» of forming plutonium

YUZHNOYE

As an example of such joint researches the following may be:

- choice of a composition of elements removable into space, under the hypothesis of the set of requirements for a treatment level of waste of the nuclear power station reactors and permissible levels of the radioactive radiation from capsules being a payload for the space removal modules;
- determination of the required reliability and safety indices in estimate of the parameters of the rocket module with radioactive waste during its functioning from the launch to the going into a final orbit (or to a contact with a burial place, for example, on an asteroid);
- study and choice of the means and methods confirming the reliability and safety indices of the rocket-space elements of the common system for removal of radioactive waste; these confirming means and methods include experimental ones also;
- choice of a burial place (or a full destruction) of radioactive waste; versions of this choice can be asteroids, far-out orbits beyond the bounds of the Solar System or hit in an area of Solar protuberances.

YUZHNOYE

Zenit-3SLБ

A three-stage integrated launch vehicle (ILV) closely derived from the Sea Launch Zenit-3SL, is suited for delivering payloads to medium and high, circular and elliptical Earth orbits, including GTO and GEO, as well as escape trajectories.

ILV type	**Monoblock, Liquid-Propelled, Three-Stage**
Propellants	
Fuel	**Kerosene**
Oxidant	**Liquid Oxygen**
Payload mass injected into the GSO (1500 m/s), kg	**3600**
Maximum flight g-loads	**4**
LV launch periods	**During all year**
LV launch time	**in any time of day and night**
Injection Accuracy	
Perigee, km	**± 40**
Apogee, km	**± 100**
Inclination, degree	**± 0,1**
Reliability of LV flight	**0,96**
Probability of launch in preset time	**0,97**

YUZHNOYE

Launch Forecast

The number of "Zenit" type LV launches necessary to remove LRW corresponding to an annual work cycle of NPPs in function of their capacity is shown below.

Country	NPS power, Giga Watt	Launch number of Land Launch Zenit LV with new orbital stage
France	63	10
Germany	21	(3,15)
Russia	20	3
Great Britain	13	2
Ukraine	12	(1,8)
Bulgaria	4	(0,6)
Czech Rep.	3	(0,5)
Slovakia	2	(0,3)
Totally per year		21 (21,35)

YUZHNOYE

Version of Stage Work

Stage №	Name of Works	Result
1.	Development of the concept on removal of NPS high-level radioactive waste	Concept
2.	Scientific and research work on development of OS and RRC technical view	RDW on «Curie» subject
3.	Development and construction of OS and RRC experimental version for demonstration launch.	Experimental OS and RRC
	Demonstration launch using non-standard launch-vehicle	Demonstration launch
4.	Development and construction of the rocket-space complex with OS and RRC for removal of high-level radioactive waste	

YUZHNOYE

Contact Details

Stanislav Konyukhov
General Designer-
General Director
Yuzhnoye SDO

3, Krivorozhskaya Street
Dniepropetrovsk, UKRAINE, 49008
Phone: +380 56 770 04 47
Fax: +380 56 770 01 25
e-mail: space@yuzhnoye.com

Alexander Degtyarev
First Deputy General Designer-
General Director
Yuzhnoye SDO

3, Krivorozhskaya Street
Dniepropetrovsk 49008, UKRAINE
Phone: +380 56 770 04 47
Fax: +380 56 770 01 25
e-mail: space@yuzhnoye.com

Oleg Ventskovsky
Director
European Representation
Yuzhnoye SDO

20, rue Vautier, B-1050, Bruxelles,
BELGIUM
Phone/Fax +32 (2) 644 90 64
e-mail: oventskovsky@brutele.be