

Seminar at Kyoto University Research
Reactor Institute, Kumatori, 16 March 2011



Punishing legacy of atomic
bomb and nuclear energy
projects in Ukraine

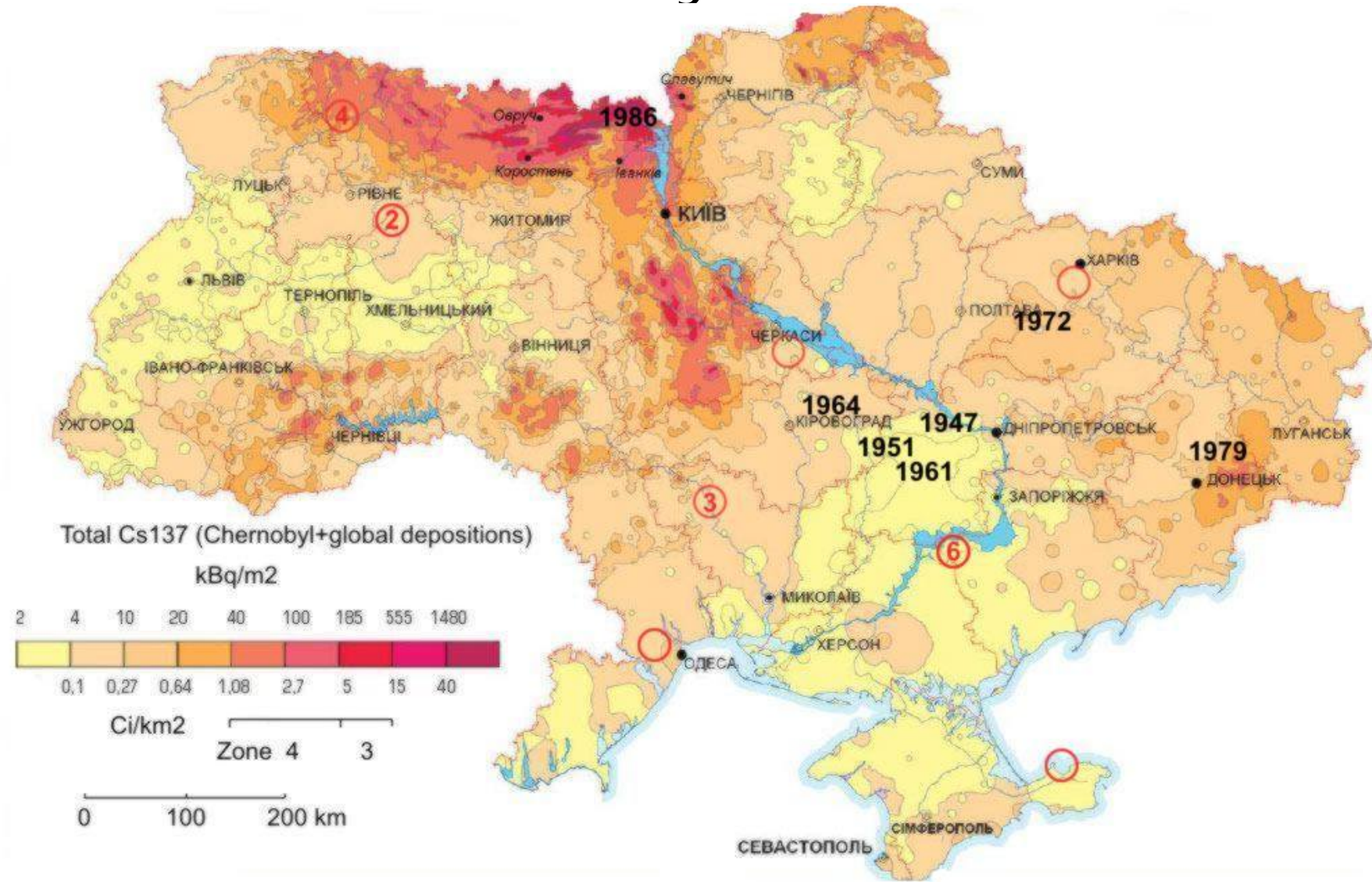
Volodymyr Tykhyy, Ukraine

Overview of the presentation



- ⌘ Map of Ukraine and timeline
- ⌘ Prydniprovsky chemical plant (1947) - extraction of uranium
- ⌘ Uranium ore mining (from 1948) and leaching (from 1961)
- ⌘ Zhovti Vody (*Yellow waters*) Hydrometallurgical plant (1951)
- ⌘ Peaceful underground nuclear blasts 1972, 1979
- ⌘ Chernobyl 1986
 - ⊞ Nuclear waste around ChNPP – clean up, processing, dumps
 - ⊞ Agreements between Ukraine and donors – CSF, CIP, NSA
 - ⊞ Interim fuel storage 2 (IFS-2)
 - ⊞ New safe confinement (NSC)
 - ⊞ Money for NSC and it's cost
 - ⊞ Central storage for VVER nuclear fuel

Nuclear industry sites in Ukraine



Abandoned Crimean NPP



Tykhyy - KURRI 18 March 2011

Abandoned Crimean NPP (1998)



Tykhyy - KURRI 18 March 2011

USSR A-bomb project and nuclear arms race

- ⌘ Key facilities for production of nuclear bombs and nuclear reactors located in Russian Federation
- ⌘ Ukrainian SSR was the most important supplier of uranium (mined and processed) for Soviet A-bombs
- ⌘ Processing of uranium ore started in 1947 at Prydniprovsky plant # 906 near the city of Dniprodzerzhynsk, Dnipropetrovsk province
- ⌘ Large-scale mining of uranium ore in Ukraine started at Zheltorechensky deposit in Dnipropetrovsk province. It goes on to these days in this and other areas nearby
- ⌘ Hydrometallurgical plant was set up in Zhovti Vody in 1951; it is still in operation and supplies uranium for production of uranium (enrichment of uranium and fuel production are carried out in Russia)

Prydniprovsky chemical plant (1)

- ⌘ **1947** – production of **uranium from metallurgical slag**. Main production was carried on at blast furnace # 6
- ⌘ Next year a specialized **Plant # 906**, known by its non-secret name as a “Slag Fertilizers Plant“ was created.
- ⌘ More than 16,000 people worked on its construction in 1940s; many of them were inmates of **concentration camps** which were relocated to the area from the Urals; many were later employed by the plant.
- ⌘ At the peak of the "cold war", Prydniprovsky Chemical Plant (PCP) # 906 processed over 60 % of uranium ore mined in the Soviet Union
- ⌘ In 1990s the plant was divided into several separate plants (production of ion-exchange resins, nonferrous metals, zirconium, hydrometallurgical plant etc) and bankrupted in 2002.

Prydniprovsky chemical plant (2)

- ⌘ A state enterprise "**Baryer**" was created in December 2000 to manage the PCP's radioactive tailings of uranium production (**over 42 mln ton** with estimated average activity 6,4 kBq/kg).
- ⌘ Storage "C" – **0.2 mln ton**, average activity **2.2 MBq/kg**
- ⌘ One of the storages contains parts of the dismantled blast furnace # 6.
- ⌘ Major environmental threats: pollution of ground water; run-off of contaminated water into Dnieper
- ⌘ Enterprise "**Baryer**" implements the State Program of 26.11.03 (amended 30.09.09): monitoring, strengthening dams and dikes, recultivation, dismantling dilapidated buildings etc.

Prydniprovsky chemical plant – one of tailings



Uranium ore mining and leaching

- ⌘ Uranium mining company "Plant # 9" in the city of Zhovti Vody, Dnipropetrovsk oblast, was created in July 1951. Hydrometallurgical facility created in 1955-1958. First kilogram of U_3O_8 (*yellowcake*) produced in 1959.
- ⌘ New uranium deposits were discovered the area in 1950s (**Dnipropetrovsk, Kirovograd, Mykolaiv** provinces).
- ⌘ Production at Devladivske and Bratske deposits was organized in 19961 with the technique of bore-hole sulphuric-acid underground leaching (other chemicals were used too)
- ⌘ Environmental problems in areas of uranium mining: tailings of liquid wastes; groundwater pollution; soil and air pollution
- ⌘ Many villages in Sofiivsky rayon (Devlatovo deposit) cannot use ground water and suffer from severe water shortage

Underground nuclear blasts

- ⌘ **Published data list 124 peaceful underground blasts in USSR (including 140 kt nuclear blast of 1965, which created an artificial lake Chagan in Kazakstan)**
- ⌘ **In Ukraine, in 1972 a 3.5 kt underground nuclear blast was used to extinguish a fire on a gas production well in Kharkivska province (unsuccessful attempt - fire continued for over a year after the blast).**
- ⌘ **In 1979, a 0.2-0.3 kt nuclear blast was detonated at "Yunyi kommunar" coal mine at 800 m below the surface to reduce the concentration of methane gas in the mine. Glassified capsule of about 100 m³ still exists at the site of the explosion.**
- ⌘ **Apparently only minor environmental pollution occurred, but public agitation was high in recent years when information about these blasts became available**

Chernobyl catastrophe of 1986

- ⌘ Last operating reactor # 3 shut down 15 December 2000.
- ⌘ Chernobyl NPP became a “State specialized enterprise “Chernobylska NPP” (SSE ChNPP)” with the main task of decommissioning the NPP. License for decommissioning works was issued by SNRCU to SSE ChNPP in March, 2002.
- ⌘ 30-km exclusion zone is managed by the State Department (Administration of the Zone) of the Ministry of Emergencies
- ⌘ Radioactive waste storages: several closed; one operational – “Buriakivka”. Most problematic – “Pidlisny” (closed in 1988, over 22,000 ton in concrete storages). Territory is prone to flooding, still no design and funding for reconstruction
- ⌘ Over 800 “simple” radioactive wastes dumps of 1986-1987 (trenches, clamps): “Sand plato”, “Oil depot”, “Red forest” etc.
- ⌘ Processing of radioactive wastes: complex “Vector”, facilities for liquid and solid RAW built with international assistance

30-km zone: "Pidlisny" and cooling pond



"Rossoha" - early 90s



“Rossoha” – early 2000s



“Red forest”, pine of late 2000s



Decommissioning of Chernobyl NPP: Chernobyl Shelter Fund (CSF) and SIP

- ⌘ Chernobyl Shelter Fund (CSF) and Shelter Implementation Plan (SIP) were developed in 1997 (G-7, EU, other countries; EBRD). CSF is managed by EBRD.
- ⌘ Pledging conferences in 1997 (New York), 2000 (Berlin) and 2005 (London).
- ⌘ Shelter Implementation Plan (SIP): **to convert the sarcophagus into a stable and environmentally safe system** (including safety of work during construction of NSC).
- ⌘ By 2008, most of SIP objectives were achieved.
- ⌘ However, remaining are:
 - ☒ Interim Storage Facility 2 (**ISF-2**) funded from **Nuclear Safety Account** at EBRD and
 - ☒ New Safe Confinement (**NSC**), funded through **Chernobyl Shelter Fund**.

CSF major contributors (over \$20m, data of 2007)

⌘ Canada	34.9 m USD
⌘ European Community	204.8 m USD
⌘ France	41.8 m USD
⌘ Germany	60.5 m USD
⌘ Italy	33.0 m USD
⌘ Japan	41.7 m USD
⌘ Ukraine	45.0 m USD
⌘ United Kingdom	47.6 m USD
⌘ United States	138.8 m USD
⌘ Contributions by end-June 2007	- 739 m EURO

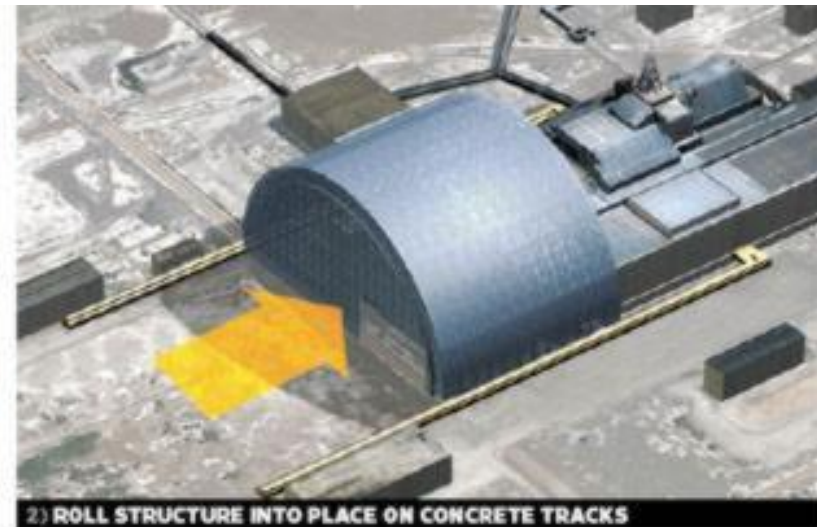
A story of Interim Storage Facility (ISF-2)

- ⌘ **EBRD Nuclear Safety Account** projects: construction of a facilities to treat liquid and solid radioactive waste (completed) and
- ⌘ **ISF -2 for spent fuel** from units 1, 2 and 3
- ⌘ Construction of ISF-2 was started in 2003 by **Framatome** (acquired by Areva NP in 2005).
- ⌘ Could not meet the requirements, contract canceled
- ⌘ **New ISF-2 contract** signed with Holtec Int. in 2007, for 200 m EURO.
- ⌘ Design for completion of IFS-2 **approved** by SNRCU on 20 October 2010; end of construction (agreed in February, 2011) – **March 2015**
- ⌘ **Implementation depends on funding.** Deficit as of end-December 2010 - 130-140 m EURO

IFS-2 (Framatome's)



New Safe Confinement (NSC) data



Confinement fast facts

Width 257 m

Height 105 m

Length 150 m

Weight approx. 20,000 ton

Life time 100 years min.

New Safe Confinement (NSC) - timeline



- ⌘ 2001 – decision in principle on the design of NSC
- ⌘ 2004 – approval of NSC **concept design**
- ⌘ August 2007 – Ukraine and EBRD sign grant agreement for NSC
- ⌘ 2007 – Contract between Ukraine and French consortium Novarka signed
- ⌘ 2006-2008 – Shelter stabilization works completed, safety infrastructure for NSC works in place
- ⌘ Beginning of 2011: Site preparation for NSC in progress. Novarka placed orders for the 20.000 ton of steel and placed a subcontract for the construction of heavyweight cranes.

New Safe Confinement (NSC): money



- ⌘ Initial estimated cost of NSC (1997) - **\$505 m**
- ⌘ 28 September 2010 – CSF Assembly of Donors: estimated cost of NSC - **EURO 870 m** (due to higher safety requirements – official explanation)
- ⌘ Deficit of funding for NSC – **EURO 550 m**
- ⌘ December 2010 – Ukraine’s contribution into CSF increased to \$104 m; Ukraine becomes full participant of the NSC project
- ⌘ Next meeting of donors scheduled for April 2011

New Safe Confinement - trenches



Central Storage Facility for VVER fuel

- ⌘ Current situation: **7 VVER-1000** – “Mining and Chemical Combine”, Krasnoyarskiy kray; **2 VVER 440** – “Mayak” Cheliabinskaya obl., **6 VVER-1000** – on site (Zaporizhyya)
- ⌘ **NAEC “Energoatom”** initiated construction of Central Storage Facility for spent nuclear fuel of Ukrainian VVER reactors in the 30-km exclusion zone. Initial Statement of Intent issued in **October, 2006**
- ⌘ Technological solutions – **Holtec International**. Capacity – **1000 spent fuel assemblies** per year; 50 years loading, 50 years storage
- ⌘ **New Statement of Intent issued in 2008**; public hearing on environmental consequences – 22 March 2008, Slavutich
- ⌘ Parliament decision needed to construct CSF; in the meantime, Ukrainian spent nuclear fuel from 9 VVER units is shipped to Russia

Proposed location for CSF



Zaporizhya NPP spent nuclear fuel storage



Health problems in brief

Children thyroid cancer (TC).

- ⌘ During 1986-2008, **5427 persons** born in 1968-1986 had TC surgery, of them 73.6% were children.
- ⌘ In 2008, **442** persons (who were children 0-14 at the time of Chernobyl) had TC surgery, and **119** who were adolescent (15-18). Average for 2008 is more than 21 higher than before Chernobyl.

TC in whole population

- ⌘ 2.5 higher in 6 most contaminated regions of Ukraine compared to other 21.
- ⌘ In all groups of sufferers TC prevalence is higher than nationwide average: in liquidators - 5.6 times, in evacuated - 4.4 times, in those who live on contaminated territories - 1.4 times

Disabled (*invalidy*)

- ⌘ In 1986-2008 - **264 100** patients applied to establish causal relation with Chernobyl. Of this, **174 306** patients received status.
- ⌘ In 2009, **8931** patients applied, causal relation established in 84% of cases. Main causes – oncologic, cerebrovascular, blood circulation and nervous system diseases.

Reproductive health becomes a serious problem

Дякую за увагу!

ご清聴ありがとうございました