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EXAMINATION OF PCB-CONTAMINATED SITES AND ASSESSMENT OF METHODS OF THEIR REHABILITATION

(Decontamination Project in Serpukhovsky District, Moscow Region)

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- **Task 1. Identification of PCB-contaminated sites:**
  - identification of location and size of PCB-contaminated areas and sites as well as amount of soil to be decontaminated;
  - assessment and analysis of existing concentrations of PCBs at contaminated sites;
  - preliminary risk assessment on the basis of priority directions of impact of PCBs contained in soils; priority sites in different regions.

- **Task 2. Collection of data on potential technologies for site decontamination:**
  - analysis of international experience;
  - analysis of processes developed in Russia.

- **Task 3. Assessment and comparison of prospect technologies for site decontamination:**
  - elaboration of assessment criteria;
  - selection of optimal decontamination technologies for concrete sites.

- **Task 4. Preliminary planning of activities on site decontamination:**
  - elaboration of recommendations on equipment and logistic support;
  - cost assessment for selected decontamination technologies;
  - elaboration of recommendations in the field of environmental protection.

- **Strategy of identification and prioritization of sites to be decontaminated**
  - Development, adoption and implementation of an integrated programme that could be entitled “National Strategy” or “National Action Plan” and financed from Russian sources with support of international financial organizations.

- **Strategy on provision of PCB safety shall have the following objectives:**
  - improvement of environmental situation in Russia;
  - minimization of negative impact on human health;
  - active participation in international environmental protection activities in the field of PCBs.

- **Actual activities on identification and prioritization of sites subject to decontamination shall incorporate:**

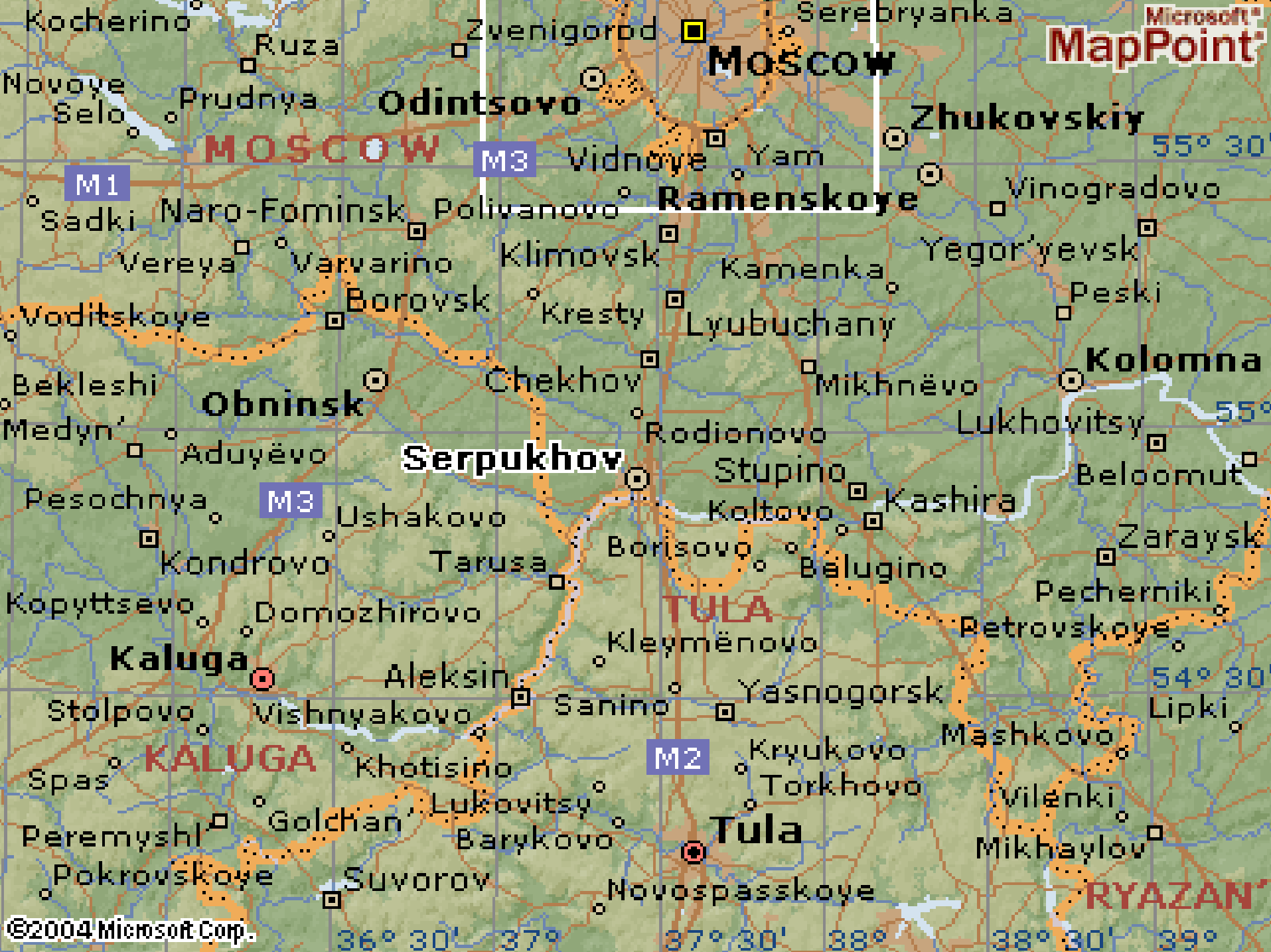
  - Obtaining of verified and timely statistical data
  - Characterization of contaminated site
  - Assessment of hazard posed by the contaminated site
  - Further monitoring of PCB-contaminated sites
  - Technical support of monitoring of PCB-contaminated sites
  - Composition of the Register of PCB-Contaminated Sites in the Russian Federation
  - Development of the List of Environmentally Sound Decontamination Technologies and Methods for PCB-containing soils
  - Decontamination of PCB-contaminated sites

- **Prioritization of sites to be decontaminated should be based on the relevant Register and risk assessments, taking into account:**
  - Level of contamination of surface and ground waters which is one of the main criterion for the soonest treatment of the site in order to prevent peroral intake of the toxicant;
  - Number of people subject to risk of contact of PCB and not only the population inhabiting the contaminated site;
  - Potential threat to environmental systems.

Identification of PCB-contaminated sites

- Identification of PCB-contaminated sites consisted of localization and estimate area of PCB-contaminated sites as well as the amount of soil subject to decontamination.

- Death rate, increase in disease rate and number of abnormalities (especially children's) served as the basic criteria for identification of PCB-contaminated sites.
- Serpukhov (Moscow Region)
- Located at the distance of 100 km to the South of Moscow. Railway station (Moscow-Tula railway line), port on the left bank of the Oka River.
- Population: 152 thousand (census 2002)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Identification of PCB-contaminated sites

- The territory of the town of Serpukhov (Moscow Region) contaminated with PCBs that were used for many years at the local condenser manufacturing plant “KVAR” corresponded to the proposed identification criteria. The studies undertaken right after the shut down of the plant and ten years later showed that overall area of contamination amounts to about **600-700 hectares or 6-7 km2**. This area covers sediment ponds of the former runoff treatment system of the condenser plant (**about 3 hectares**) with the content of **18300 mg/kg** with penetration depth of 0.5 m and agricultural lands of Zaborye district (**about 200 hectares**) used for vegetable planting with content of up to **8.5 mg/kg**.

- **Assessment and comparison of prospect soil decontamination technologies**

- International and Russian soil decontamination technologies can be divided into *in-situ* (treatment of soil on site) and *ex-situ* (excavation of soil and its further decontamination). 5 Russian and 11 foreign technologies were considered (visit http://www.amap.no for details).
- Selection of optimal decontamination technology:
  - environmental, technological economic parameters
  - assessment of effectiveness
  - completeness of PCB destruction
  - administrative criteria were proposed as the guiding principles for selection of methodology to local authorities and environmental protection bodies.
- Different environmental, technological and economic assessment criteria and criteria of acceptability by different organizations were determined to make the assessment and selection of technologies possible.

Foreign decontamination technologies:

- ***On-situ*:**
  - biological treatment technology
  - liquid-phase sintering
- ***Ex-situ:***
  - high-temperature technologies with application of rotating kiln (both its mobile and stationary variant)

Russian decontamination technologies:

- ***On-situ*:**
  - biological treatment
  - physical-chemical treatment with humic mineral concentrate (HMC)
- ***Ex-situ:***
  - high-temperature oxidation with application of cyclone type reactor

Assessment of *in-situ* technologies:

- Environmental criteria:
  - confinement (isolation);
  - biological treatment;
  - liquid-phase sintering.
- Technological criteria :
  - confinement (isolation);
  - biological treatment.

- Confinement (isolation) and biological treatment technologies are optimal from the economic point of view.
- Administrative aspect:
  - confinement technology is acceptable only for unused sites;
  - biological treatment is preferably applicable for big areas, including agricultural lands.
- Liquid-phase sintering technology:
  - most complex from the point of the equipment necessary for its implementation
  - applied for decontamination of small areas with PCB content >50 mg/kg characterized by deep penetration in soil.

Assessment of *ex-situ* technologies

- **All** considered *ex-situ* technologies **satisfied environmental protection requirements**.
- The simplest *ex-situ* technologies include **burial (landfilling)**, **extraction by solvent** and **thermal desorption**.
  - But they **do not guarantee destruction** of PCBs. Other foreign technologies such as **confinement of PCB-containing soil postpone** the **decontamination process** and have temporary character.
- **Burial** requires significantly **less capital investment** and **technological preparation** than any other technology. Nevertheless, **administrative criteria** make this technology **hardly feasible** to use on the industrial scale. At present **burial of PCB-containing soils is not practiced in Russia**.

Assessment of *ex-situ* technologies

- **Technology with application of rotating kiln, mobile facility equipped with oxy-fuel torch or cyclone kiln** imply **complex multi-stage processes** resulting in **practically complete destruction of PCBs**.
- **Mobile facility equipped with oxy-fuel torches** requires **less capital investments** compared to other high-temperature oxidation technologies.
- **Cyclone kiln and thermal desorption technologies** can be considered to be most acceptable as they allow to **decrease the PCB content** in soil to the **levels corresponding to environmental protection requirements**.

EXAMINATION OF PCB-CONTAMINATED SITES AND ASSESSMENT OF METHODS OF THEIR REHABILITATION

Assessment of activities on decrease of risk to human health and environment

- Short-term activities *(immediate response and rapid risk decrease measures)*:
  - Administrative and organizational activities – reduction of the risk at small cost. However, the source of risk is not eliminated, thus, application of such measures is not sufficient and they can be recommended as supplementary.
- Long-term measures *(minimization of distribution and impact of PCBs in long-range outlook)*:
  - *in-* and *ex-situ* technologies considered in the framework of the project.

Preliminary planning of site decontamination and assessment of effectiveness of the proposed activities

- Activities preceding treatment of PCB-contaminated soil:
  - pilot and full examination of the contaminated site
  - further provision of basic data
  - implementation of the feasibility study
  - selection of optimal technology
  - design of the project
  - development of the business plan

- **Preliminary stage of the project on decontamination of Serpukhovsky District included the following steps:**
  - Ranging of PCB-contaminated sites by urgency of the beginning of treatment
  - Assessment of effectiveness of risk decrease activities by the "cost-effect" method as the basis for development of recommendations on treatment of the territory of the former sediment ponds (about 3 hectares) with **cyclone kiln technology.**
  - **Physical-chemical treatment with HMC** was recommended as the basic methodology for **decontamination of agricultural lands** (200 hectares).
  - **Supplementary administrative activities** aimed at reduction of consumption of PCB-contaminated products were recommended for decontamination of the agricultural lands.

- **On the basis of the "cost-effect" analysis the following activities were recommended for decontamination of sites in Serpukhovsky District:**

  - Decontamination of the soils of sediment ponds (≈ 3 hectares) of the former condenser producing enterprise with application of cyclone kiln technology. The total cost of this activity amounts to **US$ 7.2 million including investment in technology development** (US$ 0.9 million) **and annual operational costs** (US$ 0.525 million) during 12 years;

  - Decontamination of agricultural lands (200 hectares) through treatment with HMC and biological treatment. The total cost of such option is **US$ 10.675 million including investment in development of HMC producing facility** (US$ 0.675) **and annual operational costs** (US$ 3.34 million) during three years;

  - Decrease of impact on human health through a number of administrative activities aimed at reduction of production and consumption of contaminated agricultural products.

THANK YOU FOR YOUR ATTENTION

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