Nuclear Legacy Management and Low-level Radioactive Contaminant Management in Terrestrial and Aquatic Ecosystems: Experience and Lessons Learned from Regulatory Cooperation between Norway and Russian

3rd International Symposium
Decontamination of Radioactive Materials
5 July 2014, Koriyama City Cultural Centre

Malgorzata K. Sneve
Director
Regulatory Cooperation Program
Norwegian Radiation Protection Authority

Norwegian 'Plan of Action' to support nuclear and radiation safety in northwest Russia

Objectives of regulatory cooperation on legacy management as part of 'Plan of Action':-

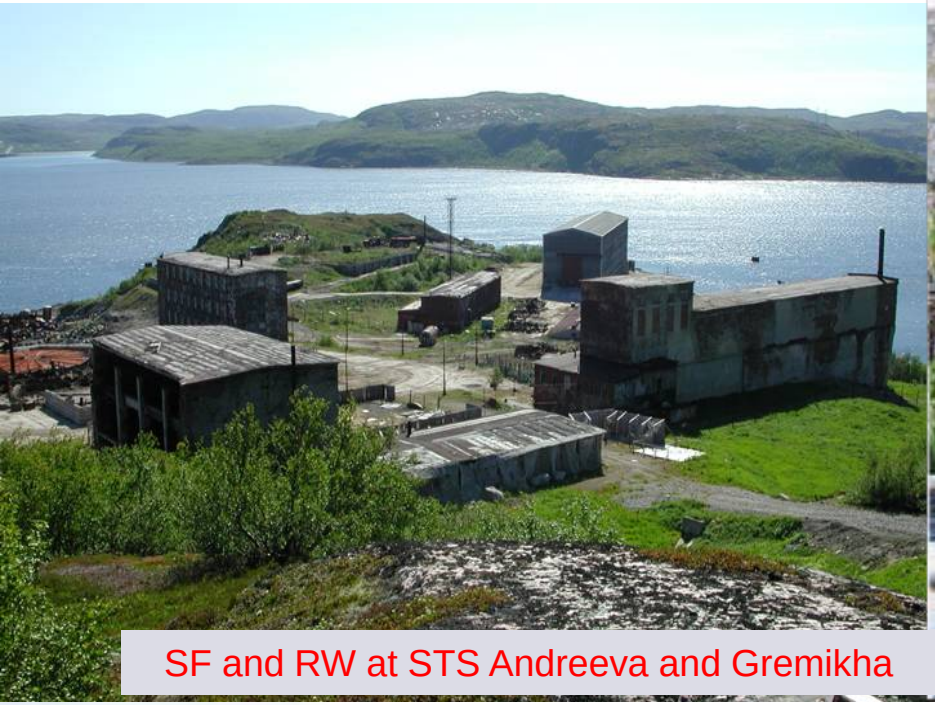
- Generate confidence that nuclear legacy management is under-pinned by a robust and independent regulatory process, by

- Working with relevant authorities to support them in their regulatory supervision **over specific problems,** adopting a

- Holistic approach to environmental and human health protection, avoiding short term measures which create new legacies.

We assume a legacy is an area or facility ***presenting abnormal conditions due to the previous absence of, or loss of, effective control of radioactive material, so that current standards for radiation and nuclear safety and security are not met.***

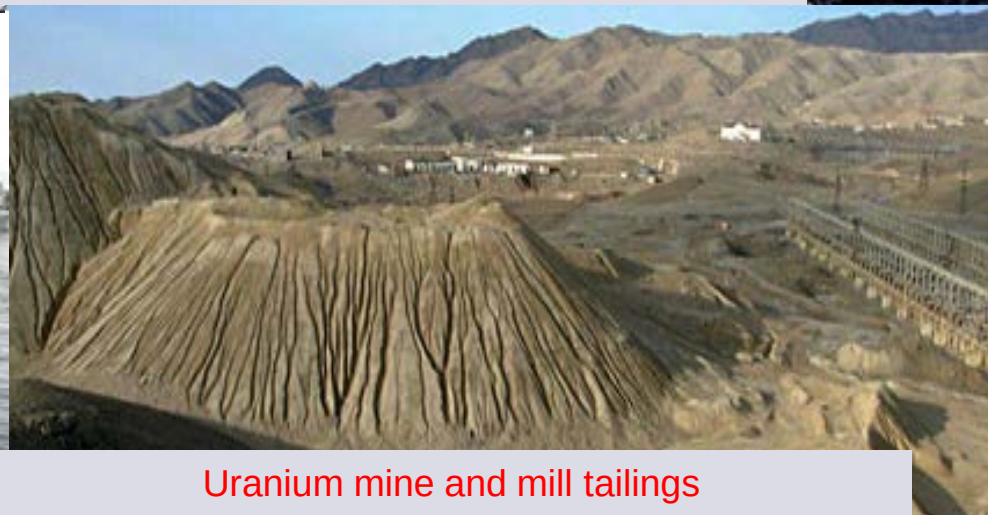
Examples of legacy in Russia



SF and RW at STS Andreeva and Gremikha

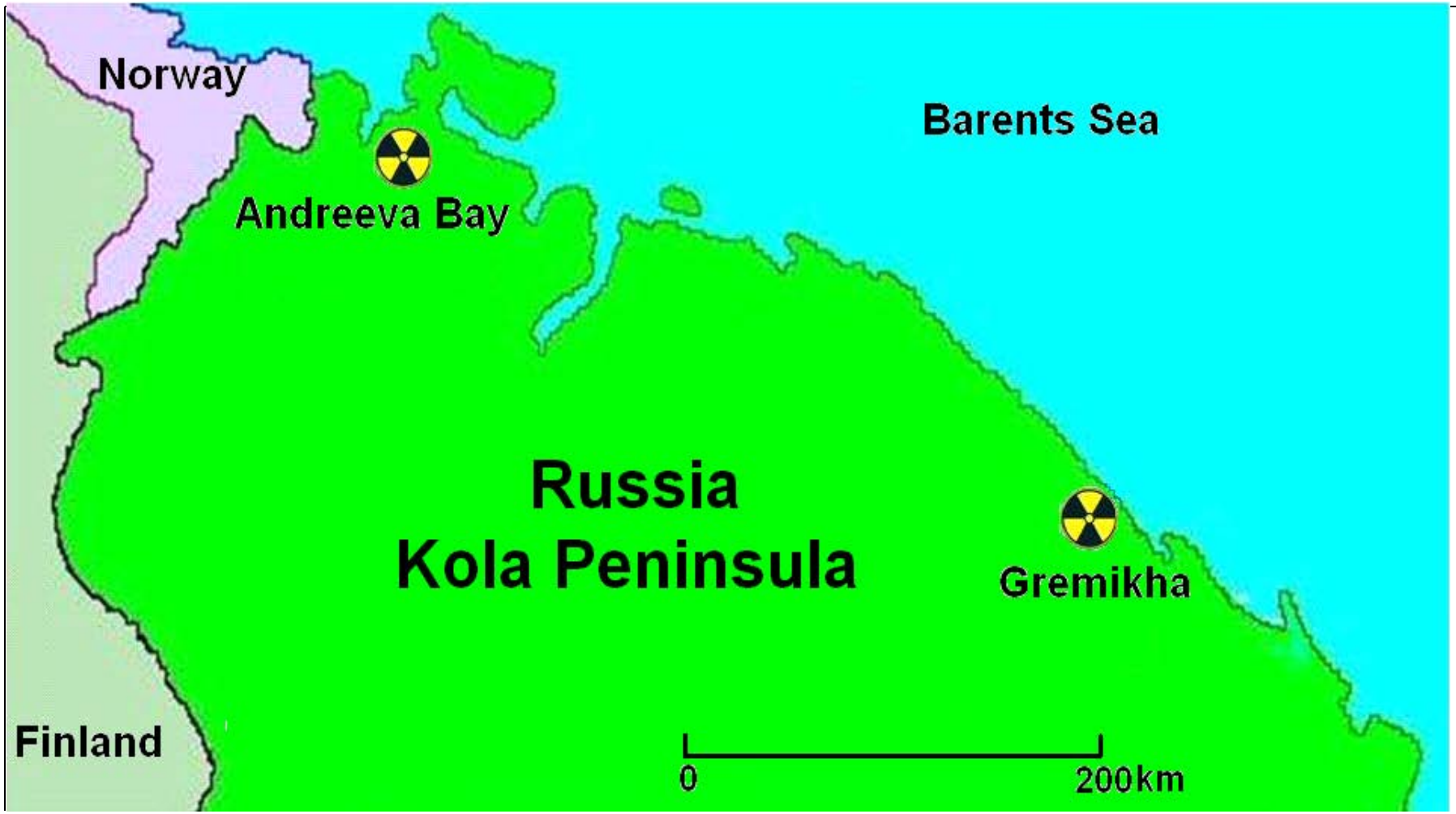
RTGs in lighthouses

Nuclear submarine and surface vessels



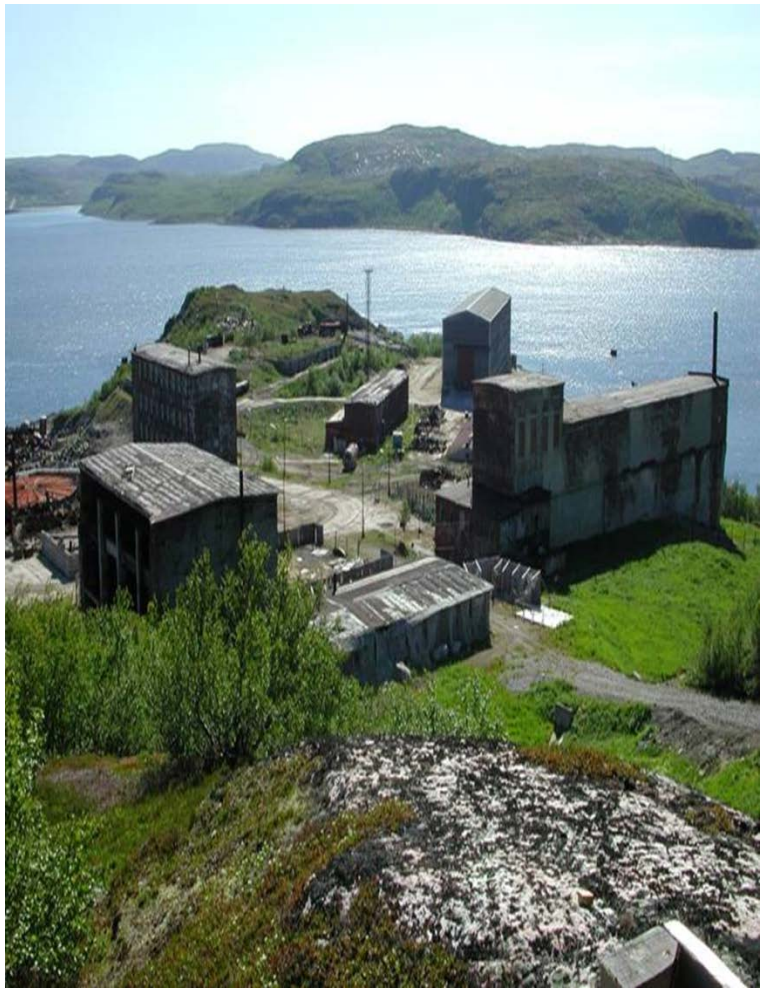
Uranium mine and mill tailings

Why is this of interest to Norway?



Abnormal conditions at Andreeva Bay

- Very large inventory of submarine spent fuel (SF) in degraded stores which do not meet standards
- Significant fraction of SF is damaged
- Technical infrastructure very weak
- Contaminated environment due to past spills and leakages from stores for SF and radioactive waste



Improved conditions at Andreeva Bay

Technical infrastructure and conditions for workers

Environmental monitoring and control systems

Statens strålevern
Norwegian Radiation Protection Authority

Activities in support of legacy supervision

- Threat assessments to determine the more significant radiation protection issues which require closer regulatory supervision
- Measurements of radiation situation
- Training and exercises in emergency preparedness and response
- Enhanced and wider bi-lateral and international cooperation on legacy issues
  - US DOE, US NRC, US EPA
  - ASN and IRSN, France
  - ONR and EA, within UK
  - IAEA International Working Forum for Regulatory Supervision of Legacy Sites (RSLS)

Outputs

Enhanced regulatory requirements and guidance for abnormal situations at legacy sites, supporting safe and effective implementation of industrial projects within an efficient regulatory process:

- Improved procedures for emergency preparedness and response, with focus on ***coordination and communication***
- Independent assessment of radiation situation at Andreeva
- Innovative approach to performance reliability monitoring (PRM)
- Practical support in control of radiation exposures during the most hazardous remediation operations (SF recovery!)
- Radiological criteria for monitoring and site restoration, terrestrial and marine environments
- Linking remediation activities to radioactive waste management programs
- Coordination of radiation regulation with relevant RF authorities concerned with other pollution issues

Example 1: Requirements for industrial waste management

Regulatory document for **Safe management of industrial waste containing toxic substances and low level man-made radionuclides,** from past activities and generated during remediation:

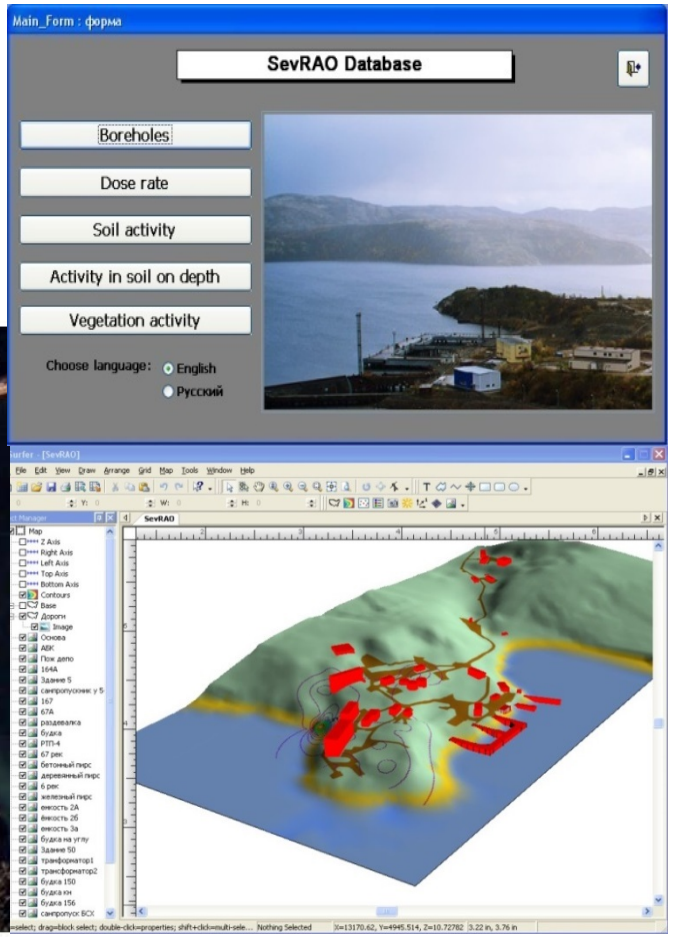
- Establishes the system of criteria, rules and restrictions ensuring safety and protection of workers and the public
- Establishes requirements for arrangement, maintenance and operation of the landfill for disposal of this waste, including its decommissioning
- Establishes requirements for contents of toxic and radioactive substances in waste conveyed to the landfill for disposal

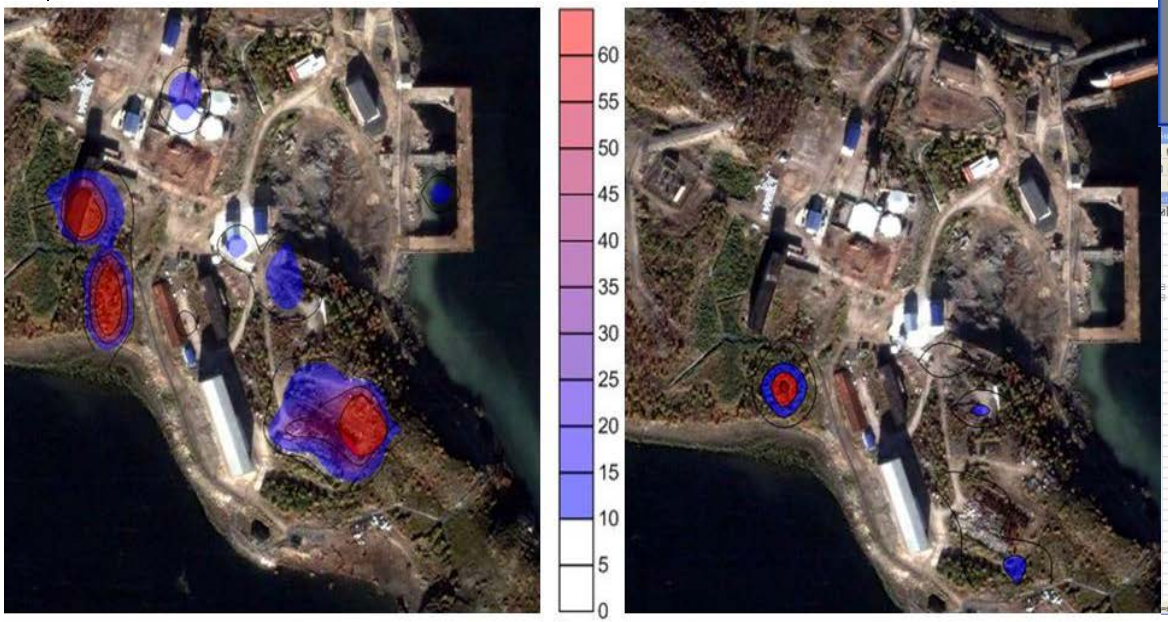
Specific details take into account the actual waste characteristics and regulatory requirements that apply in normal conditions

One document addresses both radiation and other toxicity hazards for disposal of, (IAEA GSR-1), Very Low Level Waste (VLLW)

Example 2: Visualization and simulation tools

Support:
Analysis of current radiation situation
And change of situation during remediation
Optimization of remediation and dose control





2002 2010

Extension of cooperation to PA Mayak in 2010

a) Norwegian Plan of Action strategy includes long-term safe management of SNF and RW

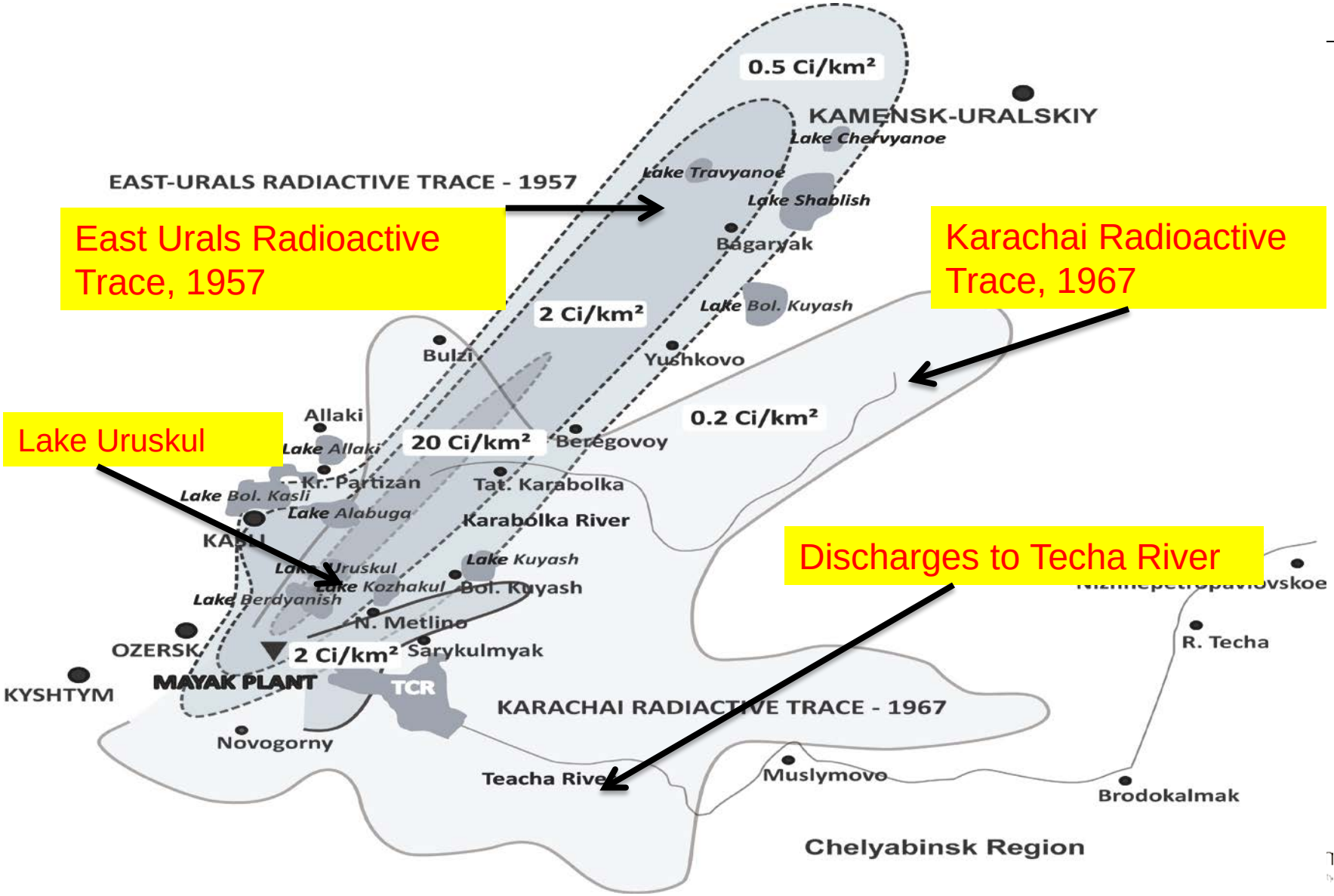
b) Regulatory decisions ***have to be supported by the best available scientific information***

c) Threat assessments can be used to identify scientific priorities

These points all lead to conclusion that studies at Mayak can be an important part of the program

Three research projects *set up with the kind cooperation of Russian counterparts*

Main environmental releases from PA Mayak



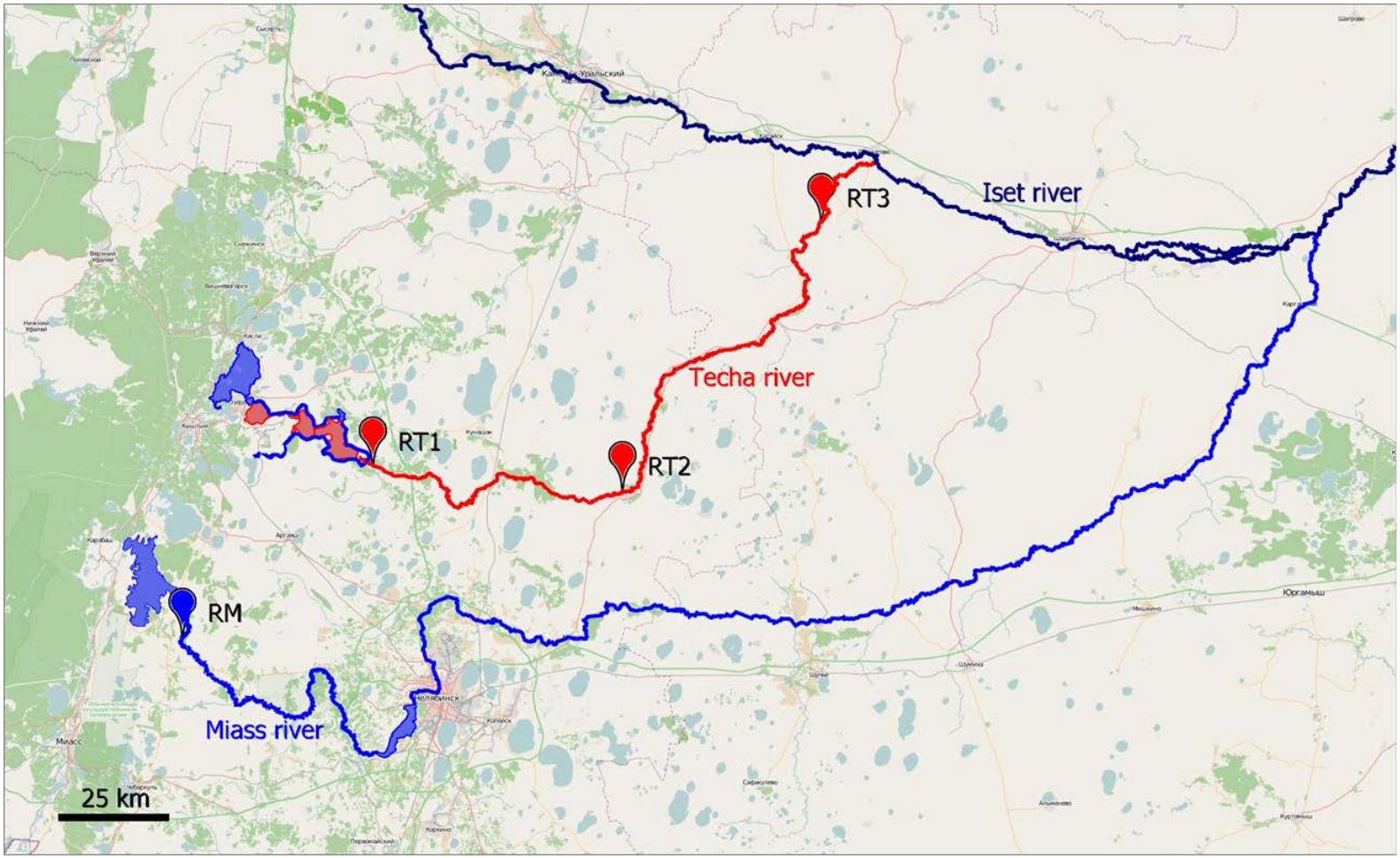
1. Characterization of the current status of ichthyofauna in the Techa River

Partner: Urals Research Center for Radiation Medicine, FMBA of Russia

Objectives: Study of current radiological and biological status of ichthyofauna in the Techa River that has been contaminated by radionuclides (^{90}Sr, ^{137}Cs,^{238}Pu, $^{239,240}Pu$, ^{3}H) due to history of Mayak operations

Research into population, morphometric, haematological, genetic effects will allow identification of main biological effects in populations of fish that inhabit radioactively-contaminated water ecosystems for a long period of time.

Location of sampling stations in Techa River and Miass River



Frequency of erythrocytes with micronuclei in fish from Techa and Miass Rivers, pooled data 2012-2013

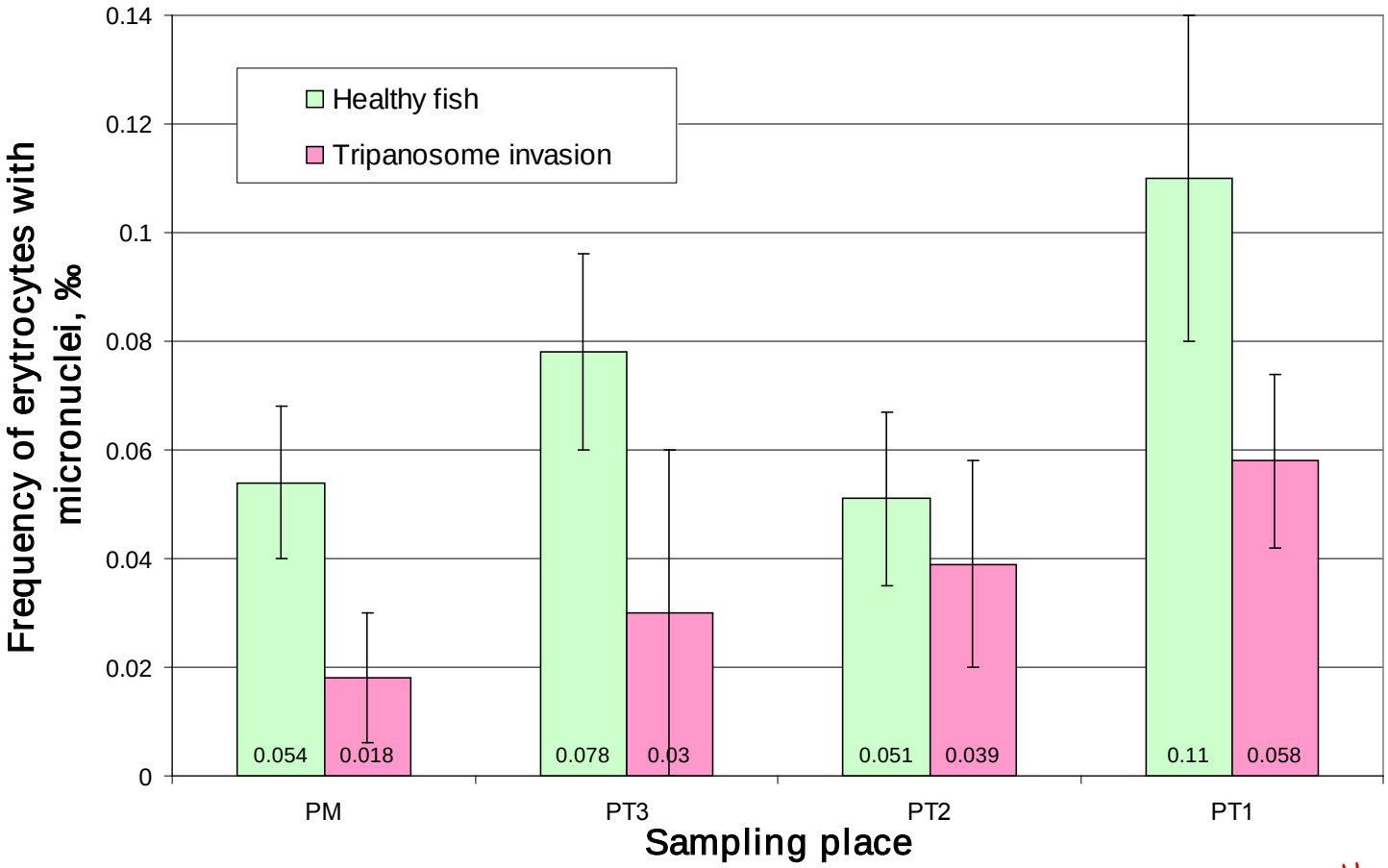
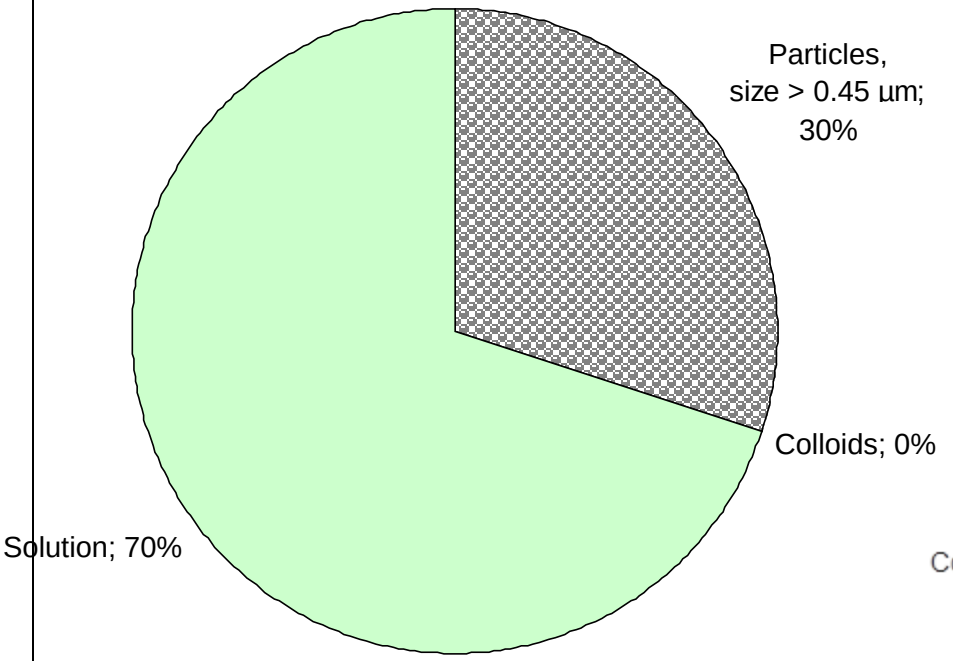
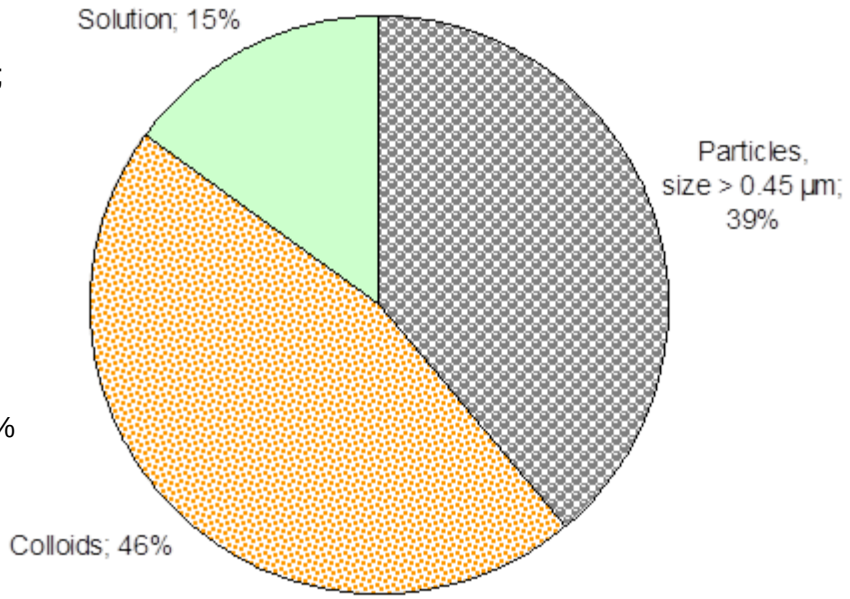


Illustration of ecological factors which affect potential for exposure

Results of fractionation in particulate: Forms of ^{137}Cs in water at station RT1



Spring 2012



Summer 2012

2. Study of treatment of surface water bodies at Mayak

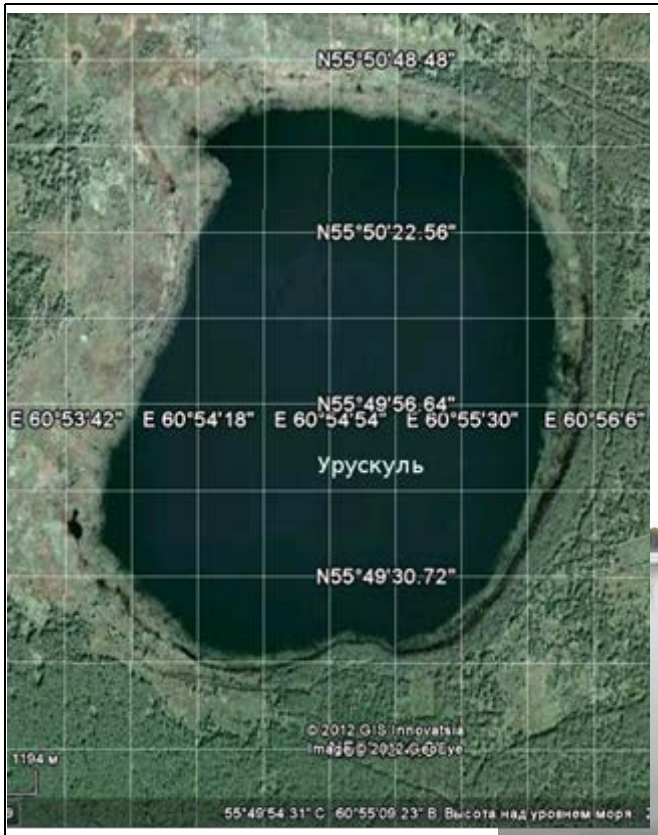
Partners: MAYAK Production Association and Federal Center for Nuclear and Radiation Safety, of Rosatom

Objectives: Obtain a forecast of the natural self-purification of radioactively polluted water systems and to develop strategies and practical measures for the radiation rehabilitation of water bodies

Output: Information important for protection of aquatic ecosystem resources and future of levels of radioactivity in aquatic ecosystems in Mayak surface water bodies.

Supports on-going decisions on regulation of use of resources in area.

2. Example water body: Lake Uruskul

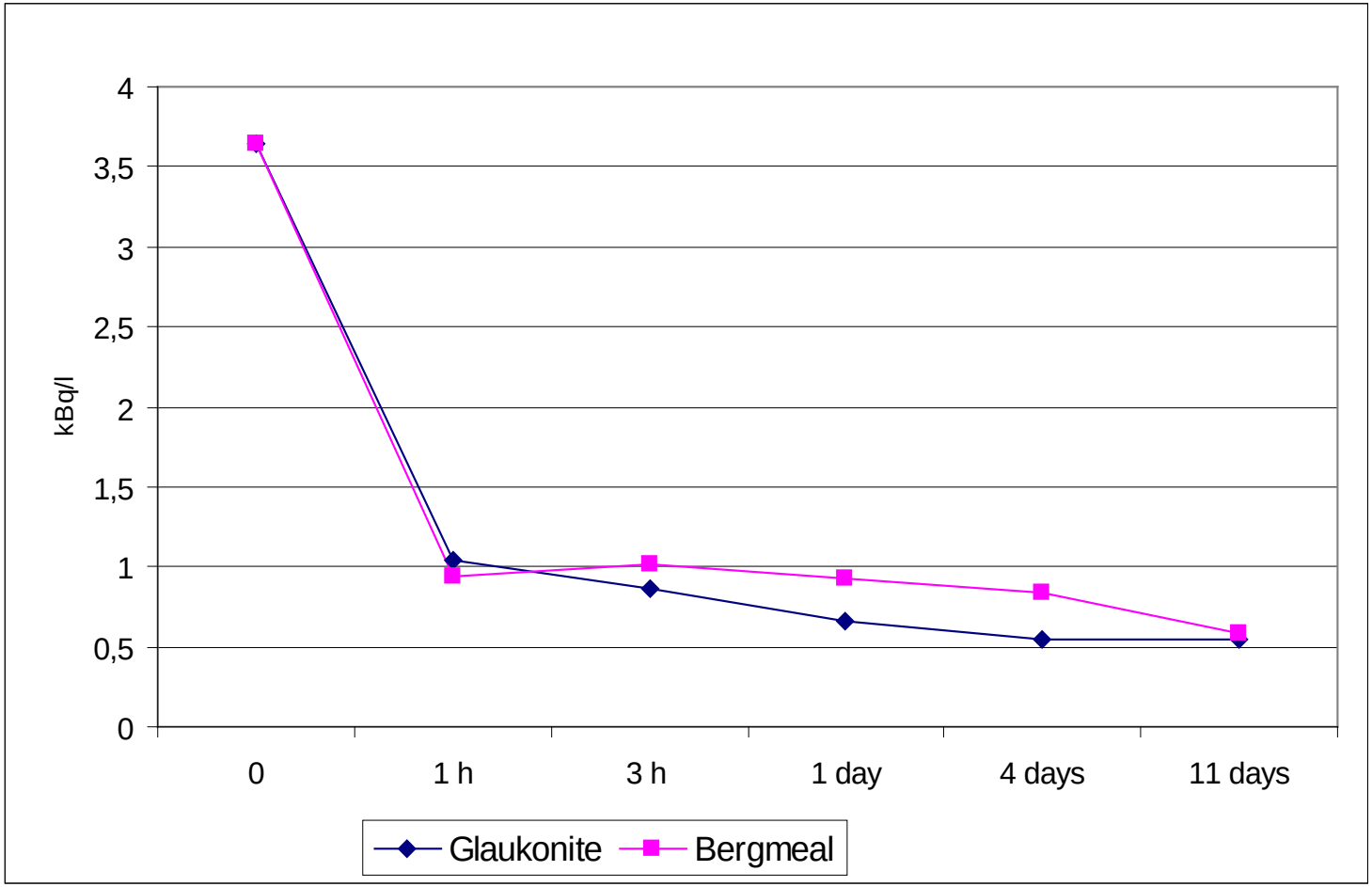


Main tasks

- Describe water bodies and history of radioactive contamination
- Analysis of current contamination in water, sediments and biota
- Analysis of data on processes of natural self-purification
- Simulation of natural purification processes; validation of models with long-standing monitoring data to support 100 y forecast of dynamics
- Evaluation of methods of rehabilitation of water bodies and experiments on water treatment
- Assessment of time for which contamination in water bodies is a threat to aquatic biota and people
- Development of recommendations for rehabilitation of water bodies

Experimental work: sorbing minerals and water hyacinths

Mineral purification experimental results: Sr-90 sorption



Accumulation factors in phytoplankton of water bodies under study

Lake	Accumulation factor	
	Cs-137	Sr-90
Berdenish	4470	120
Uruskul	2530	36

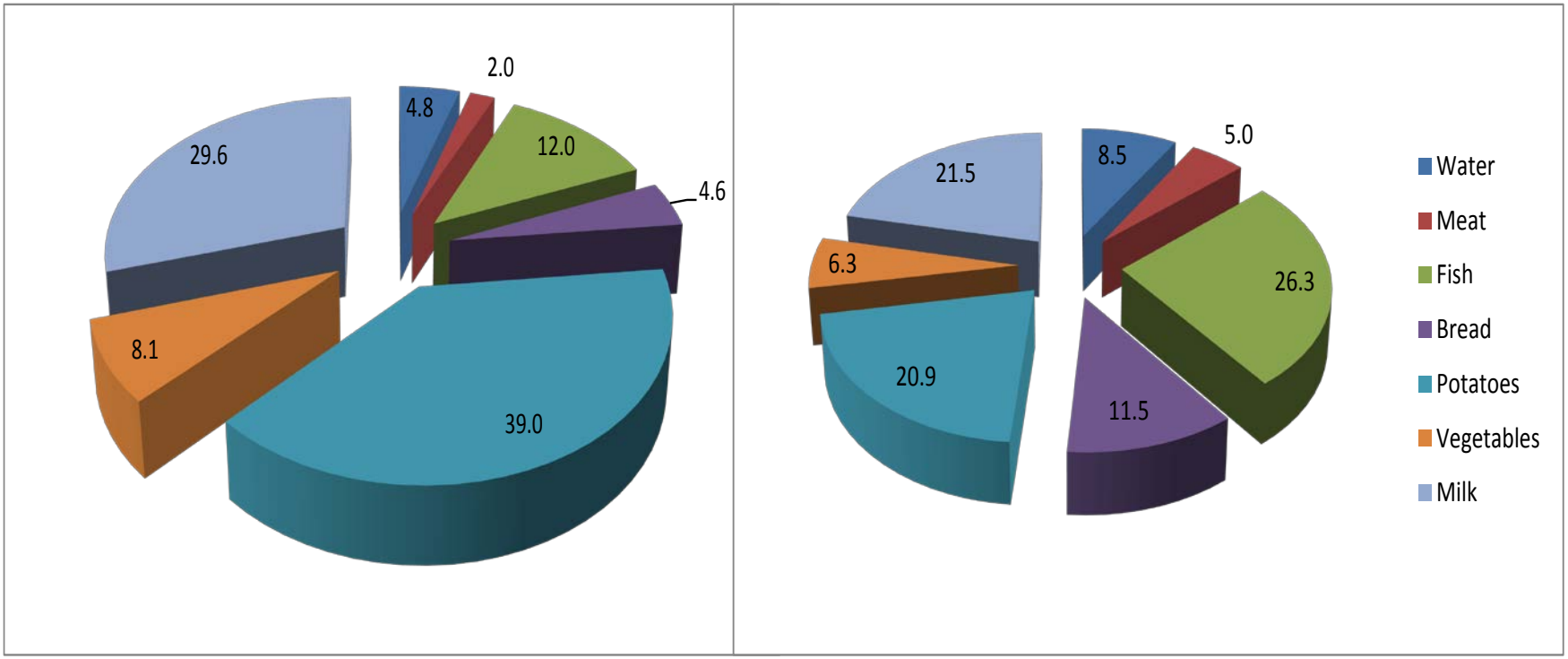
3. Study of internal exposure of public in Mayak area due to protracted exposure to long-lived radionuclides

Partner: Southern Urals Biophysics Institute, FMBA of Russia

Objectives: Perform new measurements of Pu-238, Pu-239/240, Am-241 and Sr-90 in autopsy samples, Cs-137 by whole body counting, and evaluate dynamic body burdens in Ozyorsk population, allowing for period of residence.

Determine dynamic annual growth rate of the body burden for Ozyorsk residents and to assess the expected effective dose from inhaled Pu and Am-241 and ingestion of Sr-90 and Cs-137 for the Ozyorsk population over different periods, taking account history of releases and old and new results of measurements.

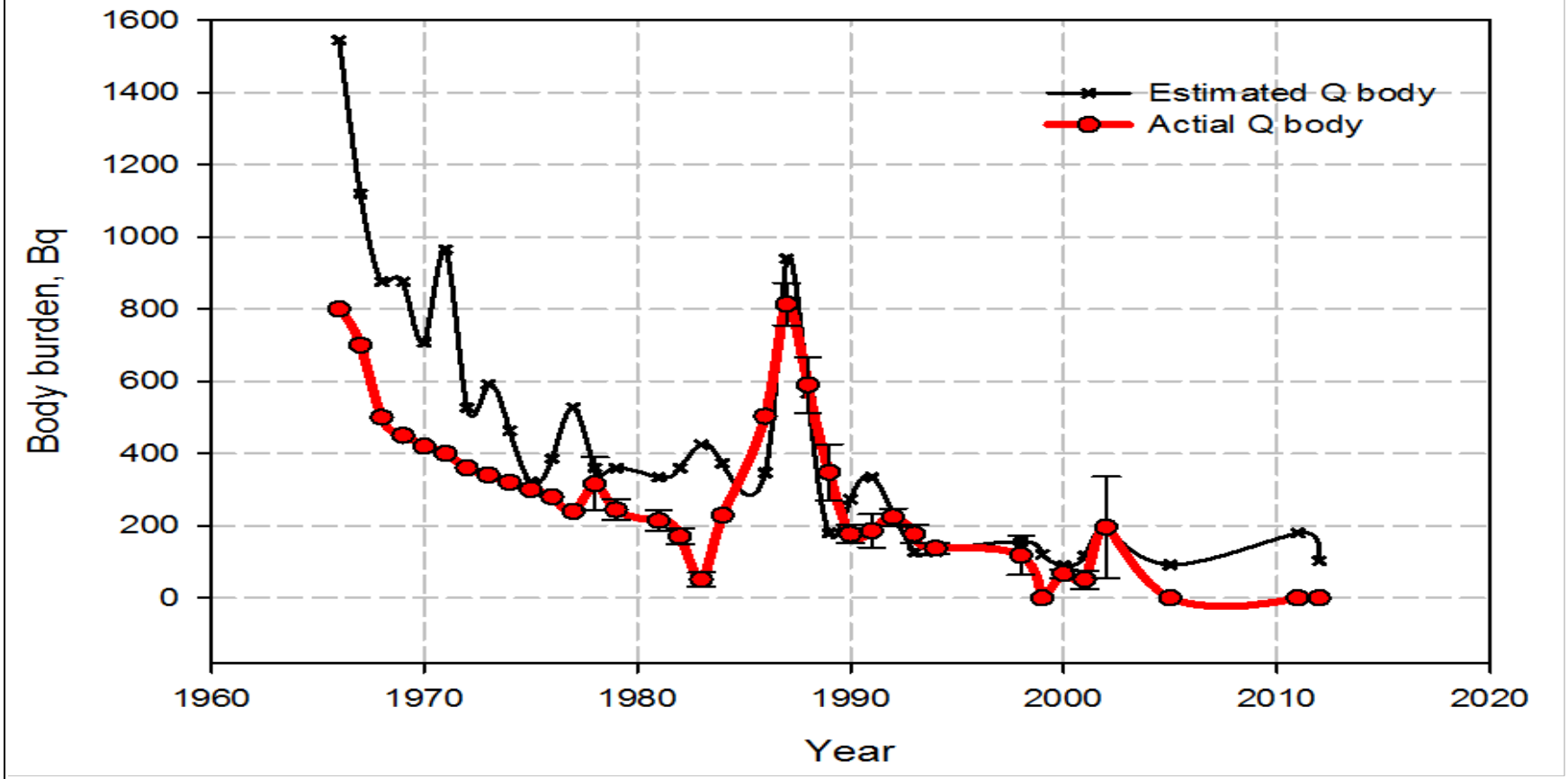
Illustrative results for contribution of foodstuffs to dietary intake in Ozyorsk residents in 2012



Sr-90:
77% with potatoes, vegetables, milk

Cs-137:
60% with potatoes, vegetables, milk and bread

Comparison of calculated from the diet and actual estimates of the 137 Cs body burdens



Project linkages

These projects illustrate the links between:

1. Environmental radioactivity and its dynamics
2. Exposure modes:
   - inhalation
   - ingestion
   - external

   and environmental factors which affect them, and
3. Radiation doses and dose rates
4. Implications for environmental and human health

Overall assessment must consider all aspects equally.

Key lessons

- Scientific information is needed to address *all* the environmental and human health issues, not just radiation
- Prognostic assessment of future conditions is needed
- Science program should focus on key assessment uncertainties to improve confidence in the prognoses
- This is necessary to be able to give balanced advice to decision makers
- Decisions should not be based on just one issue (e.g. radiation) but optimisation across them all. International guidance on such complex issues needs to be improved.
- Regulators, operators and other organisations need to maintain own responsibilities in transparent manner, but dialogue between them is necessary

Continuing cooperation activities

- NRPA and Russian partners are extending the current research activities to support:
  - decisions on de-restricting use of land and resources affected by PA Mayak releases, and
  - management of wastes arising from remediation works
- A flexible regulatory process will be needed to addresses local conditions in optimum manner, but confidence needs to be maintained that basic standards are met.
- All sites have their unique characteristics, but hopefully the experience in NW Russia and around PA Mayak can be of interest in implementation of **Legal Framework for the decontamination program after the nuclear accident of Fukushima Daiichi NPP**

Invitation

On behalf of all colleagues in our program, I would like to extend an offer to share scientific and regulatory experience with colleagues in Japan to all our mutual benefit.

Many thanks for your attention

Thank you for your attention!

For more information:

malgorzata.k.sneve@nrpa.no

www.nrpa.no