Federal Medical and Biological Agency of Russia

Radiation Protection Strategies for ensuring radiation safety of the population of the East-Urals Radioactive Trace

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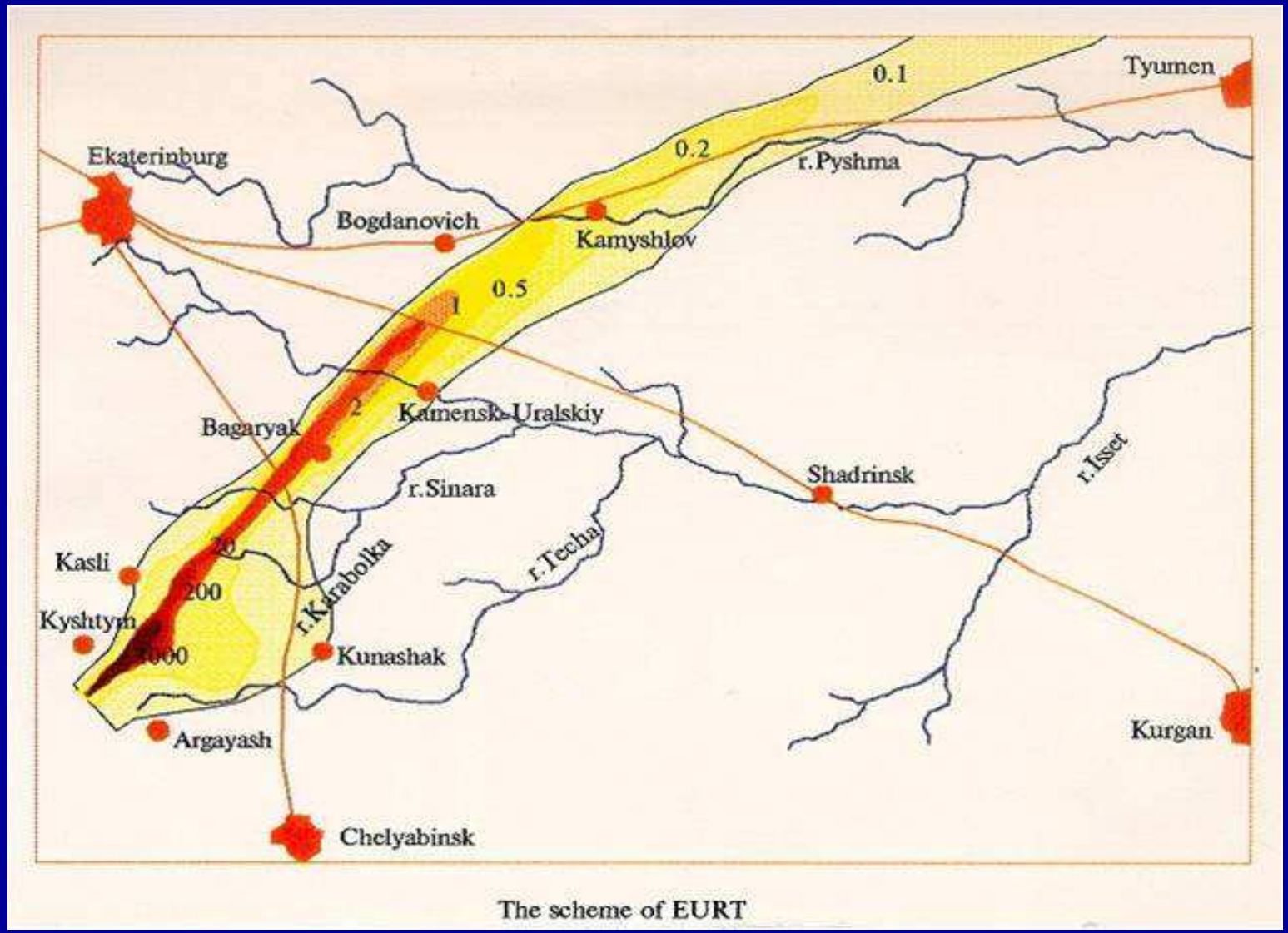
1. Brief characteristics of the accident

Schematic map of the East-Urals Radioactive Trace (EURT)



The scheme of EURT

Special Governmental Commission

R F Governmental authorities:

- **Ministry of middle machine-building industry**
- **(the Mayak PA)**
- **Ministry of Health (FMBA of Russia)**
- **Ministry of Agriculture**

- **Government of Sverdlovsk and Chelyabinsk region**

Radionuclide composition of the 1957 accidental discharge

Radionuclide	Half-life time	Type of radiation	Contribution to activity, %
^{89}Sr	50.5 days	β,γ	traces
$^{90}Sr+^{90}Y$	29.1 years	β	5.4
$^{95}Zr+^{95}Nb$	64 days	β,γ	24.9
$^{106}Ru+^{106}Rh$	1.01 years	β,γ	3.7
^{137}Cs	30 years	β,γ	0.036
$^{144}Ce+^{144}Pr$	284 days	β,γ	66
^{147}Pm	2.62 years	β,γ	traces
^{155}Eu	4.96 years	β,γ	traces
^{239}Pu	24,100 years	α	traces

2.Period of Emergency Countermeasures

(duration: 1-2 weeks)

Major goal for radiation protection of EURT residents:

to prevent deterministic health effects

Patterns of gamma background for the villages located on the EURT

Village	Gamma background value, μR/s		
	30.09.1957	**16.10.1957**	**20.10.1957**
Berdyanish	**400**	**190**	**85**
Saltykova	**300**	**80**	**60**
Galikayeva	**170**	**125**	**32**
Rus. Karabolka	**25**	**3**	**1.7**
Yugo-Konevo	**6**	**1.5**	**0.7**
Bagaryak	**4**	**1.2**	**0.1**
Kamensk-Uralsky	**3**	**0.8**	**0.05**

Emergency evacuations (relocations) of residents

- In order to reduce the doses of external gamma exposure in the area and high levels of food contamination, the residents of 4 villages (approx 1,500 people) were evacuated in 7-10 days after the accident

- Emergency evacuations :
  - allowed a significant reduction in the potential dose of external exposure for the population
  - averted the development of acute radiation syndrome in members of the exposed communities

2.Intermediate period
(duration: 2 years)

- Major goal for radiation protection of EURT residents:

  Decrease of risk of internal exposure due to contaminated food consumption (Sr-90 is a main contaminant)

Planned remedial actions

1. Further relocation
2. Development of a system for radiation monitoring and inspection of foodstuff and feedstuff
3. Decontamination of populated localities and agricultural lands
4. Readjustment and restructuring of the agricultural enterprises

Standards for implementation of radiation protection countermeasures

- Initial contamination of land, where radiation protection measures are necessary: 74 kBq/km^2 (2 Ci/km^2)
- Initial Sr-90 contamination of land: 2 Ci/km^2

- Permissible annual intake (PAI) of Sr-90 with diet: 52 kBq

(It was established basing upon permissible Sr-90 skeleton burden of 740 Bq)

Maximum permissible concentrations of Sr-90 in foods were assessed basing upon permissible annual intake (PAI)

Status of a contaminated area

Distribution of populated settlements over the EURT area		
Contamination density, Ci/sq. km, Sr-90	Area, sq. km	Number of people
0.1	23,000	270 000
2	1000	12700

- The territory bounded by 2 Ci/km² for Sr-90 acquired the official status of a contaminated area.
- On this territory the implementation of radiation protection measures for the population was considered indispensable.

Planned remedial actions involving relocations of the inhabitants

- Over the first year after the accident, residents of contamination area (of 2 Ci/km² for ^{90}Sr) could have been exposed to internal radiation at doses exceeding the established limit

- During the period of scheduled relocations, 18 settlements with total population of over 10 thousand residents were evacuated

- After the relocations, by the end of 1959, this territory was assigned the status of a restricted zone where any kind of economic activities were banned

Sanitary-protection zone (SPZ)

- In early 1958, a sanitary-protection zone (SPZ) was established:
  - bounded by 4 Ci/km^2
  - habitation and business activity were banned
  - patrolled by police
  - The total area of the sanitary-protection zone extended to 700 km^2

East-Urals natural reserve

- The front-end part of the Trace with its contamination density of 600-1,000 Ci/km^2 ($22.2 \cdot 10^3$ - $37 \cdot 10^3$ kBq/m^2) for ^{90}Sr was turned into the East-Urals nature reserve
- The use of the land for agricultural purposes is banned.
- Scientific research is conducted in the area

Radiological monitoring

- Shortly before the accident, in Chelyabinsk and Sverdlovsk oblasts there was only one radiology laboratory based at the Mayak PA which was properly equipped to allow assessment of radionuclide concentration in foods

- By the end of 1958, more than 10 radiology laboratories were in operation, and the analyses performed over 1958-1959 amounted to over 100,000 tests.

Decontamination of populated areas and agricultural lands

The purposes of decontamination included:

- reduction in the levels of secondary contamination of the adjacent territory due to a downwind transfer of activity
- burying and fixation of the fallout activity
- prevention of the use of lands of evacuated villages for agricultural production

In 1958, 59,000 hectares (1 ha = 2.5 acres) were excluded from agricultural use in Chelyabinsk oblast.

In 1958-59, 20,000 of the 59,000 hectares were decontaminated by plowing up.

Restructuring of the agricultural production

- In order to reduce the levels of radionuclide intakes with local foodstuffs, the restructuring of the state owned farms was performed in non-evacuated villages
- Instead of small farms, large specialized factory farms were established
- They are specialized in production of meat (fattening young cattle and pigs), seed (whereas production of grain was banned), vegetables, and a limited production of milk
- The concentration of ^{90}Sr in milk was 3-4 times lower, and the contents of ^{90}Sr in meat products has decreased for 2-7 times

Remediation period
(until present time)

- Provisions for long-term and safe living of non-relocated residents under condition of national and international standards of radiation safety

- Minimal intervention (or its absence) into normal living activities of the public

Scientific potential

- **Research facilities were established:**
  - **Agricultural Experiment Research Station**

    For research of regularities of radionuclide migration to agricultural products and decrease of this contamination
  - **Urals Research Center for Radiation Medicine of FMBA of Russia**

    For medical assistance of EURT residents
- **Leading national research centres were involved**

Areas of radioecological research

- ✓ Behavior of ^{90}Sr and ^{137}Cs in the environment and in food and biological chains
- ✓ Sources of ^{90}Sr and ^{137}Cs body intakes in humans
- ✓ Migration of ^{90}Sr and ^{137}Cs in different types of soil
- ✓ Accumulation and distribution of ^{90}Sr and ^{137}Cs in different components of flowing water bodies and stagnant reservoirs
- ✓ ^{90}Sr and ^{137}Cs metabolism in the bodies of farming animals

Current tasks

- Recovery of agriculture and forestry
- Provisions for sanitary and epidemiological well-being in EURT area as well as for adequate medical assistance in affected residents

Results of efforts on these tasks are described in many publications; they can be also addressed by a specific working meeting

Current radioecological situation on the EURT

- Currently, daily ^{90}Sr body intakes in EURT residents are 1-2 Bq/day, which is equal to 1-2% of the maximum permissible level for humans

Health Effects

- The EURT Population Registry has been created which includes 22,498 persons
- Since 1957 till now the members of the cohort have been followed-up at the URCRM (vital status, causes of death, residence history, disease incidence, health status)
- Organ doses have been reconstructed (TRDS-2009) to 23 organs / tissues

- *Tissue reactions*

Some part of EURT residents exhibited leukopenia, neutropenia, and thrombocytopenia over the first year after the accident. No cases of chronic radiation syndrome were registered. Blood counts normalized within a year after the accident

- *Stochastic effects*

Disease incidence and mortality (from different causes, including solid cancer and leukemia) among residents of the EURT area have never increased over the whole period of the follow-up

Conclusions

- EURT is one of nuclear legacy sites.
- The experience and skills in radiation safety of the EURT residents could (and should) be used when elaborating the regulatory supervision of nuclear legacy sites of similar kind.
- The IAEA International Forum on the **Regulatory Supervision of the Nuclear Legacy Sites** is the suitable place to discuss such experience.

Thank you for your attention!