

EUROPEAN COMMISSION

# nuclear science and technology

## **Expanding cause-of-death registers for chronically radiation-exposed populations in the Russian Federation: Coverage, quality and analysis (CDR-REP+)**

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### **Final report (summary)**

Work performed as part of the European Atomic Energy Community's research and training programme in the field of nuclear energy 1998-2002 (Fifth Framework Programme)  
Generic research in radiological sciences

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## **Background**

Environmental and occupational exposure to ionising radiation is the most frequent type of radiation exposure in the world. Our scientific knowledge on the health effects of chronic protracted exposure, however, remains limited. This is mainly due to the difficulty of identifying and defining exposed populations and estimating their doses, in particular for environmental radiation exposure. In this context, the study of health effects of a relatively large numbers of people chronically exposed to radiation following radioactive waste releases into the environment in the Southern Urals is of great importance. Residents of the closed city of Ozyorsk occupationally and environmentally exposed to ionising radiation from the Mayak nuclear weapons plant, inhabitants of the Techa riverside villages, and people exposed to atmospheric radiation exposure in the Altai region as a result of nuclear weapons testing at the Semipalatinsk test site are most valuable to contribute to our scientific knowledge concerning health effects of ionising radiation.

Two earlier EC contracts have laid the foundation of the work, which was continued within this contract, CDR-REP+. First, the INCO-COPERNICUS contract started in May 1997 (contract No IC15-CT96-312), aiming at safeguarding existing information on the exposed populations of the closed city Ozyorsk, inhabitants along the Techa River and those of the Altai region, including a feasibility study on the possibility of creating cause-of-death registers for the future follow-up of the exposed cohorts established in the framework of this project. As a result of the positive outcome of the feasibility study, a second INCO-COPERNICUS contract started in January 1999 (contract No IC15-CT98-0204), aiming at establishing cause-of-death registers for the three areas aforementioned. In the framework of this contract, data on cause of death in resident populations of radiation-exposed territories were reconstructed from historical records. Given the huge volume of information to be collected, efforts were concentrated in collecting information from the first year of radiation exposure to sometime in the early 1990s. Comparable data collection procedures could be ensured by this particular partnership, linking the three collaborating centres with common objectives, thus ensuring close collaboration in relation to using the same data sources and abstraction methods and continuously monitoring the quality and completeness of the data collected. The partnership thus established between the collaborating institutions from the European Union and the Russian Federation proved very effective.

As a result, the CDR-REP+ contract maintained and strengthened the partnership, which has proved very effective, instructive and productive for all parties. Collaboration between Russian scientists and those working in the European Union is particularly important not only to build appropriate research infrastructure in the Russia Federation, but also to preserve the human capital and expertise in the country.

The aim of the present project was to build on the previous experience by expanding the cause-of-death registers in each of the three regions. The objectives were to complete the data collection from the 1990s to 2001, thus rendering the registers complete and up to date. At the same time the registers will continue to gather information on exposure to ionising radiation on an individual level. Each individual exposed to ionising radiation as a consequence of the discharge of radioactive waste from the Mayak nuclear facility or the nuclear tests in Semipalatinsk is also flagged in the registers, thus providing a larger potential for comparative analysis.

The tasks preformed within the framework of the project were the following:

## Ozyorsk cause-of-death register

Within the framework of the project, a cause-of-death register of the Ozyorsk population, ranging the period 1950-2001, was established. The closed city of Ozyorsk was established in the late 1940s with the aim of producing weapon-grade plutonium. Several tens of thousands of workers have worked at the Mayak nuclear facility. We have established a cause-of-death registry not only for the workers but for the entire city. As can be seen from Table 1 below, a substantial number of inhabitants have been engaged at the Mayak nuclear facility.

**Table 1:** Mean number of individuals in the different cohorts of the Ozyorsk inhabitants

| Years of follow-up | Total number of adults in the population of Ozyorsk (over 18) | "The population" cohort | "The workers" cohort |
|--------------------|---|-------------------------|----------------------|
| 1953-1957          | 31 478  | 22 031                  | 9 447                |
| 1963-1967          | 37 301  | 26 494                  | 10 807               |
| 1973-1977          | 45 442  | 33 557                  | 11 885               |
| 1983-1987          | 56 921  | 42 933                  | 13 988               |
| 1993-1997          | 64 641  | 50 616                  | 14 025               |

Thousands of death certificates have been entered into a database. We have used stringent coding criteria and logic checks in order to minimise incorrect entering of data. We have been able to identify all former workers at the plant enabling us to calculate risks of cancer and non-malignant events in former workers and contrasting the risks to those living in the city (with a living standard far from the Soviet average) but not working at the power plant. To calculate risks properly we have also established population denominators.

In very preliminary data we are able to show that the workers of Ozyorsk experienced a higher risk of dying from leukaemia compared to the non-working population of Ozyorsk (Figure 1).

**Figure 1:** Mortality rates for leukaemia in relation to year of death and gender, stratified by working status among Mayak workers



## Techa River cause-of-death registry

During a period of approximately 7 years, 1950-56, radioactive waste was released directly into the Techa River. More than 30 000 individuals lived in the riverside villages and were later resettled as a consequence of the release. These individuals were given medical treatment at the Urals Centre for Radiation Medicine in Chelyabinsk. All provided health care was registered and forms the basis for the Techa River cohort. Within the current project we have established a cause-of-death register covering the majority of the area surrounding the river. The Techa River cause-of-death registry has been expanded in study period, from 1993 to 2001. In addition, one rayon has been added to the two registries that thus cover 3 out of 7 rayons in the so-called catchment area. Population denominators have been calculated and preliminary data are presented. The most important part of the project has been to tag all individuals in the cause-of-death registry that belonged to the Techa River cohort, enabling comparisons of exposed and non-exposed individuals. As can be seen in Table 2, the mortality rates of those exposed is higher for malignancies but not for cardio-vascular events. Another interesting observation is that infections as a cause of death are dramatically reduced and cardio-vascular events and malignancies are dramatically increased.

**Table 2:** Mortality rates per 10<sup>5</sup> in relation to cause of death, decade of death, and exposure status in three rayons of the Techa River cathment area (exposed = 1, non-exposed = 2)

| Cause of death            | 1954  |       | 1959  |       | 1970  |       | 1979  |       | 1989  |       | 1999  |       |
|---------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                           | 1     | 2     | 1     | 2     | 1     | 2     | 1     | 2     | 1     | 2     | 1     | 2     |
| Infections                | 243.3 | 237.8 | 113.5 | 145.7 | 33.4  | 35.9  | 30.7  | 17.6  | 6.1   | 11.0  | 31.2  | 17.3  |
| Neoplasms                 | 91.2  | 103.4 | 140.3 | 103.4 | 137.8 | 129.9 | 179.0 | 147.7 | 202.3 | 193.6 | 327.4 | 169.0 |
| Cardio-vascular disorders | 316.2 | 237.8 | 260.5 | 284.5 | 325.8 | 520.6 | 567.8 | 723.1 | 576.2 | 674.7 | 1013  | 817.8 |
| Respiratory disorders     | 103.4 | 197.9 | 133.6 | 179.1 | 108.6 | 121.4 | 143.2 | 141.8 | 159.4 | 123.0 | 187.1 | 140.6 |
| Injuries and poisoning    | 79.1  | 84.2  | 80.2  | 61.0  | 108.6 | 139.4 | 245.5 | 201.6 | 159.4 | 153.4 | 265.0 | 270.1 |

## Altai cause-of-death registry

The Altai region is situated north-west of the Semipalatinsk test site. The total number of nuclear tests was 456. After the Moscow Treaty was signed in 1963 (the treaty prohibited atmospheric, space, and underwater nuclear weapon tests) only underground explosions were carried out. The greatest contribution to population doses in the Altai region arose from the first Soviet nuclear test carried out at the STS on 29 August 1949. Population doses have been reconstructed for this and some other detonations.

The part of the project included the establishment of a cause-of-death register in the Altai region. The register now covers the period 1993-2002 and holds information on cause of death for those considered to have been exposed to ionising radiation and for those considered to be non-exposed. Population denominators and preliminary results have been calculated. The follow-up in the Altai region started much later than in the two previous areas and copying medical death certificates and death registration acts from archives for the population

has been a large part of the project. A total of 57 753 deceased individuals have been entered into the database.

## **Summary**

The three cause-of-death registries are now well established and have already at this early phase proven to give interesting scientific results. It has been possible to establish population denominators and to identify and tag individuals that were exposed to radioactivity. We firmly believe that the registry will be regarded as a most valuable scientific resource. The initial findings include:

- (1) Mayak workers had a lower overall mortality rate than the non-exposed population of Ozyorsk. They were, however, more likely to die from malignant disorders. The most profound differences were seen for haematological and respiratory malignancies.
- (2) Among the individuals living the area of the Techa River, death due to infections decreased over time regardless of exposure status, but individuals in the exposed population were more likely to die from infections. Malignant disorders as a cause of death became more abundant and the exposed individuals seemed to be more likely to die of a cancer with increasing follow-up.
- (3) Mortality rates were not calculated for the Altai population but the proportion of people dying from infections, malignant disorders, endocrine disorders, and cardio-vascular disorders were higher among those considered exposed to ionising radiation. Tuberculosis and malignancies in the gastro-intestinal tract were more common in the exposed population.