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<th>Project Number</th>
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<tr>
<td>1.1</td>
<td>Techa River Population Dosimetry</td>
<td>Bruce Napier</td>
<td>Marina Degteva</td>
<td>123</td>
<td>This project provides the foundation for the derivation of radiation risk from studies of the Techa River Cohort. It provides the dosimetry data for Project 1.2b, Techa River Population Morbidity, and for related studies of the U.S. National Cancer Institute and the European Commission. This study is important because it addresses the question of radiogenic risk from dose received at low dose rates. In addition, this project is providing valuable, new information for improving dose estimation from the intake of $^{90}$Sr. The Techa River Dosimetry System (TRDS)-2009D (deterministic) and TRDS-2009MC (stochastic) calculations have been completed. Current work emphasizes calculation of individual external dose based upon the location of a person’s home, inclusion of additional exposure pathways, including atmospheric transport from Mayak stack releases developed by Project 1.4, and enhancement of the stochastic version of the dosimetry system with full evaluation of uncertainty in individual doses. Researchers plan to complete the next iteration of the dosimetry system, TRDS-2016, in 2016.</td>
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<td>1.2a</td>
<td>Data Preservation at URCRM</td>
<td>Donna Cragle</td>
<td>Nikolai Startsev</td>
<td>1</td>
<td>This completed project established a document imaging system at URCRM for preserving valuable medical records of residents of the Southern Urals region exposed to radiation due to the operations of the Mayak facility and environmental releases. These documents contain information from 1951 to the present with details of medical examinations, individual dose measurements, addresses, causes of death, and other data necessary for epidemiologic studies and dose reconstruction. Computer scanning equipment was purchased, installed, and later updated. Scanning, verification, indexing, and creation of a computer database of the scanned documents were completed.</td>
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<tr>
<td></td>
<td>1997-2005</td>
<td>Oak Ridge Institute for Science and Education</td>
<td>Urals Research Center for Radiation Medicine</td>
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<td>1.2b</td>
<td><strong>Techa River Population Cancer Morbidity and Mortality</strong> 1997-2003 2004-2006 2007-2009 2010-2014 2015-2018</td>
<td>Faith Davis <em>University of Illinois at Chicago</em></td>
<td>Alexander Akleyev and Ludmila Krestinina <em>Urals Research Center for Radiation Medicine</em></td>
<td>29</td>
<td>The combined work of Projects 1.1 and 1.2b addresses the important question of the validity of the dose-response model (linear, non-threshold) used by national and international authorities in the development of radiation-protection standards, particularly as applied to radiation delivered at low dose rates. The Extended Techa River Cohort reflects a general population exposed to moderate doses of radiation at low dose rates 50 years ago. The population is relatively large (~30,000) and has been actively followed so that results can be expected within a reasonable time frame. Preliminary results using the new Techa River Dosimetry System (TRDS)-2009D (deterministic) indicate an excess in leukemia and solid cancer risks in this population. Work identifying confounding sources of exposure and other risk factors is ongoing.</td>
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Lynn Anspaugh *University of Utah* | Yuri Mokrov *Mayak Production Association* | 9 | This project is concerned with the reconstruction of doses to the residents of Ozersk from the airborne radionuclide emissions from Mayak. Focus is on the emission of $^{131}$I and dose to the thyroid glands of children. Data may be used to support a potential epidemiologic study of thyroid cancer in children sponsored by the National Cancer Institute. This should help resolve the dichotomy between the studies at Hanford (no observed effect) and Chernobyl (large effect). The project and associated documentation was completed in 2013. |
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<td>2.2</td>
<td><strong>Mayak Worker Cancer Mortality</strong>&lt;br&gt;1997-2001&lt;br&gt;2002-2004&lt;br&gt;2005-2007&lt;br&gt;2008-2012&lt;br&gt;2013&lt;br&gt;2014-2018</td>
<td>Dan Stram&lt;br&gt;&lt;i&gt;University of Southern California&lt;/i&gt;</td>
<td>Mikhail Sokolnikov&lt;br&gt;&lt;i&gt;Southern Urals Biophysics Institute&lt;/i&gt;</td>
<td>9&lt;br&gt;</td>
<td>This project is the first to demonstrate statistically significant associations between occupational exposure to plutonium (Pu) and lung, liver, and bone cancer. Dose-response analyses based on the Mayak Worker Doses 2005 database have been conducted for lung, liver, and bone cancer and express the excess relative risk as a function of plutonium dose, external dose, gender, and attained age. Statistically significant dose-response relationships for external dose have also been demonstrated for leukemia; all solid cancer excluding lung, liver, and bone cancer; and lung cancer. Researchers also published cancer risk estimates for cancers other than lung, liver, and bone based on the Mayak Worker Dosimetry System (MWDS)-2008. They are now analyzing the MWDS-2013, which provides, instead of a single dose estimate, many realizations of possible true dose given uncertainties in dose determinants. A paper describing statistical strategies for the incorporation of the dosimetric uncertainty characterized by the multiple realizations of dose into future epidemiological dose-response analysis is presently under review for publication. Researchers also are working on the computational aspects of manipulating and using the very large files generated by the new dosimetry system and for the epidemiologic analysis.</td>
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### Project 2.4: Mayak Worker Dosimetry

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<tr>
<td>2.4</td>
<td>Mayak Worker Dosimetry</td>
<td>Bruce Napier, Pacific Northwest National Laboratory-Battelle</td>
<td>Alexander Efimov, Southern Urals Biophysics Institute</td>
<td>62</td>
<td>In addition to providing the dosimetric data for Project 2.2, Mayak Worker Cancer Mortality, this project has enhanced the understanding of Pu metabolism in the human body and improved the biokinetic models for assessing dose from Pu uptakes. These outcomes will be of direct benefit to DOE in improving the determination of dose to DOE workers from Pu exposure. Additionally, this project has improved the interpretation of worker external dosimetry and developed improved methods of estimating organ doses based on dosimeter results. These improved methods can be applied to the evaluation of worker dose at DOE facilities. This project also developed important relationships for the role of medical x-rays for worker exposure. Researchers completed the Mayak Worker Dosimetry System (MWDS)-2013 for 25,757 workers hired between 1948 and 1982, with full stochastic uncertainty analyses, which is being used to develop cancer and non-cancer risk estimates. Work started on enhancements for MWDS-2016.</td>
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<td>2.5</td>
<td>Improved Plutonium Dose Assessment Methods for Mayak Workers</td>
<td>Robert Scherpelz Pacific Northwest National Laboratory-Battelle (formerly Raymond Guilmette, Lovelace Respiratory Research Institute)</td>
<td>Sergey Romanov Southern Urals Biophysics Institute</td>
<td>12</td>
<td>The earlier efforts in this project focused on determining the amount and location of long-term-retained Pu in the lungs of Mayak workers. This study was the first to demonstrate very long-term sequestration of Pu particles in human lung parenchyma. Then, this knowledge of Pu distribution in lung was used with state of the art dose assessment methods to modify the human respiratory tract dosimetry models to improve dose assessment. In 2009, the activities of Project 2.5 were merged into Project 2.4, and the results of the earlier investigations were used in the development of the Mayak Worker Dosimetry System 2008.</td>
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<tr>
<td>2.6</td>
<td>Molecular Markers of Lung Cancer in Mayak Workers</td>
<td>Steve Belinsky Lovelace Respiratory Research Institute</td>
<td>Vitaly Telnov Southern Urals Biophysics Institute</td>
<td>4</td>
<td>The original phase of this completed project demonstrated that the p16 tumor suppressor gene was targeted for inactivation by promoter hypermethylation in plutonium-induced adenocarcinomas of the lung. In the final phase, researchers examined methylation profiles in adenocarcinomas and squamous cell carcinomas of the lung in Mayak workers and controls.</td>
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<td>2.7</td>
<td>Radiation Biomarkers</td>
<td>David Brenner Columbia University</td>
<td>Tamara Azizova Southern Urals Biophysics Institute</td>
<td>5</td>
<td>The feasibility study of this completed project indicated a statistically significant dose-response between Pu exposure and intra-arm chromosomal aberrations from worker blood samples. In the final phase, researchers developed a calibrated, dose-related biomarker of Pu exposure.</td>
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<td>2.8</td>
<td>Mayak Worker Tissue Repository</td>
<td>Christopher Loffredo</td>
<td>Evgenia Kirillova</td>
<td>35</td>
<td>The Mayak Worker Tissue Repository now holds tissues from 1,843 subjects (975 from autopsy and 868 from surgery or biopsy) and blood DNA, cells, serum, plasma, and other biological samples from 5,905 Mayak workers and residents of Ozersk. In conjunction with medical, occupational, and dosimetry information, data collected in the repository will make possible the conduct of molecular epidemiology studies. Such studies combine epidemiologic with genetic/molecular methods to establish an association between disease and radiation exposure in individuals.</td>
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<td>2.9</td>
<td>Database Integration</td>
<td>Dale Preston</td>
<td>Sergey Romanov</td>
<td>0</td>
<td>This completed project successfully combined databases located in two Russian organizations so as to facilitate researcher access to data. As such, it is not intended to result in publications or influence radiation protection standards.</td>
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<td>2001-2005</td>
<td>Hirosoft International</td>
<td>Southern Urals Biophysics Institute;</td>
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<td>Eric Grant</td>
<td>Evgeny Vasilenko Mayak Production Association</td>
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<td>Radiation Effects Research Foundation</td>
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As of December 31, 2014, U.S. and Russian investigators working on projects funded by the Russian Health Studies Program have generated 289 peer-reviewed publications. Of these, 15 were published in 2014.
Russian Health Studies Program  
289 Peer Reviewed Publications  
December 31, 2014

Project 1.1: Techa River Population Dosimetry (123)


105. Trapeznikov, A.V.; Molchanova, I.V.; Karavaeva, E.N.; Peremyslova, L.M.; 
Mikhajlovskaya, L.N.; Popova, I.Ya.; Nikolkin, V.N.; Vorobiova, M.I.; 
Trapeznikova, V.N.; Kostychenko, V.A.; Korzhavin, A.V. Results of long-term 

106. Veronese, I.; Shved, V.; Shishkina, E.A.; Giussani, A.; Göksu, H.Y. Study of dose rate 

107. Veronese, I.; Fattibene, P.; Cantone, M.C.; De Coste, V.; Giussani, A.; Onori, S.; 
Shishkina, E.A. EPR and TL-based beta dosimetry measurements in various tooth 

108. Volchkova, A.Y.; Chuvakova, D.A.; Shishkina, E.A. Calculations of tooth enamel doses 
from internal exposure based on a set of voxel phantoms by example of the 1st low 

Degteva, M.O. Harmonization of dosimetric information obtained by different EPR 


111. Vorobiova, M.I.; Degteva, M.O.; Burmistrov, D.S.; Safronova, N.G.; Kozheurov, V.P.; 
Anspaugh, L.R.; Napier, BA. Review of historical monitoring data on Techa River 

112. Vorobiova, M.I.; Degteva, M.O. Simple model for the reconstruction of radionuclide 
concentrations and radiation exposures along the Techa River. *Health Phys.* 77:142–149; 
1999.

113. Vozilova, A.V.; Shagina, N.B.; Degteva, M.O.; Edwards, A.A.; Ainsbury, E.A.; Moquet, 
J.E.; Hone, P.; Lloyd, D.C.; Fomina, J.N.; Darroudi, F. Preliminary FISH-based 
177:84-91; 2012.

114. Vozilova, A.V.; Shagina, N.B.; Degteva, M.O.; Akleyev, A.V. Chronic radioisotope 
effects on residents of the Techa River (Russia) region: Cytogenetic analysis more than 
50 years after onset of exposure. *Mutation Research* 756:115–8; 2013.

115. Vozilova, A.V.; Shagina, N.B.; Degteva, M.O.; Moquet, J; Ainsbury, E.A.; Darroudi, F. 
FISH analysis of translocations induced by chronic exposure to Sr radioisotopes: Second 


Project 1.2a: Data Preservation at URCRM (1)


Project 1.2b: Techa River Population Morbidity (29)


**Project 1.4: Reconstruction of Dose to Residents of Ozersk from Mayak Operations (9)**


**Project 2.2: Mayak Worker Epidemiology (9)**


**Project 2.4: Mayak Worker Dosimetry (62)**


**Project 2.5: Improved Plutonium Dose Assessment Methods for Mayak Workers (12)**


**Project 2.6: Molecular Markers of Lung Cancer in Mayak Workers (4)**


**Project 2.7: Radiation Biomarkers (5)**


**Project 2.8: Mayak Worker Tissue Repository (35)**


Project 2.9: Database Integration (0)

None.