

Descriptive characteristics of the cohort of workers from the Siberian Group of Chemical Enterprises (SGCE)

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Siberian Group of Chemical Enterprises (SGCE) is a large complex for production of nuclear fuel which includes multiple processing facilities, including isotope separation and sublimation. The Isotope separation plant and the Sublimation plant were put into commercial operation in 1953 and in 1954, respectively. They produce uranium enriched by isotope U-235 and uranium hexafluoride. Both natural and regenerated uranium are used as raw materials.

Systematic monitoring of uranium alpha-emitting radionuclides in the SGCE employees was initiated in the mid-1950s by specialized biophysical laboratory using the indirect method based on the radiochemical analysis of biological samples. Biophysical examination of the uranium body burden was conducted once per year.

The cohort of SGCE workers potentially exposed to uranium includes all employees who were hired during January 1, 1950-December 31, 2010 and worked for at least 1 year (~3,500 workers). Workers from this group may have been exposed to both external radiation (approximately 60 %) and to internal radiation from incorporated plutonium. Table 1 shows descriptive characteristics of SGCE employees potentially exposed to uranium. Follow up was conducted through 2014 through a specialized medical registry for SGCE employees (vital status known for ~75 %). Table 2 shows the distribution of uranium group employees by uranium content in urine and cumulative dose of external exposure.

Table 1. Descriptive characteristics of SGCE workers potentially exposed to uranium

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first employed 1950 to 2010.

Variable	Sex	Radio-chemical plant	Plutonium plant	Plutonium plant	Sublimate plant	Support facility	Total
Total number of employees	M/F	154/58	1,664/464	311/133	506/122	89/53	
	Total	212	2,128	444	628	142	3,554
Outpatient examination	M/F	35/7	1,349/93	219/108	315/78	50/35	
	Total	42	1,442	327	393	85	2,289
Hospital examination	M/F	124/52	859/192	70/18	269/56	53/19	
	Total	176	1,051	88	325	72	1,712
Uranium body burden	M/F	25/6	389/97	41/21	94/9	13/5	
	Total	31	486	62	103	18	700
Monitored for external exposure	M/F	199/51	975/168	85/12	418/87	56/28	
	Total	250	1,143	97	505	84	2,079
Cancer patients: total number (%)	Total	32 (15.1)	289 (13.6)	99 (22.3)	116 (18.5)	28 (19.7)	564 (15.9)

Table 2. Distribution of SGCE workers potentially exposed to uranium by categories of uranium content in urine and by cumulative dose of external exposure.

Variable	Uranium content in urine (kBq)						
	< 0.046	0.046-0.74	> 0.74-1.48	> 1.48-3.70	> 3.70		
Male	883	1,395	133	47	30		
Female	256	448	21	7	12		
Total	1,139	1,843	154	54	42		
Index	Cumulative Dose of External Exposure (mSv)						
	0	> 0-50	> 50-150	> 150-200	> 200-300	> 300-500	> 500-1,000
Male	1,068	722	408	113	167	152	87
Female	491	189	89	25	23	11	2
Total	1,559	911	497	138	190	163	89

In summary, we presented a first description of the cohort of workers employed at the SGCE who were exposed to a complex combination of external and internal irradiation and potentially could have been exposed to uranium. The electronic database contains detailed information on occupational activities including the information on the measured doses of external exposure and dynamics of their accumulation, as well as the data on biophysical studies for detection of uranium body burden. The cohort has been followed up for mortality and cancer incidence for over 65 years and presents a unique opportunity for conducting research on the medical and biological effects of low-dose chronic radiation exposure. This cohort of SGCE employees is uniquely suited for research on the effects of the long-term low-dose occupational radiation exposures.