Early Medical Consequences of Radiation Incidents in the Former URRS Territory

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Abstract. The paper sums up the information on radiation incidents at the former USSR territory, which incidents are related to the human exposure of clinically significant effects. Within more than 50 years (since 1949), at least 349 radiation incidents accompanied by the clinically significant human exposure have happened at the former USSR territory, which has resulted to clinically significant health effects in 747 victims. This exposed cohort includes 348 acute radiation sickness (ARS) patients including cases aggravated by local radiation injuries (LRI). 399 victims were affected by local radiation injuries only. Totally, 71 radiation induced fatalities were observed within first 3-4 months after the irradiation.

As a result of the Chernobyl NPP Unit IV accident, 28 workers and firemen have perished as a result of irradiation to lethal and super-lethal radiation doses among 134 acute radiation sickness (ARS) patients. It, in effect, is the plate of rough miscalculations in maintenance of the nuclear installations. And what human health effects were *before* and *after* Chernobyl in the territory of the former USSR?

The reviews on chronology of radiation incidents in the former USSR were done earlier [1,2,3], however, in the given paper we try to get more complete generalization of the available information, in which is thebasis of the Registry of radiation accidents and incidents of the State Research Center - Institute of Biophysics (SRC-IBP).

The registry of radiation incidents of SRC-IBP, which clinical department and its branch (Ozersk) have done the medical examination and treatment of the majority of victims within more than five decades, is managed for more than 20 years. It contains the information on radiation incidents having place in the former USSR since 1949 (date of incident, place, conditions of radiation exposure, main radiation factors, the information on medical consequences including the number of people involved in the accident, number of patients with clinically consequences, i.e. an acute radiation sickness or local radiation injuries, and also fatalities at the acute period of development of the radiation injury). It is necessary to mark, that SRC-IBP also disposes the unique database on acute radiation injuries under the computer-controlled case history with developed user interface and including outcomes of personal clinical observation and treatment of the patients with the ARS diagnosis in the acute period and subsequent time (about 200 case histories).

Some information on radiation incidents having place in 1950^{th} - 1960^{th} was restored retrospectively, since such information was classified and was kept in incomplete volume. Whenever possible, such information is updated in the process of its entry from reliable sources. In the present activity, we have tried to set up all information, available for us as of 30.06.2003.

Table 1 gives the chronological list of radiation incidents registered (excluding two well known accidents happened in Southern Urals from industrial activities of "Mayak" PA in 1957 and in 1967, where clinically significant consequences are known to be absent). The Table provides the information on the date and geographical place of incident, brief incident information (brief description or radiation source data), main characteristics of radiation exposure (external exposure to charged particle beam at the accelerator and the X-ray exposure are noted separately), number of people involved in the incident with separated figures for those who developed ARS or LRI and those, who died at the acute period of radiation sickness (first 3-4 months after exposure).

For ARS patients, the structure of severity grading is provided. Table 2 generalizes the information and provides incident classification.

Tables 1 and 2 show that at least 349 radiation incidents with serious human overexposure have happened in the former USSR territory at the period since 1949 (each LRI case in “Mayak” PA is considered as the separate event in 1949-1956). 747 people had clinically significant effects including 348 ARS cases (including those aggravated by LRI) and 399 only LRI cases were established. 71 acute fatalities at first 3-4 months after exposure are registered in this group (9.5% of total victim number or 20.4% of ARS patient number).

When considering the radiation incident dynamics, one can state that one to four radiation accidents have happened annually at recent three decades. One incident with fatal outcome at the acute ARS period was observed per each two years. In average, 5-6 persons per year had serious clinical effects. At recent years (since 1991) the rate and severity of incidents have decreased, which is apparently related to both the radiation safety improvement and to the decrease of radiation technology activities.

Most significant early medical consequences were noted for the 1986 Chernobyl NPP accident resulted to 30 fatalities (2 persons perished due to the reactor explosion and 28 radiation induced fatalities). Two nuclear submarine accidents in 1961 and 1968 have resulted to 12 fatalities [6]. The incident in the military regiment situated in Azerbaijan (1982) has resulted to 5 radiation burn fatalities due to the exposure to powerful ^{137}Cs source in the clothes pocket. Three radiation fatalities were caused by reactor criticality accident at "Mayak" PA (1958, Chelyabinsk-40) and 1970 Sormovo accident of the vapor release at the nuclear submarine construction. Three incidents have to be marked including 1952 "Mayak" PA incident (highly radioactive water leakage) and two criticality accidents at critical assemblies (Chelyabinsk, Sungul, 1968 and Kurchatov institute, 1971, Moscow) have resulted to two fatalities in each incident. 1982 Kramatorsk incident (present Ukrainian territory) has to be mentioned, when the radiation source in the living apartment wall has resulted to two fatalities in the single family. Other fatal incidents (see Table 1) have resulted to only one fatality each.

First decades of the considered half-century were dominated by atomic industry incidents including criticality incidents; later on, incidents with radioisotope devices and sources were predominant.

It should be noted that □+□ source incidents are generally specific to maximal number of people involved including members of the public, so they require complex organizational measures to reveal really affected individuals. It is also valid for other similar incidents worldwide (1983 Mexico; 1987, Brazil).

When considering structure of early medical consequences of registered radiation incidents (on ARS severity grade), it should be noted that 54 ARS patients had extremely severe grade (15.5%), 46 ARS patients had severe grade (13.2%), 91 ARS patients had moderate grade (26,1%) and 157 ARS patients had mild grade (45.1%). Maximal number of victims, 57 out of 100 (57%) ARS patients of severe and extremely severe grades were noted for 1986 Chernobyl NPP accident; for criticality accidents and reactor accidents (excluding Chernobyl accident) such diagnosis was established in 25 persons (25%); for nuclear submarine accidents, it was found in 19 persons (19%), and 11 persons (11%) had such diagnosis in case of radioisotope source incidents. It should be stressed that mild ARS grade composes almost half of all cases (157 out of 348) and it has known favorable outcome of the acute period.

Table 1. Radiation incidents taken place at the territory of the former USSR and structure of early medical effects (information from SRC-IBP Registre[a] [1,2,3,6])

Date of incident[b]	Place		Major radiation features			Number of people involved					
	Current name of the country[b]	City, region or medical facility	Incident type[c]	Major radiation factor	Kind of exposure	Total	Those with significant clinical symptoms				Died
							Total (I-IV)	ARS severity[d]			
								II-IV	III-IV	IV	
05.07.50	Russia	Chelyabinsk-40 (Ozersk)	R	-n	external	5	1	1	-	-	-
19.08.50	Russia	Chelyabinsk-40 (Ozersk)	R	-n	external	1	1	-	-	-	-
28.09.50	Russia	Chelyabinsk-40 (Ozersk)	R	-n	external	1	1	-	-	-	-
??.01.51	Russia	Chelyabinsk-40 (Ozersk)	R (FR)	-n	external	1	1	1	1	-	-
01.10.51	Russia	Chelyabinsk-40 (Ozersk)	R (FR)	-	external	4	4	1	1	1	1
??.07.51	Russia	Chelyabinsk-40 (Ozersk)		-	external	1	1	-	-	-	-
02.12.51	Russia	Chelyabinsk-40 (Ozersk)	R (FR)	-n	external	2	2	2	2	-	-
??.??.52	Russia	Chelyabinsk-40 (Ozersk)			internal	2	2	2	2	2	2
??.??.52	Russia	Chelyabinsk-40 (Ozersk)			external	1	-	-	-	-	-
??.??.52	Russia	Chelyabinsk-40 (Ozersk)		-	external	3	-	-	-	-	-
04.07.52	Russia	Chelyabinsk-40 (Ozersk)	R (FR)	-n	external	1	1	-	-	-	-
??.??.53	Russia	Chelyabinsk-40 (Ozersk)			internal	2	2	1	-	-	-
15.03.53	Russia	Chelyabinsk-40 (Ozersk)	crit	-n	external	2	2	1	-	-	-
09.09.53	Russia	Moscow	crit	-n	external	4	4	4	1	-	-
18.09.53	Russia	Chelyabinsk-40 (Ozersk)	R (FR)	-n	external	1	1	-	-	-	-
13.10.53	Russia	Chelyabinsk-40 (Ozersk)	R (FR)	-n	external	5	5	-	-	-	-
28.12.53	Russia	Chelyabinsk-40 (Ozersk)	R (FR)	-n	external	7	7	1	-	-	-
11.03.54	Russia	Obninsk	crit	-n	external	1	1	1	1	-	-
28.06.54	Russia	Arzamas-16 (Sarov)	source	(^{210}Po)	external	2	2	2	1	1	1
24.01.55	Russia	Moscow	source	(^{124}Sb)	external	1	1	1	-	-	-
03.06.55	Russia	Chelyabinsk-40 (Ozersk)	R	-n	external	2	2	-	-	-	-
??.06.57	Russia	Moscow	accelerator	e	external	1	-	-	-	-	-
21.04.57	Russia	Chelyabinsk-40 (Ozersk)	crit	-n	external	6	6	5	3	1	1
02.01.58	Russia	Chelyabinsk-40 (Ozersk)	crit	-n	external	4	4	4	4	3	3
??.??.60	Kazakhstan	?	source		external	1	-	-	-	-	-
08.06.60	Russia	Moscow	suicide		external	1	1	1	1	1	1
20.03.61	Russia	Moscow	I	(^{60}Co)	external	1	-	-	-	-	-
26.06.61	Russia	Moscow	crit	-n	external	4	4	-	-	-	-
04.07.61	Russia	Nuclear submarine	crit		external	30	30	16	12	8	8
14.07.61	Russia	Tomsk-7 (Seversk)	crit	-n	external	1	1	-	-	-	-
30.09.61	Russia	Moscow	source		external	1	-	-	-	-	-
06.02.62	Russia	Moscow	I	X	external	1	-	-	-	-	-

10.04.62	Russia	Moscow	source	□	external	1	-	-	-	-	-
02.11.62	Russia	Obninsk	crit	□-n	external	2	2	1	1	-	-
26.07.63	Russia	Chelyabinsk-40 (Ozersk)		□	internal	1	1	1	1	-	-
??.??.63	Russia	Chelyabinsk-40 (Ozersk)		□-□	ext+int	1	-	-	-	-	-
??.??.63	Russia	Chelyabinsk-40 (Ozersk)	R(FR)	□	external	1	-	-	-	-	-
11.03.63	Russia	Arzamas-16 (Sarov)	crit	□-n	external	2	2	-	-	-	-
28.06.63	Russia	Sverdlovsk (Ekaterinburg)	source	□	external	3	-	-	-	-	-
29.05.65	Russia	Moscow	accelerator	e	external	1	-	-	-	-	-
11.06.66	Russia	Kaluga	I	X	external	1	-	-	-	-	-
??.??.66	Russia	Chelyabinsk-40 (Ozersk)	source	□	external	1	-	-	-	-	-
20.05.66	Russia	Moscow		□	external	1	-	-	-	-	-
15.04.67	Kirgizia	Frunze	I	X	external	1	-	-	-	-	-
24.05.67	Russia	Moscow	I	X	external	1	-	-	-	-	-
09.12.67	Russia	Moscow	I	X	external	1	-	-	-	-	-
22.12.67	Russia	Moscow	source	□-□(^{46}Sc)	external	1	-	-	-	-	-
??.??.68	Russia	Nuclear submarine		□□□	external	92	44	10	7	4	4
05.04.68	Russia	Chelyabinsk-70	crit	□-n	external	2	2	2	2	2	2
??.05.68	Russia	Moscow	I	X	external	1	-	-	-	-	-
27.06.68	Russia	Arzamas-16 (Sarov)	I	□(^{210}Po)	internal	2	-	-	-	-	-
10.12.68	Russia	Chelyabinsk-40 (Ozersk)	crit	□-n (Pu)	external	2	2	2	2	1	1
07.12.68	Russia	Moscow	I	X	external	1	-	-	-	-	-
??.??.69	?	?	I(SI)	□	external	1	1	-	-	-	-
02.01.69	Russia	Moscow	I	X	external	1	-	-	-	-	-
20.01.69	Russia	Obninsk	R(FR)	□	external	2	2	-	-	-	-
11.02.69	Russia	Moscow	accelerator	e	beam	1	-	-	-	-	-
11.03.69	Russia	Melekes	I	□(^{60}Co)	external	1	-	-	-	-	-
22.04.69	Russia	MSF-99?	R	□-□	external	2	1	-	-	-	-
07.05.69	Russia	Voronezh NPP	R (FR)	□	external	2	2	-	-	-	-
24.09.69	Russia	Tomsk-7 (Seversk)		□-□	external	1	-	-	-	-	-
13.10.69	Russia	Far East	I(IR)	□(^{192}Ir)	external	1	-	-	-	-	-
??.??.69	Russia	Chelyabinsk-40 (Ozersk)		□, □	internal	1	-	-	-	-	-
24.11.69	Russia	Novomoskovsk	I	□(^{137}Cs)	external	3	-	-	-	-	-
??.??.69	Russia	Moscow	I	X	external	1	-	-	-	-	-
13.10.69	Russia	Moscow	I	X	external	1	-	-	-	-	-
20.12.69	Russia	Moscow	I	X	external	1	-	-	-	-	-
04.02.70	Ukraine	Kiev	crit?	□-n	external	1	1	1	1	-	-
13.02.70	Russia	?	I	□(^{60}Co)	external	1	1	-	-	-	-
15.04.70	Russia	Moscow	accelerator	e	beam	1	-	-	-	-	-
??.09.70	Russia	Chelyabinsk	source	□(^{137}Cs)	external	1	-	-	-	-	-

18.01.70	Russia	Sormovo, Gorky region	R	-□	external	5	5	5	3	3	3
15.02.71	Russia	Moscow	crit	-n	external	3	3	3	-	-	-
??.03.71	Russia	Tula	source	□(^{137}Cs)	external	1	-	-	-	-	-
26.05.71	Russia	Moscow	crit	-n	external	4	4	4	4	2	2
05.12.71	Russia	Arkhangelsk region	source	□(^{137}Cs)	external	3	-	-	-	-	-
??. ??.71	Russia	Ufa	source	□(^{137}Cs)	external	1	-	-	-	-	-
??.09.71	Russia	Voronezh NPP		-□	external	1	-	-	-	-	-
31.03.72	Russia	Moscow	I	X	external	1	-	-	-	-	-
??.06.72	Russia	Moscow	I	X	external	1	-	-	-	-	-
09.10.72	Russia	Primorsky Region	crime	□(^{192}Ir)	external	1	-	-	-	-	-
04.10.72	Russia	Moscow	I	X	external	1	-	-	-	-	-
22.12.72	Russia	Irkutsk	I	X	external	1	-	-	-	-	-
11.01.73	Russia	Moscow	source	□(^{60}Co)	external	1	-	-	-	-	-
17.03.73	Ukraine	Odessa	crime	□(^{60}Co)	external	1	1	-	-	-	-
??.03.73	Russia	Kaliningrad, Moscow reg.	I	X	external	1	-	-	-	-	-
??.04.73	Russia	Moscow	I	X	external	1	-	-	-	-	-
26.07.73	Russia	Elektrogorsk, Moscow reg.	I	□(^{60}Co)	external	1	1	1	-	-	-
05.09.73	Russia	Khokhol, Vladimir region	source	□(^{137}Cs)	ext/int	4	-	-	-	-	-
??.12.73	Ukraine	Donetsk	source	□(^{137}Cs)	external	1	-	-	-	-	-
09.01.74	Russia	Novosibirsk	I	X	beam	1	-	-	-	-	-
24.05.74	Russia	Tomsk-7 (Seversk)	source	□(^{106}Rh)	external	1	-	-	-	-	-
24.10.74	Russia	Perm’	source	□(^{60}Co)	external	1	-	-	-	-	-
15.12.74	Russia	Lipetsk	crime	□(^{137}Cs)	external	2	2	1	-	-	-
??. ??.74	Russia	Sverdlovsk (Ekaterinburg)	source	X	external	1	-	-	-	-	-
20.06.75	Russia	Kazan’	I	□(^{60}Co)	external	2	2	1	1	-	-
11.07.75	Russia	Sverdlovsk (Ekaterinburg)	source	□(^{60}Co)	external	3	3	3	2	1	1
??.03.76	Russia	Moscow	I	X	external	1	-	-	-	-	-
12.07.76	Russia	Moscow	I	□(^{60}Co)	external	1	1	-	-	-	-
22.07.76	Russia	Melekes	I	-□	external	1	-	-	-	-	-
01.03.77	Russia	Obninsk	crit?	-n	external	1	1	1	-	-	-
05.03.77	Ukraine	Kiev	accelerator	p+	beam	1	-	-	-	-	-
07.03.78	Russia	Primorsky Region	I(IR)	□(^{192}Ir)	external	1	-	-	-	-	-
04.04.78	Russia	Primorsky Region	I(IR)	□(^{192}Ir)	external	1	-	-	-	-	-
03.06.78	Russia	Protvino, Kaluga region	accelerator	p+	beam	1	-	-	-	-	-
21.09.78	Russia	Moscow	accelerator	e	beam	1	-	-	-	-	-
17.10.78	Russia	Moscow	R	□	external	1	-	-	-	-	-
25.11.78	Russia	Udmurtia	I(IR)	□(^{192}Ir)	external	1	-	-	-	-	-
13.12.78	Russia	Tomsk-7 (Seversk)	crit	-n	external	3	3	1	-	-	-
??.??.79	Russia	Nuclear submarine		-□	external	4	4	2	-	-	-

08.05.79	Russia	Sverdlovsk (Ekaterinburg)	R (FR)	□+□	external	1	-	-	-	-	-
20.07.79	Russia	Leningrad (S.-Peterburg)	accelerator	e	beam	2	-	-	-	-	-
20.09.79	Kirgizia	Frunze	I(IR)	□(^{192}Ir)	external	1	-	-	-	-	-
01.12.79	Kazakhstan	Semipalatinsk	I	□(^{60}Co)	external	1	1	-	-	-	-
23.05.80	Russia	Chelyabinsk-40 (Ozersk)	I	X	beam	1	-	-	-	-	-
01.09.80	Russia	Leningrad (S.-Peterburg)	I(SI)	□(^{60}Co)	external	1	1	1	1	1	1
19.09.80	Russia	Yuzhno-Sakhalinsk	source	□(^{192}Ir)	external	1	1	1	-	-	1
03.12.80	Russia	Vladivostok	I(IR)	□(^{192}Ir)	external	1	-	-	-	-	-
09.01.82	Ukraine	Kramatorsk	source	□(^{137}Cs)	external	2	0 [f]	0 [f]	-	-	2
15.03.82	Russia	Krasnodar	source	□(^{192}Ir)	external	1	-	-	-	-	-
19.05.82	Russia	Smolensk NPP	I(IR)	□(^{192}Ir)	external	1	-	-	-	-	-
14.06.82	Turkmenia	Ashkhabad	crime	□(^{60}Co)	external	7	3	1	1	-	-
05.10.82	Azerbaidjan	Baku	source	□(^{137}Cs)	external	18	5	5	1	-	5
18.12.82	Russia	Urengoy	I(IR)	□(^{192}Ir)	external	2	-	-	-	-	-
27.01.83	Russia	Moscow	I	X	beam	1	-	-	-	-	-
28.04.83	Ukraine	Kharkov	I(IR)	□(^{137}Cs)	external	2	1	-	-	-	-
17.05.83	Russia	Volgograd	I(IR)	□(^{192}Ir)	external	1	-	-	-	-	-
11.06.83	Russia	Ufa	I(IR)	□(^{137}Cs)	external	1	-	-	-	-	-
07.12.83	Russia	Ufa	I(IR)	□(^{192}Ir)	external	1	-	-	-	-	-
07.02.84	Russia	Perm’	I(IR)	□(^{192}Ir)	external	5	-	-	-	-	-
21.04.84	Russia	Chelyabinsk-40 (Ozersk)	I	X	external	1	-	-	-	-	-
12.06.84	Russia	Ufa	I(IR)	□(^{192}Ir)	external	1	-	-	-	-	-
15.06.84	Russia	Gorky (Nijny Novgorod)	source	□(^{192}Ir)	external	8	4	-	-	-	-
24.10.84	Russia	MSF-13?	I(IR)	□(^{124}Sb)	external	1	-	-	-	-	-
03.03.85	Russia	Norilsk	source	□(^{137}Cs)	external	3	-	-	-	-	-
26.09.85	Lithuania	Ignalinskaya NPP	I(IR)	□(^{192}Ir)	external	1	-	-	-	-	-
16.10.85	Russia	Podolsk, Moscow region		□	external	1	-	-	-	-	-
??.??.85	Russia	Nuclear submarine		□+□		7	7	1	-	-	-
26.04.86	Ukraine	Chernobyl NPP	R	□+□	external	134	134	93	43	21	28
11.06.86	Russia	Obninsk	I	□(^{60}Co)	external	1	-	-	-	-	-
05.08.86	Russia	Kalinin NPP	I(IR)	□(^{192}Ir)	external	1	-	-	-	-	-
19.02.87	Russia	Moscow	I	X	beam	1	-	-	-	-	-
22.03.88	Russia	Sverdlovsk (Ekaterinburg)	source	□(^{90}Sr+^{90}Y)	external	3	-	-	-	-	-
05.04.88	Uzbekistan	Tashkent	I(IR)	□(^{192}Ir)	external	2	-	-	-	-	-
18.08.88	Latvia	Riga	crime	n-□(^{252}Cf)	external	1	-	-	-	-	-
20.03.89	Russia	Moscow	I	X	beam	1	-	-	-	-	-
04.08.89	Russia	???	I(IR)	□(^{192}Ir)	external	1	-	-	-	-	-
14.08.89	Russia	Zagorsk (Sergiev Posad)	accelerator	e	beam	1	-	-	-	-	-

30.10.89	Russia	Moscow	I	X	beam	1	-	-	-	-	-
27.02.90	Russia	Kalinin NPP	source	[(^{192}Ir)	external	**1**	**-**	**-**	**-**	**-**	-
13.03.90	Russia	Moscow	accelerator	e	beam	1	-	-	-	-	-
13.09.90	Ukraine	Kharkov	source	[(^{192}Ir)	external	1	1	-	-	-	-
01.11.90	Russia	Komsomolsk-on-Amur	I(IR)	[(^{192}Ir)	external	**1**	**-**	**-**	**-**	**-**	-
24.08.91	Russia	Bratsk	crime	[(^{137}Cs)	external	**1**	**1**	**-**	**-**	**-**	-
26.10.91	Belarus	Nesvij	I(SI)	[(^{60}Co)	external	1	1	1	1	1	1
09.01.92	Russia	Riazan'	I(IR)	[(^{192}Ir)	external	2	**1**	-	-	-	-
25.05.92	Kazakhstan	Axay	I(IR)	[(^{192}Ir)	external	1	-	-	-	-	-
14.04.93	Russia	Moscow	crime	[(^{137}Cs)	external	1	0 [f]	-	-	-	1
07.08.93	Russia	Dimitrovograd	R	[+n	external	1	-	-	-	-	-
11.07.93	Estonia	Tallinn	source	[(^{137}Cs)	external	4	4	1	-	-	1
12.07.93	Russia	Vologda	source	[(^{192}Ir)	external	1	-	-	-	-	-
09.11.93	Russia	Tula region	source	[(^{192}Ir)	external	1	-	-	-	-	-
28.11.94	Russia	Voronezh	I(IR)	[(^{192}Ir)	external	1	-	-	-	-	-
18.03.95	Russia	Pervouralsk	I(IR)	[(^{192}Ir)	external	1	-	-	-	-	-
23.05.95	Russia	Smolensk	source	[(^{192}Ir)	external	1	-	-	-	-	-
07.07.95	Russia	Moscow	crime	[(^{137}Cs)	external	1	0 [f]	-	-	-	-
11.09.95	Russia	Moscow	source	[(^{137}Cs)	internal	1	-	-	-	-	-
03.10.95	Russia	Nijny Novgorod /Gorky/	I(IR)	[(^{192}Ir)	external	1	-	-	-	-	-
23.02.96	Russia	Moscow	accelerator	e	beam	1	-	-	-	-	-
08.06.96	Russia	Nijny Novgorod /Gorky/	I(IR)	[(^{192}Ir)	external	1	-	-	-	-	-
04.09.97	Georgia	Tbilisi	source	[(^{137}Cs)	external	9	0 [f]	-	-	-	-
17.06.97	Russia	Sarov /Arzamas-16/	crit	[+n	external	1	1	1	1	1	1
02.12.97	Russia	Volgograd	source	[(^{192}Ir)	external	1	-	-	-	-	-
29.11.97	Russia	Grozny	source	[(^{60}Co)	external	3	-	-	-	-	-
18.03.98	Russia	Moscow	source	[(^{60}Co)	external	1	-	-	-	-	-
16.08.00	Russia	Samara	I(IR)	[(^{192}Ir)	external	3	3	2	-	-	-
13.10.00	Russia	Dubna	accelerator	p+	external	1	-	-	-	-	-
06.02.01	Russia	Nijny Novgorod /Gorky/		X	external	4	-	-	-	-	-
24.06.01	Russia	Stavropolskij Kraj	I(IR)	[(^{192}Ir)	external	1	-	-	-	-	-
02.12.01	Georgia	Liya	I(IR)	[(^{90}Sr)	external	3	2	1	-	-	-
01.08.01	Russia	Salavat	I(IR)	[(^{192}Ir)	external	2	-	-	-	-	-
01.09.02	Russia	Nijny Novgorod /Gorky/	I(IR)	[(^{192}Ir)	external	1	-	-	-	-	-

[a] excluding Mayak PA cases in 1949-1956

[b] "?" Date or another information is unknown correctly

[c] Following abbreviations are applicable: atomic reactor, *R;* atomic reactor incidents with fuel rod manipulations, *R(FR);* lost control of criticality of fissile materials, *crit;* X-ray or radioisotope installation, *I;* radiation sterilization unit, *I(SI);* industrial radiography unit *I(IR);* incidents with radioisotope sources, *source;* criminal cases, *crime*
[d] excluding Mayak PA cases in 1949-1956
[e] ARS severity: I – mild, II – moderate, III – severe, IV – very severe ("II-IV" means "moderate and above")
[f] Chronical radiation sickness only

Table 2. Summarized SRC-IBP registry data on radiation accidents and incidents at the former USSR territory for 50 years period (as it is in 30.06.03) and the number of victims with ARS and LRI [a] [1-6]

Incidents class	Number of incidents	Number of victims with clinically significant effects (ARS+LRI)					
		Subtotal	ARS severity**				Including fatalities
			I-IV	II-IV	III-IV	IV	
1. Incidents with radioisotope devices and radiation (total)	92	170	49	27	11	6	16
including: ^{60}Co	17	28	15	9	6	3	3
^{137}Cs	19	59	13	7	1	-	9
^{192}Ir	37	54	10	3	-	-	1
other -emitters	8	10	2	1	-	-	-
( ) emitters	2	2	-	-	-	-	-
-emitters	9	17	9	7	4	3	3
2. Xray devices and accelerators (total)	39	43	-	-	-	-	-
Including: X ray devices	27	30	-	-	-	-	-
electron accelerators	9	10	-	-	-	-	-
proton accelerators	3	3	-	-	-	-	-
3. Reactor incidents and criticality accidents of fissile materials (total; excluding 1986 Chernobyl accident)	33	82	73	39	25	13	13
including criticality accidents	16	42	42	30	20	10	10
reactor incidents (other causes)	17	40	31	9	5	3	3
4. LRI cases at "Mayak" PA in 1949-1956	168 [b]	168 [b]	-	-	-	-	-
5. Nuclear submarine accidents	4	133	85	29	19	12	12
6. Other incidents (total)	12	17	7	3	2	2	2
SUBTOTAL (excluding 1986 Chernobyl accident)	*348* [b]	*613* [b]	*214*	*98*	*57*	*33*	*43*
7. 1986 Chernobyl accident	1	134	134	93	43	21	28
TOTAL	349 [b]	747 [b]	348	191	100	54	71

[a] ARS severity – see notice to table 1
[b] every case at Mayak PA in 1949-1956 is considered as an accident

The Figure provides the accumulation structure of the victim number for clinically significant effects of radiation incidents in the former USSR. The Figure clearly demonstrates that recent 15 years are dominated by mild grade of the radiation damage and the severe effect incidence is significantly decreased.

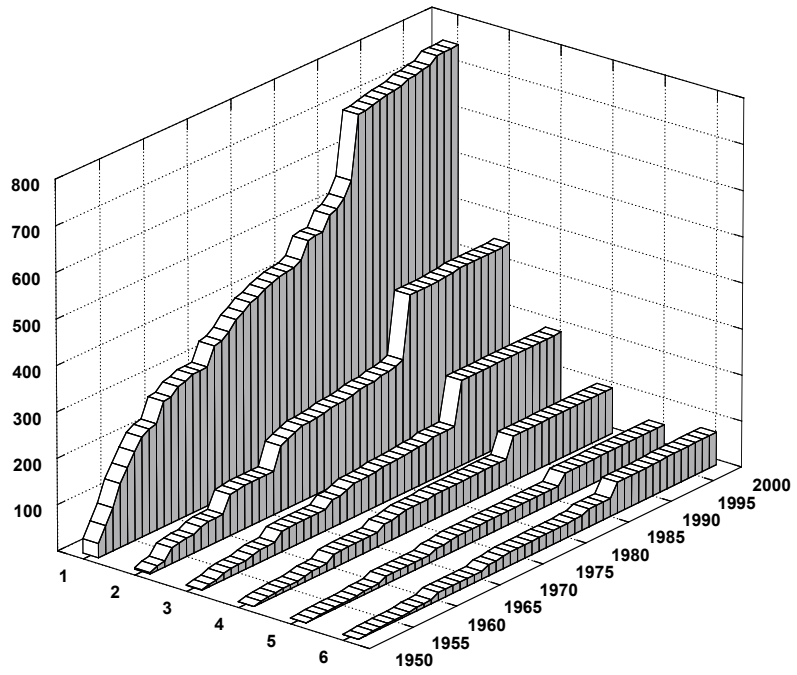

Figure. Early medical effects of radiation incidents in the former USSR (annual accumulation dynamics). Legend: 1 – total number of victims; 2 – number of ARS patients (including 3 – grade II-IV ARS, 4 – grade III-IV ARS, 5 – grade IV ARS); 6 – number of radiation induced fatalities.

Similarly, Table 3 provides information on other technological emergencies (fragment of the official statistics of the Emergency Situation Ministry of Russia in only one year (2000)) [7].

The provided materials state that direct human health danger of nuclear industry and technologies applied in industry, medicine and research is significantly lower than health hazards of other non-nuclear industries.

However, this statement does not decrease the potential danger of radiation incidents which was evidenced by 1986 Chernobyl disaster. It should be noted that the radiation incidents can not be completely excluded in future. The probability of such events is increased on the background of out-of-date equipment and increase of terrorist activity. The radiological terrorism (so-called “dirty bombs”) as well as the sabotage at nuclear facilities are not excluded. Ignoring the terrorist radiation usage can result to the unpredicted destabilization of megalopolis and whole country life even in case of limited usage of “radiological weapons”.

SRC - IBP seriously deals with this issue. Accidental Medical Radiation Dosimetric Center (AMRDC) of SCR-IBP provides the medical reacting to radiation incident situations. Particularly, AMRDC analyzes possible scenarios of terrorist applications of the ionizing radiation and protection against such situations.

Table 3. Technological emergencies in Russian Federation: year of 2000 [7]

Technological emergency		number	fatalities	victims
Railroad and aviation accidents		42	86	316
Traffic accidents		157596	29594	179401
Pipeline and chemical plant accidents		76	32	12
	At industrial enterprises	54	67	234
Fires	At living premises (urban environment)	167633	9366	9968
	At living premises (rural environment)в	78203	6898	4015
Ammunitions and explosives		15	3	3
Toxic releases		38	10	117
Radiation facilities (personnel safety malpractice)		19	-	-
Destruction of industrial and living buildings		20	20	93
Accidents at energy transferring systems, communal systems and heat networks		100	8	523
Hydro constructions		2	2	7
Total:		**403798**	**46086**	**194689**

The adequate assessment of the potential danger of hidden terrorist application of the radiation is very important for the separate facility, settlement, and megalopolis taking into account the infrastructure specificity of the affected facility in Russia and in other countries in case of the international cooperation.
At the same time, the category of danger began to be identified in consciousness of many people with any radiation sources. It is necessary also to mark the largely distorted performance of this category in mass media, when contingencies bound even with a minor overexposure of the separate workers bound with ionizing radiation sources of the above established standards are represented as fatal for their life. Therefore, one of actual problems is the formation of adequate perception of actual and potential dangers accompanying life of the modern person and, first of all, significance of the radiation factor. Unfortunately, it was much overlooked in the past, and it is still necessary to catch up developed countries, many of which have already passed a route of fluidized information performance about actual events bound with ionizing radiation sources.

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