Beisen	grass	3-12	2.2-2.3	15	62	14-22	ND	ND
Chinji	grass	3-17	3-12	308	15-99	23	128	ND
Belokamenka	grass	1.5-6.85	ND	23.8	ND	ND	ND	ND
Vladimirovka	grass	1-14	3-14	31-55	5-42	15-18	ND	19-36
Kanonerka	grass	1-21	ND	20-28	8-23	9-33	ND	35
Dolon	grass	2.6-10.4	4.63-5.4	ND	4.44	ND	ND	ND
Mostik	grass	2-16	7.4-12	3.1	6-10	ND	ND	75
Cheremushki	grass	1.5-2.2	ND	90	6-24	13-24	ND	82.5
Grachi	grass	2-18	3-7.4	33.8	3.7-23	9.55	ND	ND
Semiyarka	grass	2-14	5-12.6	16-88	7.8-16	13-25	127	37.6

Notes: x - below detection; ND - no data

In the period from 1981 to 1990, the maximal meaningful gamma-ray doses were detected in 1987. These data were confirmed by the more severe pollution of vegetation. In a majority of the populated areas, the exposure dose of gamma-rays was 0.43 roentgen. This dose corresponds to absorbed dose in air of 0.43 0.864=0.3456 cGy. Because of shielding by tissues, the absorbed dose in the human body is 70% of the absorbed dose in air, or 0.3456 0.7=0.242 cGy. The RBE coefficient for gamma-rays is 1.0, so the dose equivalent of the whole body (for a person who is in the open) was 0.242 cSv. The coefficient of decrease of dose is 2.5 in a city, and 1.5 in the rural area. So, in 1987 the dose equivalent in 1987 from external sources of gamma-ray exposure of an urban population was 0.242/2.5=0.968 cSv, and that of a rural population was 0.242/1.5=0.161 cSv.

How much was it? According to the generally accepted opinion, the level of exposure to ionizing radiation from natural sources is approximately 0.1 cSv (Gofman J.W.,1981; Hoshi M.,1993) . So, the population living in Semipalatinsk city received a 97% addition to the background dose from just the external gamma-ray sources. Military experts usually use the coefficient 1.8 for calculation of the dose of internal radiation exposure (Gusev B.I.,1993). In this case, the internal radiation dose would be 97%·1.8=174.6% from background level, and the total additional to the background level dose would be 97% + 174.6%=271.6% for the Semipalatinsk-city-residents.

For the rural population, the same calculation gives 161% as additional exposure from external sources, 290% as exposure from the internal sources, for a total - addition of 451% to the background exposure.

The dose to bone tissues derived mainly from external radiation exposure and also from internal irradiation by nuclides (mainly Sr-90) taken in with the diet. The critical group for bone tissue (namely, bone marrow) exposure was the population of children under 7 years of age. The total dose equivalent of the bone marrow of children in the period of underground nuclear explosions was approximately 453 millirem per year.

The dose to the bare skin surfaces derived from contact with beta-emitters from the air sedimented to the skin when radioactive air streams came. The dose equivalent of the skin of Semipalatinsk city residents in the study period (from 1981 to 1990) was 413 millirem per year.

Most of the exposure dose to the thyroid gland derived from consumption of milk contaminated by I-131. The "critical" group for such exposure were children younger than 5 years. The dose equivalent of the thyroid glands was estimated after the accident occurred in May 28,1973. The dose equivalent of the children population from this accident alone was 970 millirem.

Therefore the main sources of exposure to ionizing radiation during the period of underground nuclear tests were:

1. Sr-90 intake with the diet
2. radioactive gases leaking into the atmosphere due to accidents
3. so-called "old radioactive tracks".