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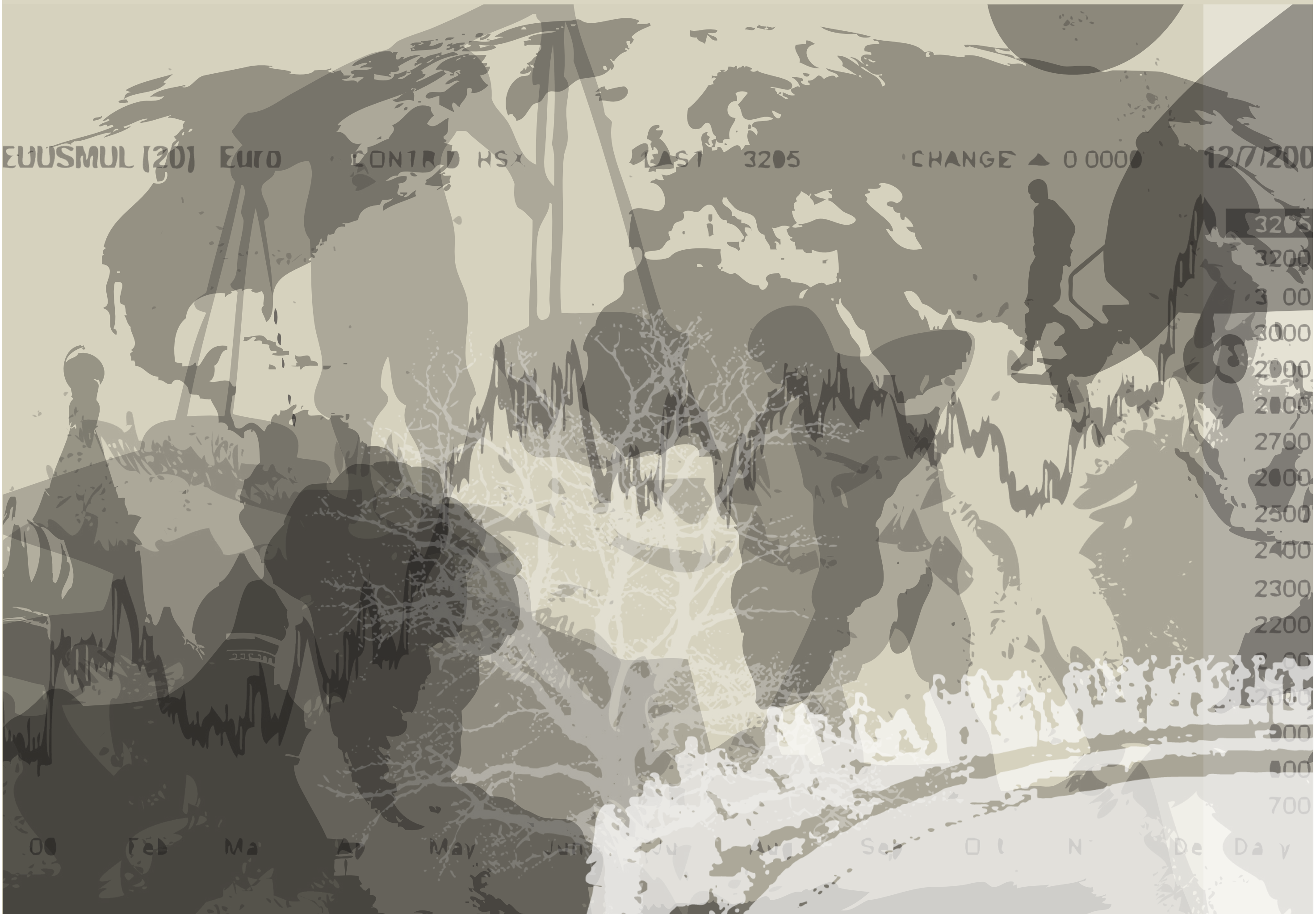

NUPI Report

[Report no. 1, 2014]

Publisher: Norwegian Institute of International Affairs

ISBN: 978-82-7002-339-4

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Semipalatinsk nuclear testing: the humanitarian consequences

Roman Vakulchuk and Kristian Gjerde with Tatiana Belikhina and Kazbek Apsalikov

Report prepared for the Second Conference on Humanitarian Impact of Nuclear Weapons in Nayarit, Mexico, 13–14 February 2014.

Published by Norwegian Institute of International Affairs

Foreword

Its dark legacy endures: poisoned rivers and lakes,
children suffering from cancer and birth defects...
Today, Semipalatinsk has become a powerful symbol of hope.
– Ban Ki-moon (*International Herald Tribune* 28 April 2010)

During the Cold War, there were widespread and well-founded worries about the humanitarian consequences of nuclear weapons, and considerable public information about the subject. The world's nuclear arsenals are still massive – yet many people today seem to have forgotten about the potential impact of these weapons. In some places, however, the legacy of nuclear detonations is a real part of everyday life. One such place is the area around the former Semipalatinsk Nuclear Test Site (SNTS) in Kazakhstan, where the Soviet Union conducted more than 450 nuclear tests until the test site was closed in 1991. This report shows some of the ways in which the nuclear activity has affected people living in the region – and the measures undertaken to improve the situation.

The report is intended to help fill the gap between scientific studies (in physics, medicine, etc.) that may be difficult for non-specialists to comprehend, and more journalistic accounts that do not aim to present systematized information about the situation. The language is kept as accessible as possible, and the most salient issues regarding the humanitarian consequences of the activity at the SNTS are covered. This report is thus meant as a broad and systematic introduction to a complex issue, but not an in-depth scholarly treatise. Those interested in a deeper study should consult the list of recommended literature at the end of this report.

We would like to thank our partners in Kazakhstan. At the Institute of Radiation Medicine and Ecology (IRME) in Semey Tatiana Belikhina, Kazbek Apsalikov and Boris Gusev played an essential role by providing the data about the health impacts of the nuclear testing. At the Institute of Radiation Safety and Ecology (IRSE) in Kurchatov city, Sergey Lukashenko and Aleksandr Moshkov shared their expert knowledge of the environmental situation at and around the test site. Further, the advice provided by Professor Susanne Bauer has been of great help. We gratefully acknowledge the support from the Norwegian Ministry of Foreign Affairs, and express our gratitude to Victor Jensen and Indra Øverland for invaluable support.

Contents

Executive summary

- From 1949 until the site was closed in 1991, the Soviet Union carried out more than 450 nuclear detonations at the Semipalatinsk nuclear test site (SNTS) in Kazakhstan. More than 110 of the tests were conducted in the air and on the surface of the earth. Over one million people have been recognized by the government of Kazakhstan as having suffered (in a broad sense) from the SNTS.

- This report seeks to offer a humanitarian perspective on the legacy of the nuclear testing at the SNTS. By presenting research-based findings in an accessible language, we hope to help fill the gap between scientific (medicine, physics, etc.) studies that are difficult for non-specialists to comprehend, and more journalistic accounts that do not aim to present systematized information about the situation.

- The humanitarian approach: We show some of the ways in which the nuclear testing has impacted and still affects people living in the region, by investigating health consequences, the environmental situation around the test site, people's experiences, and the state support system.

- The nuclear tests have had serious negative consequences for the health of the local population. For many diseases, further studies are needed to pinpoint the associations between radiation and health problems.

- The situation regarding radioactive contamination at and around the former test site remains non-uniform, with varying risks of radiation exposure. Much of the site presents no danger, but some parts need to be safeguarded indefinitely.

- People living close to the test site experience psychological stress.

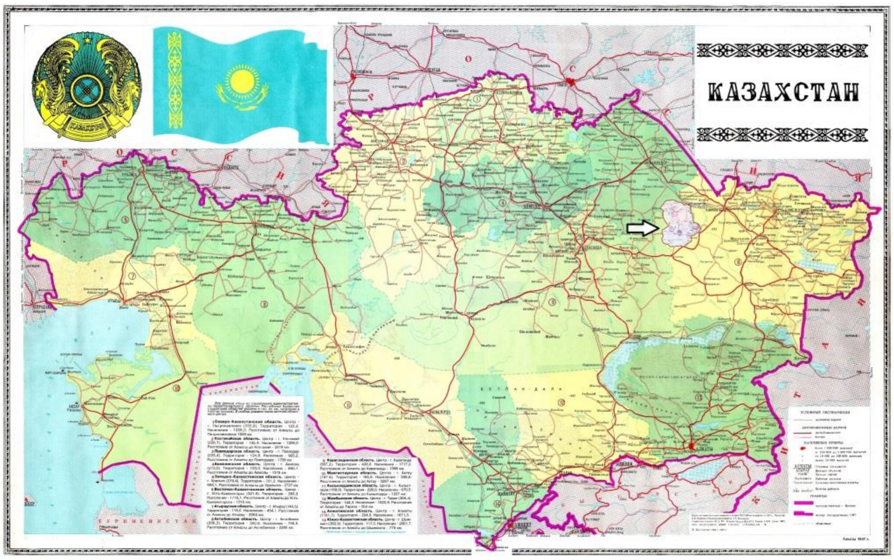
- The legacy of nuclear tests is evident even after more than 20 years after the closure of the test site and more than 50 years after the last surface detonation. The SNTS stands as a testimony to the horrifying impact of nuclear weapons.

The Semipalatinsk story

The world learned about the horrifying power of nuclear weapons when the USA dropped a uranium bomb over the Japanese city of Hiroshima on 6 August 1945 and a plutonium bomb over Nagasaki three days later. For Stalin, the conclusion was clear: the new weapon had completely changed the balance of power in the world, and the Soviet Union had no choice but to develop its own nuclear weapons. Stalin appointed Lavrentiy Beria, the ruthless former chief of NKVD, predecessor to the KGB, to supervise the Soviet nuclear bomb project. The physicist Igor Kurchatov was chosen to head the programme and lead the work of the USSR's finest scientists, including the later dissident and Nobel Peace Prize laureate Andrey Sakharov. Huge resources were put into the nuclear programme. By 1950, about 700,000 people were involved, more than half of them prisoners (Medvedev 1999, p. 61).

In order to test the planned atomic weapons, a designated test site was necessary. On 21 August 1947, the Soviet government decided to establish a test site in the north-eastern part of the Kazakh Soviet Socialist Republic (KSSR). The Semipalatinsk Nuclear Test Site (SNTS) occupied a territory of 18,300 km^2, to the west of Semipalatinsk city (the city was renamed Semey in 2007).

Map 1. Kazakhstan with the Semipalatinsk Nuclear Test Site. Map reproduced with permission of the Institute of Radiation Safety and Ecology (IRSE)



It was in Semipalatinsk that Soviet efforts to create a bomb were crowned with success on 29 August 1949, with the detonation of a plutonium bomb that was almost an exact copy of the US bomb dropped on Nagasaki four years earlier. It was at the SNTS that the USSR first dropped an atomic bomb from a plane, on 18 October 1951. And it was here the USSR's first thermonuclear detonation was made in 1953. Out of a total 715 Soviet nuclear tests, 456 were carried out in Semipalatinsk.[1] An estimated 111 of these were carried out on the surface of the earth (25) or in the air (86) between 1949 and 1962, until the Partial Test Ban Treaty of 1963 banned such tests.[2] It was these atmospheric tests that caused most contamination of the environment and radiation exposure to the public (estimated at as much as 95% of the total dose) (ibid.). After 1962 all tests at the SNTS were conducted underground in tunnels and shafts, and the contamination was generally limited to the test site itself, with some exceptions (ibid). The last test was conducted on 19 October 1989. The total yield[3] of the atmospheric tests at the SNTS is estimated at approximately 6.4 Mt – the equivalent of more than 400 Hiroshima bombs.[4]

When Mikhail Gorbachev’s perestroika opened up for protest movements of various kinds in the Soviet Union, the ‘Semipalatinsk–Nevada’ movement in Kazakhstan advocated closure of the SNTS. Then first secretary of the Kazakh Communist Party and, after independence, president of Kazakhstan, Nursultan Nazarbayev, made the decision to close the site in 1991. But while the test site has been closed, its legacy remains.

One reason – not at least for secrecy purposes – for the initial choice of Semipalatinsk as nuclear test site was the vastness and relative remoteness of the Kazakh steppes. But atomic bombs do not restrict their impact to the location of their detonation, and a large population could potentially be affected. While people were not allowed to live on

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1 130 tests were carried out at the Novaya Zemlya test site, and 129 tests outside these two test sites. See Bauer et al. 2013, p. 244.

2 Published figures of nuclear tests in the Soviet Union slightly vary. These figures are from Grosche 2002, p. 53.

3 ‘The ‘yield’ of a nuclear weapon is the amount of explosive energy the weapon can produce. The usual practice is to state the yield in terms of the quantity of TNT that generates the same amount of energy when it explodes…The Hiroshima atomic bomb which the U.S. used in 1945 was the equivalent of 15 kt of TNT. The quantity of U-235 that completed fission was only about 800 grams.’ (Takada 2005, pp. 6–7).

4 This is just a fraction of the estimated yield of the atmospheric tests at the remote Novaya Zemlya test site in Northern Russia, at 239.6 Mt (Bauer 2006, p. 61). The most powerful nuclear detonation to date was conducted at Novaya Zemlya: the ‘Tsar Bomba’ with a yield of approx. 50 Mt – an explosive power of more than 3,000 times the Hiroshima bomb.

the territory of the SNTS itself, there were one million people residing within 160 km of the nuclear test site, and there were several villages close to the test site borders (Carlsen et al. 2001; Werner and Purvis-Roberts 2005, pp. 5–6). Nuclear fallout from the testing spread even further, also to the neighbouring Altai region in today's Russian Federation.[5]

That the world has avoided use of nuclear weapons in actual warfare since 1945 does not mean that the weapons have not had victims. During the Cold War 'hundreds of thousands of American and Soviet citizens suffered exposure to dangerous levels of radiation as their governments produced and tested nuclear weapons that could be used if international tensions escalated into a "hot" war' (Werner and Purvis-Roberts 2005, pp. 5–6). The Institute of Radiation Medicine and Ecology in Semey estimates that in the vicinity of the Semipalatinsk nuclear test site, between 500,000 and one million people were exposed to substantial radiation doses in the years 1949–1962, when the last detonation above ground took place.[6]

There are no simple answers as to the degree of the impact of the nuclear tests on humans. Both the numbers of victims and the ways in which people are affected are disputed. But that the testing of nuclear weapons at the SNTS has affected the health of a great many people as well as their children is beyond doubt. Moreover, radioactive contamination of the test site itself and some adjacent areas continue to present potential risks for the population – although experts assert that these risks are often exaggerated. In addition to the actual impact on health and observable dangers in the environment, the local population continues to live in uncertainty – radioactivity is invisible and difficult for lay people to comprehend.

On the following pages, various aspects of the humanitarian impact of the nuclear testing in Semipalatinsk will be presented and discussed.

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5 This report focuses on the situation in present-day Kazakhstan, however.

6 IRME 2013. Both lower and higher estimates exist; see also Brunn 2011.

Health impact

While the blast and heat of a nuclear explosion can destroy large cities, it was exposure to radiation from nuclear fallout that was the most potent threat to human health from nuclear testing at Semipalatinsk.[7] One estimate is that four tests alone (the first test on 29 August 1949, one on 24 September 1951, the first thermonuclear test on 12 August 1953 and one on 24 August 1956) in Semipalatinsk contributed more than 95% of the collective dose to the population living close to the test site (Grosche 2002, p. 53). There seems to be consensus among scientists that, to a large extent, 'the currently observed health effects are a result of exposure during the period of testing, not a consequence of exposure to residual radioactivity'.[8]

Map 2. Fallout trajectories of major atmospheric detonations at the SNTS

7 It is usually considered that 50% of the energy in a nuclear detonation is released as an explosive blast, and 35% as heat. 15% of the energy is released as nuclear radiation, approximately 5% of which is initial radiation, produced within one minute of the explosion. Approximately 10% of the energy is emitted over time as residual radiation in fallout, potentially carried over large distances as a radioactive cloud drifts away from the epicentre in a trajectory that depends on the wind and meteorological conditions and therefore is difficult to predict (Takada 2005, p.6; Borrie and Caughley (eds.) 2013, p. 6.)

8 Studies show that 'about 64% of the dose received by the nearby populace from fallout occurred during the first week, and about 85% during the first 3 months after the explosion' (Carlsen et al. 2001, p. 5, referring to Gusev et al. 1997).

During Soviet times, nuclear tests and their consequences for human health were surrounded by total secrecy. In fact, until 1956 the government did not even conduct studies about the nuclear testing's effect on the population living close to the test site.[9] There are no clear statistics available about the acute effects of the testing.

At first, the Soviet state paid little attention to the impacts of nuclear tests on the local population. Only once, prior to the most powerful thermonuclear detonation in August 1953 (480 kT – some 30 times more explosive power than the Hiroshima bomb), were the residents of certain nearby settlements evacuated from their home villages, for a period of almost two weeks. Even so, during the entire period the evacuees remained in areas with nuclear fallout from the test (IRME 2013). The immediate impetus for health studies came later, in connection with an emergency situation caused by a surface nuclear detonation on 16 March 1956, the radioactive cloud of which reached the city of Ust-Kamenogorsk, 400 km from the explosion epicentre. The city's population was exposed to nuclear fallout with radiation doses so high as to cause acute radiation poisoning. In response, the Soviet leadership established a special medical institution and hospitalized 638 persons suffering from radiation poisoning. No information about the fate of these people is available, however (ibid.).

In 1957, a permanent research institute was established in Semipalatinsk to carry out research on the impact of the activity at the SNTS on the population's health. It was given the neutral designation 'Dispensary No. 4' in order not to draw attention to its real activity. With the break-up of the Soviet Union, this 'dispensary' was succeeded by the Institute of Radiation Medicine and Ecology (IRME). IRME is a part of Kazakhstan's Ministry of Health and is responsible for studying the health consequences of nuclear testing.[10]

It is difficult to establish the size of the population affected by the nuclear testing at SNTS. In 1949 the total population of the Semipalatinsk, Pavlodar, Karaganda and East Kazakhstan regions was 1.2 million. By 1962, this figure had increased to 1.7 million, due to migration caused by Soviet agricultural reforms in Kazakhstan. (IRME 2013) On the basis of residency in areas close to the SNTS, Kazakhstani authorities have recognized 1.2 million as victims of the SNTS (see section on the state compensation system). A frequently-cited estimate puts the number of exposed people at about 500,000, but some Kazakhstani experts consider the total number of people exposed to

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9 For information about the 'Balmukhanov-Atchabarov expeditions' that documented health effects in 1956–1960 and claimed to find many cases of 'chronic radiation disease', see e.g. Bauer et al. 2013, pp. 245–246; IRME 2013.

10 Also for compensation purposes: see the section about state support later in this report.

radiation to be about 1 million.[11] In addition come the people in the Altai region in the Russian Federation who were affected.[12]

In this section, we present data provided by IRME about various health indicators for exposed population groups in Kazakhstan compared to control groups.[13] The data are based on research conducted by IRME, including Soviet-era studies that were strictly secret until the break-up of the USSR.[14] IRME's database and registers are the main source for researchers studying the health impact of the SNTS, and the institute has since the early 1990s had numerous cooperation projects with researchers from Japan, Europe and the USA.[15]

The data from IRME are ordered into three periods: acute and early effects (1–10 years from the start of radiation); early long-term effects

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[11] Katayama et al. 2006; IRME 2013; communication with IRME experts (2013).

[12] The total number of affected people in the Altai region is difficult to estimate, but one assessment is that 140,000 people in rural settlements and the city of Rubtsovsk were exposed to doses of 50 mSv or higher. See Bauer 2006, p. 104.

[13] Based on estimates of the doses of radiation to the population, the territories adjacent to the SNTS have been divided into four categories of radiation risk.

1) Areas of extraordinary risk: eight settlements in three districts in Semipalatinsk oblast', situated at a distance of 50–100 km from the SNTS. Radiation dose higher than 1000 mSv.
2) Areas of maximal risk: settlements in four districts in Semipalatinsk oblast and one district in Pavlodar oblast', situated 150–250 km from the SNTS. Radiation dose 350–1000 mSv.
3) Areas of increased risk: four towns and twelve districts in Semipalatinsk, Pavlodar, Karagandinsk and East-Kazakhstan oblasts,.situated 300–400 km from the SNTS. Radiation dose 70–350 mSv.
4) Areas of minimal risk: twelve districts in Semipalatinsk, Pavlodar, Karagandinsk and East-Kazakhstan oblasts, situated 450–800 km from the SNTS. Radiation dose 10–70 mSv.

For the first period in the following overview, the data are based on studies of the population from the first two groups. For the two later periods, the data are based on studies of the population from the three first groups. The control group is represented by population unexposed to radiation. Usually, the group was formed from the population of Kokpektinsk district of Eastern Kazakhstan region, a territory free of radioactive fallouts. In some cases, the control group consisted of people who came from other places in territories close to the test site which were also free from radioactive fallout. Comparisons between the exposed population and the control groups are based on absolute numbers. For further details about IRME's studies, Tatiana Belikhina, head of IRME's research management department, can be contacted at tatyan-ivanovn@yandex.ru.

[14] Sources for IRME's data are their examinations of the exposed population in Soviet times, official data on birthrates, infant mortality, mortality among adults, certificates of cause of death. See also Katayama et al. 2006.

[15] A selection of research based on such cooperation: Bauer et al. 2005; Grosche et al. 2002; Grosche et al. 2011; Katayama et al. 2006; Kimura et al. 1998.

(10–20 years from the start of radiation); late long-term effects (20 years and more).[16]

While the following pages reveal clear differences between the exposed and non-exposed population, and many of these differences can plausibly be assumed to be caused by the nuclear testing, the reader should keep in mind that there is scientific disagreement about the level of radiation exposure as well as about to what extent radiation has impacted on health (Simon et al. 2003).[17] While researchers seem to have established a significant association between solid cancer and radiation dose (Bauer et al. 2005), there is consensus that further in-depth epidemiological studies are necessary in order to establish the relationship between exposure to radiation and a range of health problems, and medical researchers continue to conduct such studies.[18]

Acute and early effects of irradiation (1950–1960)

- Because health studies around the test site started late, acute effects were not investigated immediately after the first tests started in 1949 (Grosche et al. 2002, p. 54). However, it is possible to trace some indicators of early acute effects, based on descriptive comparisons. One such effect is high **infant mortality**.[19] Figures were 3.4–4 times higher than in the control group and in the Kazakh Soviet Socialist Republic (KSSR) as a whole. The highest rate of infant mortality (100–110 cases per 1000 infants) was reported from the settlements known to have been most exposed.

- **Congenital malformations** among children in the exposed groups were significantly more frequent than in the control group. Prevalent types included congenital malformations of the nervous system and facial malformations.

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[16] Unless otherwise indicated, all data on health impact are based on IRME 2013.

[17] In 1998, Logachev et al. noted: 'There is little doubt that people living in the STS region suffer from a range of adverse health effects...However, the task of definitively relating any of these effects to nuclear weapons testing will be complicated by numerous confounding factors such as inadequate nutrition, poor water quality, and unsanitary living conditions' in Carlsen et al., 2001. Since then, many studies have been conducted, and some answers found.

[18] For example, Shunichi Yamashita (chair of the Atomic Bomb Disease Institute at Nagasaki University Japan, who has been visiting Semipalatinsk for 15 years) has stated, 'we need much more thorough epidemiological studies before we can make conclusions about cause and effect.' Quoted in Parfitt 2010, p. 1289.

[19] According to IRME 2003, the data for infant mortality in the period from 1950–1960 were found in death certificates collected by civilian registrar's/registry office (ZAGS).

- As a major cause of death among children, the frequency of **leukaemia** (cancer of the blood or bone marrow) doubled compared to the years 1945 to 1948.

Early long-term effects (1960–1985)

- During this period, **infant mortality** decreased to the levels found before the nuclear testing started in 1949 – an indication of the relationship between exposure to radiation and the high infant mortality during the period discussed above.

- The early 1970s saw a dramatic increase in **mortality from cancer**. IRME's descriptive comparisons show rates of mortality from cancer in exposed groups as much as 3.5 times higher than in control groups and in the KSSR as a whole. Prevalent types included oesophageal cancer, stomach cancer, and cancer of the small intestine. In the late 1980s, the level of mortality from cancer significantly decreased, but remained higher than in the period prior to the onset of nuclear testing.

- **Cytogenetic studies** carried out between 1962 and 1975 showed that among 420 people examined (ages 10 to 60 years, with doses exceeding 250 mSv), the frequency of chromosome aberrations substantially exceeded rates in the control group.[20]

- **Cardiovascular diseases** were reported more often compared to the control group and KSSR as a whole. The level of cardiovascular disease among 40–49-year-olds in the population exposed to radiation corresponded to the level found among 50–59-year-olds in the control group. Despite these figures from descriptive comparisons, studies using analytical epidemiological techniques indicate that other factors might play a role. 'Rates of mortality from cardiovascular disease in the exposed group substantially exceeded those of the comparison group … [However]… no statistically significant dose–response relationship for all cardiovascular disease, for heart disease, or for stroke was found…' (Grosche et al. 2011, p. 660). The association between exposure to radiation and cardiovascular disease in Semipalatinsk needs further study.

- Among women of reproductive age who were exposed to radiation in their childhood, **malformations** among their

[20] Cytogenetic studies investigate radiation-induced chromosome aberrations: alterations in the cell at the chromosome level in specific phases of the cell cycle.

children were reported more often (10–12 cases per 1000 infants) than in the control groups (3–5 cases per 1000 infants). After 1985, the frequency of malformation among infants has dropped significantly, most probably because the new generation of women giving birth were not exposed to radiation from nuclear testing in their childhood. Since 1985, the exposed population has not differed from the control groups on this indicator.

Late long-term effects (1985–2010)

- IRME's descriptive studies show that in the late 1980s there was a second sharp increase in the **incidence of cancer** among the exposed population, up to three times higher than the level in the control group and in Kazakhstan as a whole (420–430 cases per 100,000 people compared to 140–145 cases in the control group).

- Among the causes of mortality from cancer, oesophageal cancer, stomach cancer and intestinal cancer declined sharply compared to the previous period. Simultaneously, the share of deaths from lung and bronchial cancer and breast cancer increased. This tendency still continues.

- A study of **premature aging** (‘gerontological effects’) was conducted in 2000–2005. According to local researchers, the average age for diagnosis of oesophageal cancer, stomach cancer, breast cancer, and lung and bronchial cancer was between 6 and 9 years lower among people who had been exposed to radiation and residing in areas close to the polygon than among control groups. **Life expectancy** among the exposed group was several years lower than in the control group.[21]

- An important line of research is now to examine the health effects among the large number of descendants of people who were directly exposed to radiation living in the area today.

[21] IRME 2013. IRME considers the results of these gerontological studies to be perhaps the clearest evidence of the consequences of nuclear testing for human health in the exposed population today.

The environmental situation today – impact on people

What risks do the test-site area and radioactive fallout present for people today? How contaminated and dangerous are the adjacent areas? Here it is important to recognize that the radio-ecological situation is not uniform throughout the test site and adjacent areas. Tests of various kinds were conducted in different sections of the vast test site, leaving a complex legacy. See Table 1 in Appendix for an overview of nuclear testing activity, work being done to improve the situation, and the current status of various testing grounds within the SNTS.

The account of the radiation situation presented in this section is based on information provided by the Institute for Radiation Safety and Ecology (IRSE), a part of the National Nuclear Centre (NNC) of the Republic of Kazakhstan. IRSE is the institute responsible for managing, studying and securing the test site. The NNC is the clear authority on the issue and actively cooperates with international expertise in order to get its findings verified by the International Atomic Energy Agency (IAEA). However, there exist other opinions about the dangers presented by the environment, as we will note in this and the next section. (See also Purvis-Roberts et al. 2007; Carlsen et al. 2001; Brunn 2011.)

After SNTS closure: scavenging, and efforts to secure the area

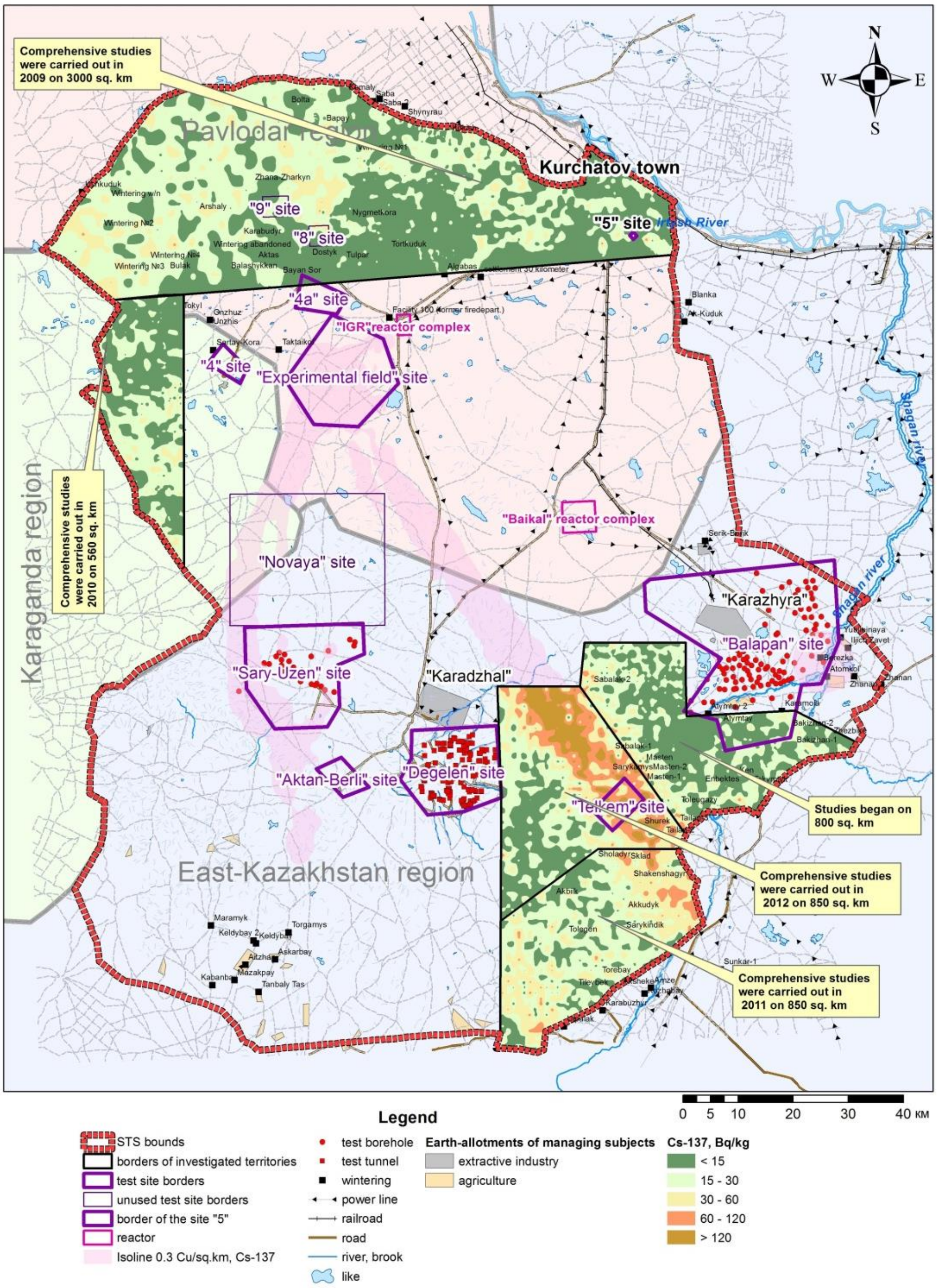
After the closure of the SNTS in 1989 and the subsequent break-up of the Soviet Union, the site was officially disbanded by the Russian Ministry of Defence in December 1993. Kazakhstan was in economic crisis and, according to experts interviewed for this study,[22] it was not yet able to exert control over the vast test site territory to ensure radiation safety and restrict access to dangerous objects.

This represented a serious problem, for two reasons. First, there ensued a high level of illegal economic activity among the local population. Metals looted from the test infrastructure and other materials were sold as scrap metal. Reportedly, many of those involved

[22] Within the scope of this study six semi-structured interviews were conducted with local experts in Kazakhstan in 2013.

in this activity lived at the places where the metals were gathered. They ‘drank the water that came up from the tunnels and presumably received substantial doses of radiation... Registration and health control of these people were, for obvious reasons, not conducted’ (IRSE 2013).

Map 3. Semipalatinsk Nuclear Test Site



Reproduced with permission from IRSE

Second, what was left at the test site was potentially dangerous not only for scavengers (and those who bought the radioactive metals): there were 'tunnels and bore holes filled with plutonium residue – enough plutonium, if fully reclaimed, for terrorists or a state to construct dozens of nuclear bombs' (Harrell and Hoffman 2013, p. 1). Much work has been carried out, in particular in cooperation with the USA and Russia. A riveting account of the massive efforts being made to clean and secure the Degelen mountain massif can be found in the report *Plutonium Mountain* (Harrell and Hoffman 2013), published by the Managing the Atom project at the Belfer Center at Harvard University.

Current situation, future perspectives

Clearly, there is no simple, single answer to the questions we posed at the beginning of this section. We asked IRSE for a summary of the situation, presented in the text box below.

IRSE summary of the situation and perspectives for the future

In the period since the closure of the test site, the Institute for Radiation Safety and Ecology (part of the National Nuclear Centre of the Republic of Kazakhstan) together with the international community has retrieved a large amount of information regarding the radiation situation at the SNTS and adjacent areas.

We have identified all significant areas of radiological contamination, as well as the main pathways and mechanisms for potential spreading of radioactive materials. The findings allow us to conclude that at present the SNTS does not negatively impact the population, with the exception of the zones of influence of the river Shagan and cases of illegal penetrations into the epicentres of conducted experiments. However, the radio-ecological situation is not stable. Processes of migration of radioactive substances have been identified, and this makes it necessary to conduct regular monitoring of the radio-ecological situation at the SNTS.

Undoubtedly, considering the volume and diversity of the tests carried out at the SNTS, the information we possess is not exhaustive. However, it allows us to have a tentative plan for further investigative work and remediation measures. This should result in up to 80% of the territory of the SNTS being returned to the community for regular economic use. The remainder of the territory, the remediation of which is economically infeasible, should be enclosed and marked with warning signs about radiation danger. In those areas, regular radio-ecological controls should be conducted. (IRSE 2013)

The main message from IRSE seems to be that they consider the test-site area today to present no danger to the population, unless unwise activities are carried out in the most-contaminated areas. While they hope that large parts of the territory will be returned to the community, some of the most-contaminated areas should be enclosed and better safeguarded.

As IRSE also points out, the borders of the SNTS were determined by Soviet generals in the 1940s and do not reflect current realities. Much of the territory formally belonging to the test site can be considered acceptable for normal use, whereas some areas currently outside of the test side should be closed to the public and carefully monitored. There are plans to adjust the borders of the test sites to correspond to the actual radiation situation.[23] The remaining areas should be safeguarded and monitored, in all probability indefinitely. According to IRSE, one explanation of the non-uniformity of the radio-ecological situation in the region is that different types of radionuclides (plutonium, tritium, uranium, etc.) have different migration characteristics. This also makes it important to distinguish between different types of radiation exposure risks from different radioactive elements.[24]

There are numerous areas where access for grazing animals and population should be restricted. This concerns the epicentral zones of the studied testing grounds, traces of radioactive fallout and emissions resulting from accidents, local areas of contamination from radiological warfare agents ('dirty' bombs containing radioactive mixtures), the area of Atomic Lake[25] and the river Shagan (within and outside of the borders of the test site), and the Degelen test ground as a whole.

Visitors to the test site have often expressed surprise at the lack of warning signs and physical barriers.[26] Work is underway to improve this, but much remains to be done.

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23 IRSE aims to return 80% of the territory to the community, perhaps even as much as 95%. Interview with Sergey Lukashenko, director of IRSE and deputy director of the National Nuclear Center, 28.11.2013.

24 For instance, while tritium can easily migrate with underground water, plutonium largely rests in place where a nuclear test was conducted. Strontium has similar characteristics to calcium, so it can migrate with surface water and easily penetrate into plants, posing radiation exposure risks. Interview with Sergey Lukashenko, 28.11.2013; e-mail communication with Aleksandr Moshkov, IRSE, 04.01.2014.

25 Atomic Lake was intentionally created on 15 January 1965 as a result of a 150 kt underground nuclear detonation. 'The result of the test was clear: The damage created by industrial nuclear technologies was incomparably greater than the potential economic benefits' (IRSE 2013).

26 For three such stories, see Brunn 2011.

Example of trench/physical barrier (picture reproduced with permission from IRSE)

'Atomic Lake' – intentionally created by a nuclear detonation in 1965 (picture reproduced with permission from IRSE)

What about the territories near the test site, including several villages? The overall conclusion from several international studies is that the 'radiation situation in the surveyed settlements varies, but it is not dangerous. Doses from external exposure are at background levels, and the values of internal doses do not exceed allowable values. However, the issue requires further research with respect not only to settlements, but also individually to each person.' (Lukashenko (ed.) 2011a, p. 33)

IRSE has elsewhere noted that they consider only the outlet of the river Shagan to be of danger to the population, not other adjacent areas.[27] The situation around the river Shagan is unstable due to migration of tritium for long distances beyond the test site. In order to limit high accumulation of tritium in humans and animals, access to these dangerous territories should be banned. Migration of other induced radionuclides along the river Shagan has not been identified.[28]

The village of Dolon is often mentioned in connection with residual radionuclides. It was located close to radioactive fallout during the atmospheric nuclear tests – in particular some of the most dose-contributing nuclear detonations, including the first nuclear test on 28 August, 1949. Exposure levels were high during the first few days after the fallout, but IRSE considers that the level of induced radionuclides today only insignificantly exceeds the global level of fallout, and does not see this as posing any threat to the population.[29]

These are difficult questions, however. The territory of the test site has been examined more thoroughly than areas outside of it, and both the level of radiation contamination in adjacent areas and the potential health risks from low-level radiation exposure remain disputed (see e.g. Purvis-Roberts et al. 2007, p. 300). In addition, there can still be individual hotspots in fallout areas, due to long-lived radionuclides.

The SNTS as a symbol of hope

In our conversations with IRSE staff we were told that people who visit the test site often leave with a dual impression. On the one hand, they realize that the test site today is not as dangerous as they had expected.

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27 National Nuclear Center of the Republic of Kazakhstan (2014): *Questions and Answers* (*Voprosy i otvety*), available at: http://sts.nnc.kz/index.php?id=54&L=0, accessed 4 January 2014; interview with Lukashenko 28.11.2013.

28 E-mail communication with Aleksandr Moshkov, IRSE, 04.01.2014.

29 Ibid.

On the other hand, they understand the horrifying power of nuclear weapons.[30]

While the professionals responsible for the test site today go to great lengths to stress that the area is not the Armageddon-like disaster that it sometimes is made out to be, one fact remains. Even though surface and atmospheric tests ended more than 50 years ago, and the test site was closed more than 20 years ago, and despite the huge efforts to study and minimize potential risks, it is clear that some areas will never return to nature, that the situation in others is uncertain and potentially dangerous, and the local people have experienced health risks as well as psychological stress. It is to the perceptions of these people that we now turn.

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30 Interview with Sergey Lukashenko, 28.11.2013.

People's experiences – perceptions of the tests' impact

As medical scientists attempt to establish the health impacts of the SNTS and nuclear scientists map the current state of radiological contamination and try to predict future developments, there is another important aspect of the humanitarian consequences of the nuclear testing that tends to be overlooked: people's own experiences and how they perceive their lives and the lives of their dear ones to have been affected by the SNTS. Psychological well-being is an important part of a person's health, and feelings of being a victim – regardless of the foundation for this feeling – are detrimental to life quality and health.

Researchers have attempted to map the experiences of those who lived near the SNTS at the time of the tests (in particular the atmospheric tests conducted until 1962). For example, a Japanese team of researchers who had previously studied such questions in Hiroshima and Nagasaki conducted questionnaire surveys in ten villages near the test site in 2002–2004. Their questionnaire contained questions about perceptions of health and effect of the nuclear tests, as well as an open-ended question where respondents were asked to freely describe their experiences from the nuclear tests – and their stories of what the tests meant for their lives.

Survey results concerning how the respondents described how they remember the actual nuclear tests can be summarized thus:

- 93% of respondents 'somehow directly experienced the nuclear tests', also in 'villages as far as 200 km away from the hypocentre', something the Japanese researchers attribute to the power of the bombs detonated at the SNTS.

- 90% of the respondents reported seeing the flash and 70% that they felt a bomb blast, 18% felt heat, 28% saw the mushroom cloud, 16% mentioned a 'deafening roar', and 7% 'referred to animals that had lost their hair', a typical sub-acute radiation injury. (Kawano and Ohtaki 2006)

The villagers made it very clear that they had not been informed about the nature of the tests, or of the dangers linked to them (ibid., p. A201). Other studies corroborate this picture. Two US researchers conducting interviews in the region:

> All of the villagers who were alive during the tests have vivid memories of military personnel showing up in the village by helicopter the day before a test to warn them of upcoming 'military exercises'... The explosions were never described as 'nuclear tests' or 'atomic bombs'... [M]any villagers note that when they were young they thought the tests were fun and exciting, and they rarely listened to these instructions [to lie down on the ground and to avoid looking at the bright clouds in the skies]. (Werner and Purvis-Roberts 2005)[31]

Importantly, when witnesses of the nuclear tests tell about their experience, they are predominantly concerned with the continuing impact on their body and their health. Japanese researchers report that 33% of residents feel that they have bad or very bad health, and, significantly, that '70% of the residents strongly recognized a causal relationship between their bad health conditions and the nuclear tests' (Kawano, Hirabayash et al. 2006, p. A209). The testimonies from the villagers contain many heart-breaking statements about lives ruined by the nuclear testing (see Matsuo 2004.)

The psychosocial situation in the Semipalatinsk region remains complex. Today, long after the nuclear tests ended, people are worried that exposure to radiation continues to affect their lives. Adding to people's uncertainty is the fact that the impact mechanisms of radiation are difficult to comprehend – radiation is an 'uncontrollable risk' that one is 'unable to detect... without special scientific equipment' (Purvis-Roberts et al. 2007, p. 292). In addition to actual health problems caused by exposure to radiation, 'people exposed to invisible environmental contaminants, such as radiation, have demonstrated traumatic psychological effects from the unknown health impacts' (ibid.)

Moreover, to better comprehend the hardships endured by the population living close to the SNTS, their experiences should also be understood in the context of the broader socioeconomic situation. After the breakup of the Soviet Union, Kazakhstan's economy nearly collapsed: inflation reached four-digit figures, unemployment was high, and the future seemed anything but clear.[32] For the population in regions close to the test site, the revelations in the late 1980s and early 1990s about the nuclear testing and its potential impact on their health added greater complexity to an already challenging situation.

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31 Yet others report: 'There was mixed advice given to farmers and herders. Some were told to leave their buildings when blasts would occur, lest they be buried by collapsing walls. Others were told to remain indoors.' (Brunn 2011, p. 1796).

32 However, after 2000 the country witnessed a period of high economic growth, decreasing income inequality and unemployment.

The legacy of the SNTS, then, was not the only factor to affect the situation of the population. Still, many local people seem to link problems of all kinds – health issues in particular – to the nuclear legacy: As one report puts it: 'the villagers tend to attribute any illness obtained in the village, from an upset stomach to a brain tumour, to nuclear testing and radiation exposure' (Purvis-Roberts et al. 2007, p. 297). This psychological stress – although physicians and scientists say it is often unfounded – surely has a real and negative impact on life quality for the population around the SNTS.[33]

The surveys and interview studies referred to above indicate that such stress is widespread. This is also the opinion of professionals, who want to cure what they call 'radiophobia' with better education and enlightenment. An ingrained tendency towards victimization, blaming the SNTS for misfortunes in life, is a large and even increasing problem which medical experts seek to examine further.[34] This is an issue of immense complexity. Yet one thing is clear: the uncertainties about the effect of the nuclear tests – not least among laypeople – make psychological stress and fear an important and continuing legacy of the nuclear testing.

[33] Interviews with IRSE and IRME, 2013. See also Purvis-Roberts et al. 2007.

[34] Interviews with IRME experts, 2013.

The state support system for victims of the nuclear tests

Recognition of the humanitarian consequences of the nuclear testing in Semipalatinsk has also been institutionalized: there exists a state system for recognition of victimhood, and compensations and benefits for those defined as affected. Introduced in 1992, this state support scheme required elaborating criteria 'to define who would and who would not qualify as a 'victim' of nuclear testing' (Werner and Purvis-Roberts 2007, p. 474).

The government has officially recognized 1,323,000 people as having been negatively affected by the nuclear tests. Out these, 1,057,000 have received 'radiation passports' (*poligonnoe udostoverenie*) officially confirming their status ('Note on the issue of Health…'). This figure does not necessarily reflect the number of people physically impacted by the tests, as the main principle for recognition of victimhood and entitlement to compensation was originally residence in areas close to the test site. As two US researchers note:

> As in similar cases of environmental disaster, there were discussions as to whether victims should be limited to those who have developed certain medical conditions associated with radiation exposure, or whether victims should be defined by permanent residence near the test site where exposure levels were significant. (…) [T]he government of Kazakhstan took the latter option, and divided 'victims' into four subcategories: minimal risk; above-minimal risk; maximal risk; and extraordinary risk. (Werner and Purvis-Roberts 2007, p. 474)[35]

In addition to these four area categories some benefits are admitted to residents of the so-called "territory of special privileged socio-economic status" – defined by law as an area adjacent to the minimum radiation risk area with a low radiation dose (measured over the entire nuclear testing period), which nonetheless poses serious negative psycho-emotional stress for people living there.[36] Until 1995 residency was the sole basis for compensation. Since 1995 additional compensation may be granted to persons based on their individual health condition (see below).

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35. See footnote 13 in the Health section for further information about these areas.

36 According to the 1992 law, the Bayanaul district of the Pavlodar region is the only area to which this special status was assigned.

Due to the economic situation in Kazakhstan in the 1990s, the government was partly unable to fulfil its obligations, and many had to wait years before they received the compensation they were entitled to. It should be noted that while the state support programme appears comprehensive, there has also been criticism regarding the size of compensation payments (Werner and Purvis-Roberts 2007).

The key official mechanisms for dealing with the consequences of the SNTS are based on the law 'On social protection of citizens suffered from nuclear tests in the Semipalatinsk nuclear test polygon' from 1992 (Law….№ 1787–X11). The law prescribes the main measures aimed at providing social benefits and protection to people who suffered from activities at the polygon. Articles 10 and 11 define the status of people who suffered from nuclear tests and set criteria for issuing 'radiation passports' that indicate to which of the four categories they belong.[37] Citizens with the status 'suffered' are entitled to:

- a lump-sum monetary compensation
- a higher pension (in areas of extraordinary and maximal radiation risk)
- state employees receive a salary top-up
- additional paid holiday – the extent of which is defined by the 'risk category': extraordinary radiation risk area (14 days); maximal radiation risk area (12 days); increased radiation risk area (10 days); minimum radiation risk area (7 days); territory with special privileged socio-economic status (5 days). The 1992 Law specifies the districts which belong to these five areas.
- women living in areas exposed to radiation are entitled to maternity leave of up to 170 days (under easy delivery) and 184 days (in case of problems with complicated childbirth or a multiple birth).
- children under the age of 18 living in areas exposed to radiation are entitled to free treatment at health centres.

In addition to these benefits based on residing close to the test site, an Interdepartmental Expert Council has been established to make

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[37] However, in the early 1990s, 'the government could not afford to provide compensation to everybody and priority was given, first, to those living in extraordinary risk zone and, second, to the elderly living in Semipalatinsk City.' (Werner and Purvis-Roberts 2007, p. 474)

judgments on associations between the individual's exposure to radiation and medical conditions. An expert decision serves as legal grounds for applying for additional social benefits. The Expert Council has investigated 30,240 cases since its establishment in 1995.[38] These have resulted in 24,100 positive decisions with respect to the relationship between disease (or death) and radiation exposure (IRME 2013). Thus, since 1995 the state support system has become a mixed one, based on two different criteria: First, residency in areas close to the test site during the years of nuclear testing (atmospheric and underground tests); second, Expert Council decisions about assumed link between the nuclear testing and an individual's health condition.

Discussions are currently underway about amending the compensation system, as it does not take into account people who moved to contaminated areas after 1991.

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[38] The Expert Council was envisioned in the law of 1992, but started functioning in 1995.

Concluding remarks

Atmospheric nuclear testing at Semipalatinsk ended in 1962, the last underground nuclear test was conducted in 1989, and the test site closed in 1991. This report has aimed to provide an introduction to the humanitarian consequences of the Semipalatinsk nuclear testing. Since the closure of the test site, much has been done to study the impact of the SNTS. To those interested in a deeper study we offer a list of recommended literature on page 29.

Yet, as this report has also shown, many questions need further exploration. For example, medical scientists continue to explore associations between radiation and health problems. The radio-ecological situation in areas close to the SNTS should be further examined in order to identify remaining risks for the population. Local researchers are also increasingly concerned with the study of the psycho-social situation in the region – how people cope with the experience of living near a former nuclear test site. Certainly the legacy of the Semipalatinsk nuclear testing continues to impact the lives of the local population.

Selected literature for further reading

Health consequences

Bauer, S., Gusev, B., Belikhina, T., Moldagaliev, T., Apsalikov, K. (2013): 'The legacies of Soviet nuclear testing in Kazakhstan: fallout, public health and societal issues', in D. Oughton & S. O. Hansson (eds.): Social and Ethical Aspects of Radiation Risk Management. Elsevier Science, pp. 239–258.

Grosche, B. (2002): 'Semipalatinsk Test Site: Introduction', Radiation and Environmental Biophysics 41 (1): 53–55.

Land, C. E., Zhumadilov, Z., Gusev, B. I., Hartshorne, M. H., Wiest, P. W., Woodward, P. W., et al. (2008): 'Ultrasound-detected thyroid nodule prevalence and radiation dose from fallout', Radiation Research, 169: 373–383.

Simon, S. L. and Bouville, A. (2002): 'Radiation doses to local populations near nuclear weapons test sites worldwide', Health Physics 82 (5): 706–725.

Simon, S., Bouville, A. and Land, C. (2006): 'Fallout from nuclear weapons tests and cancer risks exposures 50 years ago still have health implications today that will continue into the future', American Scientist 94 (1): 48–57.

The test site and the environmental situation

Carlsen, T., Peterson, L., Ulsh, B., Werner, C., Purvis, L. and Sharber, A. (2001): 'Radionuclide contamination at Kazakhstan's Semipalatinsk Test Site: implications on human and ecological health', *Human and Ecological Risk Assessment* 7 (4): 943–955.

Harrell, E. and Hoffman, D. E. (2013): *Plutonium Mountain: inside the 17-Year mission to secure a legacy of Soviet nuclear testing*, report for Project on Managing the Atom, Belfer Center for Science and International Affairs, Harvard Kennedy School, Cambridge, MA, 15 August 2013.

Lukashenko, S. (ed.) (2011): 'Semipalatinsk Nuclear Test Site: present state'. Available at: http://irse.kz/index.php/publikatsii/buklety/sip/na-anglijskom-yazyke, accessed 4 January 2014.

People's experiences

Kawano, N., K. Hirabayash, M. Matsuo, Y. Taooka, T. Hiraoka, KN Apsalikov, T. Moldagaliev, and M. Hoshi (2006): 'Human suffering effects of nuclear tests at Semipalatinsk, Kazakhstan: established on the basis of questionnaire surveys', *Journal of Radiation Research* 47 (February): A209-A217.

Purvis-Roberts, K., Werner, C. and Frank, I. (2007): 'Perceived risks from radiation and nuclear testing near Semipalatinsk, Kazakhstan: a comparison between physicians, scientists, and the public', *Risk Analysis* 27 (2): 291–302.

Werner, C. and Purvis-Roberts, K. (2005): *Unraveling the Secrets of the Past: Contested Versions of Nuclear Testing in the Soviet Republic of Kazakhstan.* National Council for Eurasian and East European Research, *Washington D.C.*, available at: http://www.ucis.pitt.edu/nceeer/2005_818_16_Werner.pdf, accessed 20 January 2014.

State support

Werner, C. and Purvis-Roberts, K. (2007): 'After the Cold War: international politics, domestic policy and the nuclear legacy in Kazakhstan', *Central Asia Survey*, 25 (4): 461–480.

More general accounts

Brunn, S. (2011): 'Fifty years of Soviet nuclear testing in Semipalatinsk, Kazakhstan: juxtaposed worlds of blasts and silences, security and risks, denials and memory', in: Brunn, Stanley (2011): *Engineering Earth. The Impact of Megaengineering Projects*, Springer, pp. 1789–1818.

Kassenova, T. (2009): 'The lasting toll of Semipalatinsk's nuclear testing', *Bulletin of the Atomic Scientists*, available at: http://thebulletin.org/lasting-toll-semipalatinsks-nuclear-testing, accessed 20 January 2014.

Parfitt, T. (2010): 'Nuclear tests leave Kazakhstan still searching for answers', *The Lancet* 376, no. 9749: 1289–1290

List of references

Bauer, S. (2006): The Local Health Impact of Atmospheric Nuclear Weapons Testing: Cancer Epidemiology in Areas Adjacent to the Semipalatinsk Test Site, Kazakhstan. Frankfurt: Peter Lang.

Bauer, S., Gusev, B., Pivina, L., Apsalikov, K. and Grosche, B. (2005): 'Radiation exposure due to local fallout from Soviet atmospheric nuclear weapons testing in Kazakhstan: solid cancer mortality in the Semipalatinsk historical cohort, 1960–1999', Radiation Research 164 (4): 409–419.

Bauer, S., Gusev, B., Belikhina, T., Moldagaliev, T., Apsalikov, K. (2013): 'The legacies of Soviet nuclear testing in Kazakhstan: fallout, public health and societal issues', in D. Oughton & S. O. Hansson (eds.): Social and Ethical Aspects of Radiation Risk Management. Elsevier Science, pp. 239–258.

Borrie J. and T. Caughley (eds.) (2013): Viewing Nuclear Weapons through a Humanitarian Lens. New York, Geneva: United Nations, available at http://www.unidir.org/files/publications/pdfs/viewing-nuclear-weapons-through-a-humanitarian-lens-en-601.pdf, accessed 14 January 2014.

Brunn, S. (2011): Fifty years of Soviet nuclear testing in Semipalatinsk, Kazakhstan: juxtaposed worlds of blasts and silences, security and risks, denials and memory', in S. Brunn: Engineering Earth. The Impact of Megaengineering Projects, Springer, 1789–1818.

Carlsen, T., Peterson, L., Ulsh, B., Werner, C., Purvis, L. and Sharber, A. (2001): 'Radionuclide contamination at Kazakhstan's Semipalatinsk test site: implications on human and ecological health', Human and Ecological Risk Assessment 7 (4): 943–955.

Grosche, B. (2002): Semipalatinsk Test Site: Introduction. Radiation and Environmental Biophysics 41 (1): 53–55.

Grosche, B., Land, C., Bauer, S., Pivina, L., Abylkassimova, Z. and Gusev, B. (2002): Fallout from nuclear tests: health effects in Kazakhstan', Radiation and Environmental Biophysics, 41 (1): 75–80.

Grosche, B., Lackland, D., Land, C., Simon, S., Apsalikov, K., Pivina, L., Bauer, S. and Gusev, B. (2011): 'Mortality from cardiovascular diseases in the Semipalatinsk historical cohort, 1960–1999, and its relationship to radiation exposure', Radiation Research, 176 (5): 660–669.

Gusev, B., Abylkassimova, S. and Apsalikov, K. (1997): 'The Semipalatinsk Nuclear Test Site: a first assessment of the radiological situation and the test-related radiation doses in the surrounding territories', Radiation and Environmental Biophysics, 36: 201–204.

Harrell, E. and Hoffman, D. (2013): Plutonium Mountain: Inside the 17-Year Mission to Secure a Legacy of Soviet Nuclear Testing. Report for Project on Managing the Atom, Belfer Center for Science and International Affairs, Harvard Kennedy School, Cambridge, MA.

IRME (2013): Mediko-demograficheskie posledstviya ispytaniy yadernogo oruzhiya na Semipalatinskom ispytatel'nom yadernom poligone (unpublished background paper).

IRSE (2013): Ekologicheskie posledstviya yadernikh ispitaniy na Semipalatinskom ispitatel'nom yadernom poligone (unpublished background paper).

Katayama, H., Apsalikov, K., Gusev, B., Galich, B., Madieva, M., Koshpessova, G., Abdikarimova, A. and Hoshi, M. (2006): 'An attempt to develop a database for epidemiological research in Semipalatinsk', Journal of Radiation Research, 47: A189–A197.

Kawano, N. and Ohtaki, M. (2006): 'Remarkable experiences of the nuclear tests in residents near the Semipalatinsk Nuclear Test Site: analysis based on the questionnaire surveys', Journal of Radiation Research, 47, no. Suppl A (2006): A199–A207.

Kawano, N., Hirabayash, K., Matsuo, M., Taooka, Y., Hiraoka, T., Apsalikov, K., Moldagaliev, T. and Hoshi, M. (2006): 'Human suffering effects of nuclear yests at Semipalatinsk, Kazakhstan: established on the basis of questionnaire surveys', Journal of Radiation Research, 47: A209–A217.

Kimura, A., Hyodo, H., Satow, Y., Tchaijunusova, N., Alexander, S. and Gusev, B. (1998): 'Leukemia in Semipalatinsk area of Former USSR', British Journal of Haematology, 102 (1): 37.

The Law of the Republic of Kazakhstan on 'Social protection of citizens who suffered as a result of nuclear tests conducted in Semipalatinsk nuclear test site' of 18 December 1992 (№ 1787–X11).

Logachev, V., Mikhalikhina, L., Darenskaya, N., Matuschchenko, M., Stepanov, Y., and Shamov O. (1998): Population Health in Regions Adjacent to the Semipalatinsk Nuclear Test Site, AFRRI Contract Report 98–4, Armed Forces Radiobiology Research Institute, Bethesda, MD,.

Lukashenko, S. (ed.) (2011a): Semipalatinskiy ispitatel'nyy poligon. Sovremennoe sostoyanie, Pavlodar: Dom Pechati.

Lukashenko S. (ed.) (2011b): Semipalatinsk Nuclear Test Site: Present State. IRSE, available at:

http://irse.kz/index.php/publikatsii/buklety/sip/na-anglijskom-yazyke, accessed 14 January 2014.

Matsuo, M. (2004): 'A full-text English database of testimonies of those exposed to radiation near the Semipalatinsk Nuclear Test Site, Kazakhstan', Hiroshima Peace Science, 26: 75–99.

Medvedev, Z (1999): Stalin and the Atomic Bomb, available at: http://www.spokesmanbooks.com/Spokesman/PDF/68Medvedev.pdf

'Note on the issue of "Health and social protection of population living around the Semipalatinsk nuclear test site"' ("Spravka po voprosu 'Ob okhrane zdorov'ya i sotsialnoy zashchite naseleniya, prozhivayushchego v zone vliyania byvshego Semipalatinskogo yadernogo poligona'"), available at: http://online.zakon.kz/Document/?doc_id=30026965, accessed 12 December 2013

National Nuclear Center of the Republic of Kazakhstan (2014): Questions and Answers (Voprosy i otvety), available at: http://sts.nnc.kz/index.php?id=54&L=0, accessed 4 January 2014.

Parfitt, T. (2010): 'Nuclear tests leave Kazakhstan still searching for answers', The Lancet, 376 (9749): 1289–1290.

Purvis-Roberts, K., Werner, C. and Frank, I. (2007): 'Perceived risks from radiation and nuclear testing near Semipalatinsk, Kazakhstan: a comparison between physicians, scientists, and the public', Risk Analysis 27 (2): 291–302.

Simon, S., Baverstock, K. and Lindholm, C. (2003): 'A summary of evidence on radiation exposures received near to the Semipalatinsk Nuclear Weapons Test Site in Kazakhstan', Health Physics Society, 84 (6): 718–725.

Takada, J. (2005): Nuclear Hazards in the World: Field Studies on Affected Populations and Environments. Berlin: Kodansha/Springer.

Werner, C. and Purvis-Roberts, K. (2005): Unraveling the Secrets of the Past: Contested Versions of Nuclear Testing in the Soviet Republic of Kazakhstan. National Council for Eurasian and East European Research, Washington D.C., available at: http://www.ucis.pitt.edu/nceeer/2005_818_16_Werner.pdf, accessed 20 January 2014.

Werner, C. and Purvis-Roberts, K. (2007): 'After the Cold War: international politics, domestic policy and the nuclear legacy in Kazakhstan', Central Asia Survey, 25 (4): 461–480.

Appendix

Table 1: Overview of major test grounds within the SNTS (Source: IRSE 2013)
The information presented here is simplified and not exhaustive. For further information, see Lukashenko (ed.) (2011): 'Semipalatinsk Nuclear Test Site: Present State'. Available at: http://irse.kz/index.php/publikatsii/buklety/sip/na-anglijskom-yazyke, accessed 14 January 2014.

Area	Test history and current state
Opytnoe pole ('Experiment field')	The atmospheric and surface tests were conducted at the 'Opytnoe pole' ['Experimental field'] test ground between 1949 and 1962. It is these nuclear tests that led to greatest contamination of the test site and adjacent regions, and to the largest extent have impacted the health and life of the population in adjacent regions, indeed as far away as the Altai region in contemporary Russia. Work carried out since site closure: • Some physical barriers have been created. • In the most-contaminated areas: elimination of contamination by removal of the upper layer of soil. In less-contaminated areas, remediation is carried out by deep ploughing. The result is a significant decrease of the concentration of artificial radionuclides in the upper layer of the soil. Present situation: • The radiation situation is at the moment rather stable, but not uniform. Frequent steppe fires lead to a certain redistribution of radionuclides in the area. • Significant areas of the testing ground can be deemed 'conditionally clean', when the concentration of artificial radionuclides is comparable to the level of global fallout.
Balapan and Sary-Uzen	At the Balapan and Sary-Uzen test grounds, 129 underground nuclear tests were carried out in vertical boreholes, depth up to 500 meter. At the Balapan test ground one can find the infamous 'Atomic Lake', intentionally created on 15 January 1965 as a result of a 150 kt underground detonation. Work carried out since site closure: • With the aim of eliminating the test infrastructure and improving the radio-ecological situation at the Balapan test ground, a series of measures have been undertaken, including the destruction of the engineering complexes over the boreholes. Entrances to tunnels have been removed. • Atomic Lake (river Shagan): Despite the difficult radio-ecological situation at the river Shagan and the large-scale migration of tritium contaminated water to territories outside of the test site, no remediation works have been carried out here.

	Present situation: • Excavation detonations at the test grounds Balapan and Sary-Uzen in boreholes no. 1003 and no. 125 led to significant radioactive contamination over an area of several hundred meters; fallout from the test in borehole no. 101 can be traced at a distance of several kilometres. • Emergency detonations in four boreholes caused considerable contamination of the surrounding areas. • As a whole, the radio-ecological situation at the test grounds Balapan and Sary-Uzen is stable. Migration processes have not been observed, except for the situation at the river Shagan. • At the outlet of the river Shagan from Atomic Lake, studies have shown that the concentration of radionuclides in the water does not exceed the threshold limit value for the population. But at the portion of land 4 to 6 km from Atomic Lake extremely high concentrations of H3 have been discovered, stretching approx. 35 km, including territories outside of the test site borders. This is a considerable problem – in the floodplain by the river Shagan there is active animal husbandry.
Degelen	In the period 1961–1989, 209 medium-yield and small-yield underground nuclear tests nuclear tests were carried out in 181 tunnels in the Degelen mountain massif. Work carried out since site closure: Massive remediation works have been carried out. During the remediation work at the Degelen test ground, protective concrete structures of a total volume of more than 90,000 m3 have been created. For more information, see Harrell and Hoffman (2013). Present situation: The situation at Degelen remains complex. In addition to water-bearing tunnels with high levels of radionuclides, there are there problems with contamination as a result of tunnels being used for tests several times. In several cases, in order to re-use an object, contaminated tunnel infrastructure was dismantled and brought to the surface, causing contamination of adjacent territories. In general, the radio-ecological situation is unstable and changes with time.
4 and 4A	Not only nuclear tests were carried out at the SNTS. At the '4' and '4A' test grounds tests of radiological warfare agents (RWA) were conducted – 'liquid or powder-like radioactive mixtures', manufactured from radiochemical waste. Work carried out since site closure: • Physical barriers are being constructed • Decontamination is a priority Present situation: • On the territory of '4' and '4A' more than 30 places with local radioactive contamination have been discovered. • The radiation situation in these places is unstable and is gradually changing. Strontium in these places can easily be transferred to vegetation and further to animals.

Nuclear tests were also conducted at the Tel'kem and Aktan-Berli testing grounds, and on several unnamed test grounds.

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Norsk Utenrikspolitisk Institutt [NUPI] ble etablert i 1959, og er et ledende, uavhengig forskningsinstitutt på internasjonal politikk og områder av relevans for norsk utenrikspolitikk. Formelt er NUPI underlagt Kunnskaps-departementet, men opererer likevel som en uavhengig, ikke-politisk virksomhet i alle sine faglige aktiviteter. Forskning utført ved NUPI spenner fra kortsiktig anvendt forskning til mer langsiktig grunnforskning.

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