RADIATION-HAZARDOUS OBJECTS AT THE WEST AND CENTRAL KAZAKSTAN TERRITORY

Kadyrzhanov K.K., Kuterbekov K.A., Akhmetov E.Z., Lukashenko S.N., Dzhazairov-Kakhramanov V.

Institute of Nuclear Physics of the National Nuclear Center, RK

INTRODUCTION

In 1965-1987, there were conducted 39 industrial underground explosions (1,2) in the territory of Kazakhstan Republic, in particular in its west and central region (explosions conducted at Semipalatinsk test site, East-Kazakhstani oblast are not included). These explosions were conducted in terms of the Program 7 " Peaceful nuclear explosions for industrial purposes" with the purpose of test-industrial investigation conducting for testing a technology for formation of cavities in rock salt in order to be used as multipurpose large volume storage. Energy from underground nuclear explosions was used for peaceful technological purposes, in particular, in the territories of hydrocarbon raw materials mining and industrial developing. It is obvious, that residual radioactivity, even if it is very small, is a factor, that hampers to use nuclear explosions for this purpose. The major problems are the following: safety measures, which are necessary for implementation of the projects on nuclear explosion usage in peaceful purposes, admissible level of environment pollution in whole and possible consequences. All necessary measures must be taken to ensure safety in the regions, where explosions were conducted, including all the least probable accidents (for instance, breach during camuflet explosions). To make sure, that existing admissible standards will not be exceeded, it is necessary to know the level of environment radiation contamination and to forecast probable contamination caused by explosions.

Nuclear explosions were conducted at the following objects of the West and Central Kazakhstani regions [1-5]:

- GALIT (Azgir, Atyrauskaya oblast, 180 km northward to Astrakhan town)
- LIRA (West-Kazakhstan oblast, 140 km eastward to Uralsk town)
- MANGYSHLAK (plateau Usturt, Mangystauskaya oblast, 110-115 km south-eastward to Aktubinsk oblast, Sai-Utes settlement)
- BATOLIT-2 (Aktubinskaya oblast, 320 km south-westward to Aktubinsk town)
- MERIDIAN-1 (Akmolinskaya oblast, 110 km south-eastward to Arkalyk)
- MEREDIAN-2 (South-Kazakhstan oblast, 230 km south-eastward to Dzhezkazgan).
- MERIDIAN-3 (South–Kazakstani oblast, 90 km south-westward to Turkestan town)
- REGION-3 (West-Kazakstani oblast, 250 km south-westward to Uralsk town)
- REGION-5 (Kustanaiskaya oblast, 160 km south-eastward to Kustanai town)

Besides the objects, which was formed as a result of underground nuclear explosions, one of the most radiation-hazardous object is a storage for toxic and radioactive wastes – KOSHKAR-ATA (Mangystauskaya oblast), which remains to be the most radiation-hazardous object due to the man-induce activity and neglecting of the environment safety regulation.

Let's list briefly the retrospective aspects of radiation hazardous objects origin at the mentioned areas and their consequences and also describe current radiation situation. Truthful coverage of these issues will allow to keep informed about real ecological conditions at test sites and speed up rehabilitation measures conduction.

1. **Object Galit (test site Azgir).** Sites of Azgir test site (object GALIT) [6-8] are located at salt –dome deposit Bolshoi Azgir, situated in north-western part of Near Kaspian lowland, which is, in its turn, a part of the system of local structures of Bogdo-Chapchachinskiy billow. Salt-dome structure of Bolshoi Azgir is a vast brachi-anticlinal fold of a diapir type, complicated by two salt-dome hills – West and East Azgir, with the distance between each other 10-12 км in average. They are separated by compensation syncline Uzhantator.

Settlement Azgir is situated at the West dome (Kurmangazinski district of Atyrau oblast). It is connected with district center Ganushkino by earth road (~250 км). Ganushkino is situated on the Caspean see shore.

Gydro-geological conditions at the place, where underground nuclear explosions were conducted. Hydro-geological conditions are rather typical for North part of Near- Caspian lowland. Major aquifers, located in persalt deposits all over covered by waterproof clay rocks and characterized by stagnant regime. These waters sufficiently mineralized (right up to rich brines) and are not suitable for household water-supply.

Retrospective data. Since 1966 to 1979 years, there were conducted 17 underground nuclear explosions, where 22 charges were exploited, in 10 wells at deposit Bolshoi Azgir. At West dome, there were drilled 2 wells, where 8 explosions were conducted. The rest explosions were conducted at Eastern dome.

In the cavity A2, filled in with water, six explosions for testing method of transplutonium elements in indicator quantity production were conducted [5].

In creation of this nuclear explosion technology in accordance with their specialization the following organizations took part: USRIEP (Arzamas-16, Sarov)– task general formulation, preparation and charges explosion, calculation and forecasts for conduction of massif under the influence of primary and repeated explosions; VNEP Prom technology (Moscow) – mountains and geological aspects of the problem, mechanical and seismic action of explosion, development of project documents; V. Khlopin Radium Institute (St. Petersburg) – investigation of explosion product, radionuclide migration, ecological aspects. Currently, radiation monitoring is being conducted by the Institute of Nuclear physics of the national nuclear Center of Kazakhstan Republic at the technological sites.

Radiation situation on the object "Galite". After an acceptance of GALITE object on balance NNC RK in 1995, the Institute of nuclear physics conducts regular inspections of radioecological sitiuation in the area of test-site and its surrounding area, in particular, there have been carrying out the radiometric surveys, sampling of ground and water, gamma - spectrometric analysis of the specific contents of radionuclides in a ground and other objects of environment. Some outcomes of radiometric and spectrometric measurements are submitted in the reports. [8, 9].

Under the data of INP NNC RK values exposure rate on sites during from 1997 to 1998 now are within the range of 15 ÷ 25 mkR/h. The heightened value of exposure rate up to 400-480mkR/h is fixed on site A2, A3 and A5 (by separate spots of area up to 0,5м^2), and the maximum value of exposure rate is registered on a site A2 - 720 ÷ 800мкR/h (spot ~ 0,2м^2).

Under the data of expedition team of the INP NNC RK for 1999 year on the GALITE object the most contaminated is a site A2, as on maximum values of exposure rate, and on number of spots of radioactive anomalies, where the highest level of exposure rate - 1200 Bq/h is marked. The substantial contamination is fixed on a site A3, where the maximum value of exposure rate is equal to 790mkR/h. Surfaces of sites A5 and A10, where the level of exposure rate reaches to 400 mkR/h and 290 mkR/h are less contaminated in comparison with A2 and A3 sites.

The background radiation on sites A7, A8, A11 and around of large crater on a site A9 is determined by a natural radioactive background of this area, relating to arid zone, and the values of exposure rate are in an interval of 10-18 mkR/h.

Formation of ground depressions on some sites, for example, A1, A2, A4, A9, A10 and A11, of bottleshaped form with the depth up to 3 m and diameter up to 2,5 m. are the distant consequences of underground nuclear explosions. The intensive depression formation has been fixed in 1997 year though these processes has been taken place to a greater or lesser extent during all after-explosive period. There is an uncovering of concrete curbstones - plugs of charge wells because of an eolation and subsidence of a earth embankment, which covering these curbstones.

The data on concentration of radionuclides in a surface ground sheet (from 0 up to 5 cm) demonstrate to considerable contamination by radionuclides of cesium - 137 in the area of sites A2, A3 and A10, where the concentration of cesium - 137 reaches up to 2084 Bq/kg, 555 Bq/kg and 4476 Bq/kg, accordingly.

Preliminary comparative data analysis under the specific contents of cesium - 137 in ground on sites A2, A3 and A10 and on sites A2, A5 and A10 (tests of 1997, the sheet 0-20 sm.) shows that the level of contamination of underlying ground sheets exceeds a level of contamination of surface sheet (0- 5 cm). This circumstance demands more detail analysis of distribution of radionuclides concentration over the depth of an ground cover.

Evidently, these contamination are caused by an outcrop of radionuclides from trenches, and also that at realization of recultivation of a separate radioactive spot, unfortunately, have remained and now there is their exposure because of water and wind ground erosion.

2.The object Mangyshlak (Ustyurt plateau). In 1969-1970, to make reservoirs in craters and to study engineering seismology 3 underground nuclear explosions were made at the object Mangyshlak. The place of the explosion is Mangystau district, Eraliyevsky region, 100-115 km away eastwards from Sai Utes village. The capacity of the explosion 30 to 85 kt., the depth of the explosive's situation 410 to 740 m.

The hydrogeological conditions of the site. The Quaternary deposits of the region are presented by loams ~ 3 m. The deposits of the neogenic age lie at the depth of to ~ 100 m. Lithologically, they are presented by cracked limestones.

The deposits of the paleogenic age lie at the depth of 100 to 280 m and are presented by marl with the thickness of ~ 50 м., situated in the lower part of the stratum and by clays with the thickness of 120-130 m. The clay layer is a regional aquifuge and a natural barrier separating the zone of an explosion influence from the biosphere..

The first water-bearing horizon of the site of charged wells lie at the depth of about 30 m in the karst cracked limestones. The horizon is non-head, fed by atmospheric precipitation. According to the data of the Institute of hydrogeology and hydrophysics of the Kazakhstan Academy of sciences, the mentioned underground waters of the Sarmat deposits are formed throughout the region on the form of more of less large lenses in the relief sags where there is no migration of water.

The water-bearing horizon being the closest to the explosion zone is situated at the depth of 600 m and a part of the water-bearing Alb-Cenomanian complex formed by the thick stratum terrigenous Albian and Cenomanian deposits consisting of interchanging layers of sand, limestomes and clays that widespread throughout the region. Depending on structural features of the region these deposits occupy very different positions. In the foothills of the mountainous Mangyshlak they come to the original ground, forming the feeding of the water-bearing complex.

Retrospective data. Due to the mechanical impact of the explosion 3 cavities with the radius of 65-100 m were formed, the zone of cracks is 275-410 m.

The ecological estimation of explosions. The implementation of the calculation estimation and the analysis have shown that when the explosion mechanically effects the massif there can be the establishment of hydraulic connection between the water-bearing horizon of the alb-semanic complex (-600 m.) and the demolished cavity, as a result of which waters can be contaminated by long-lived radionuclid Cs-137 and Sr-90, the period of decreasing in activity of which to the safe level is 300 - 250 years.

On the account of the conducted estimates there are adopted the zones of disposal in the wells area (conservation zones).

Well 1T - in an interval of depths of (0-1200) m., in radius of (400) m. from well mouth. Well 2T -in an interval of depths of (0-700) m., in radius of (350) m. from well mouth. Well 6T - in an interval of depths (0-900) m., in radius of (400) m. from well mouth.

Within the limits of these zones the well drilling, mine workings, building of facilities is forbidden. Outside the indicated zones the full safety of nature management and economic activities is guaranteed.

The characteristics of the experimental explosions at the object Mangyshlak show that from the point of ecological safety the experiment in the well 1T (Eraliyevsky region) represents the most anxiety. Here the basic object of the radioactive contamination can be the central zone of the explosion, situated in water-bearing rocks of the Alb-Cenomanian age.

In 1999, an expeditionary team of the Institute of nuclear physics at the RK National Nuclear Center, for the first time, carried out field works on the radioecological observation of craters formed by the underground nuclear explosions on Ustyurt plateau (the object Mangyshlak).

The craters dimensions on the sites T6, T2, T1, represented in the table № 2, were determined.

Table 2. Dimensions of craters of the object Mangyshlak.

The indices of sites	The crater diameter on the original ground, m	The crater depth from original ground, m
T6	400	22
T2	350	18
T1	-	-

In the vicinity of craters, one may see the ground depressions situated concentrically (well center) in the form of trenches with the depth of to 1 m, in some places to 2 m by separate pits, the trench width ~ 0,5 m, the distance between the trenches ~ 20 m on the site of T6, ~ 30 m on the site of T2. The depression formation begins from the distance of 400-450 m from the well on the site T6 and 200-250 m from the well on the site of T2, on the site of T1 no trench depressions are found.

On the site of T6 in the center of the depressed crater on its bottom there is a charge hole to which an explosive was put, with a casing column. The distance between the charge hole and the casing hole is filled with cement grout. The hole and the casing column have dropped as a result of the underground nuclear explosion almost to the bottom of the crater, that is the top of the charge hole's column is only 1,5 m from the bottom (before the explosion the column was about 1m from the original ground).

In the well mouth, that is over the cemented column the exposure rate was 2200 mcR/h, at the side of the casing tube the exposure rate does not exceed the level of the natural background. The place around the well is surrounded by a metal fence 20x20 m, 1 m in height.

The bottom of the depressed craters are covered with alluvial ground (as a result of atmospheric precipitation and melt waters), after abundant precipitation and melt water, on the bottom, a small sheet of water used by animals is accumulated. But water promptly evaporates and the bottom ground dries up and cracks.

The exposure rate on all the sites does not exceed the levels of the natural background of this locality (10-15 mcR/h), except for some points, where the exposure rate has been 60-80 mcR/h, and samples in the points situated northwards from the well, in which the relatively increased radiation background is observed–20-25 mcR/h.

The data of the radiometric survey indicate the relatively safe radioecological situation on the sites of the object Mangyshlak, but the final conclusion on how it influences on population's health and the bio-state can be made after the implementation of radionuclide analysis of soil samples by spectrometric and radiochemical methods. As for the abnormal radioactivity at the mouth of the charge hole T6 (the exposure rate is 2200 mcR/h), there is a potential threat of damaging to the cement stopper in the charge well and the cement ring in the casing tube and further appearance of radionuclides on the original ground.

3. The object BATOLIT-2. The use of underground nuclear explosions for peaceful purposes has been widely spread for seismic probing of the earth's crust to search for any structures perspective for exploring minerals. The features of a seismic signal to be formed by an underground nuclear explosion have allowed one (as compared with the usual method of geoseismic probing with the use of chemical explosions) to significantly increase the depth of probing of the earth's crust, improve quality of geophysical data, considerably reduce terms of works and their costs.

Geological and hydrogeological conditions of the site of the well БТ-2. The site is situated in the south-eastern part of the Caspian cavity in the roof part of the Taskar saline dome.

An explosion has been made in the rock-salt stratum of the Kungur layer of the lower Perm. The exposed thickness of the salt layer is 422,5 m., but can be within the dome more than 1000 m. In the roofing of the Kungur layer there are anhydrites with interlayers of argelites.

In respect of hydrogeology the halogenous stratum is practically water-free. Above, in sediments of the Mesozoic, interlayers of sands and sandstones are water-saturated, and interlayers of clays are natural aquifuge. The mineralization of underground waters increases top-down from 2 to 10 g/l.

Retrospective data. The underground nuclear explosion at the object Batolit -2 were implemented in 1987 on the profile Krasnodar - Emba – Kolpashevo (Tom district, Russia). The place of the implementation is Baiganin region, Aktyube district, 40 km away from Zharkamys vil-

lage south-eastwards (5 km away from Sorkol lake southwards). The power of the explosion is up to 8,5 kg, the depth of the explosive's situation is 1002 m.

The mechanical effect of the explosion: the cavity radius– 36 m, the radius of the plastic deformation zone – 250 m, the height of the caving column– 90 m. Due to the explosion, neither destructions of nor damages to administrative, household, production or living buildings and construction have been found.

The radioecological investigations of the object Batolit-2 were carried out for the first time by an expedition team of the Institute of Nuclear Physics at the RK National Nuclear Center in 1998. The radiometric investigation the neighbouring area was carried out on eight lines coming from the mouth of the well. Th exposure rate in all the directions, except for the northern one, does not exceed the natural background and is 10-12 mcR/hour. On the northern line one may observe an insignificant excess over the background and the exposure rate is 13-15 mcR/hour. For lab investigations at the object Batolit -2 there have been taken soil samples in three points (two points are superficial in the depth of 5 cm and four are layering), the radionuclide analysis of which is being carried out at present.

4. Toxic waste storage "KOSHKAR-ATA". Ecological situation in the Mangystau province (Kazakstan) started aggravating in 1960's, at start of exploring the deposits of uranium ores, oils, mineral raw and creation of chemical industry in Mangyshlak in neglect of environmental problems. A tailing pond KOSHKAR-ATA is the most hazardous place among all objects, that makes it considerable contribution to contamination of atmosphere by powder radioactive and toxic wastes of chemical and mining metallurgic industries. KOSHKAR-ATA represents serious hazard for habitants of Aktau, settlement Vodnikov, kyzyltobe, Bayandy and railway station Mangyshlak. The tailing pond KOSHKAR-ATA, representing the drain-free settling pool for industrial, toxic, chemical and radioactive wastes, and for ordinary domestic drains, is situated 5 km northward to Aktau (Mangystau province), which is situated on the shore of the Caspean sea. Described territory relates to arid zone, which is the most vulnerable due to its nature ecological system.

Industrial, toxic and radioactive wastes, solid sediments of unpurified ordinary domestic drains from a part of the Aktau dwelling region have been placed in tailing pond since 1965 and have been stored there up to now. Actual mass of radioactive wastes, placed in tailing pond is 356 mln ton with total activity 11243 Ki. Volume of the wastes from mining-and smelting and sulphate productions is as follows: liquid wastes – 304 mln m^3 , solid wastes – 104 mln m^3 (including low-radioactive, toxic and domestic ones). Total square of wastes allocation – 11 km^2, including mirror of water phase – 55 km^2, solid deposits of tailing wastes – 11 km^2. By that, filling marks are as follows: level of liquid phase is – 31,2m, (naked surface of the solid wastes – beginning from -31,2m and to –27,8 m (data on beginning of 1998).

Negative influence of wastes on environment is redoubled by both region soil-climate peculiarities, which are characteristic of arid zone (strong winds, specific physical and chemical features

of the soil ground, dramatic temperature drop during a year), and degradation of top-soil at near-by areas, that is due to changing their natural physical and chemical properties, which results in soil wind erosion increasing and dust transferring on big distances.

Data of radioecological investigation of tailing pond KOSHKAR- ATA territory, which were obtained by INP NNC RK during radiometric survey (1999) and ground sampling (bottom sediments) around sedimentation lake sufficiently prove, that this object is radiation hazardous for Aktau inhabitants as well as for flora around this object (quantitative characteristic of heavy metals, toxic elements, harmful organic and non-organic chemicals are not taken into consideration in this case).

Analysis of radiometric data shows that radiation background is higher than permissible level in the territory of beach around sedimentary lake from south and west side, in places, where candle ends and radioactive wastes are stored, in the regions, where there are drains from sulphiric aside plants and mining and smelting complex. For instance, in ground samples, which were taken at 0,04-1m depth exposure dose rate exceeds permissible level (200-500 mkR/hour), that shows that there is enhanced level of radiation and sufficient ground contamination up to 40 cm depth. At the same time, measurements of the radiation background, conducted on the North and East shore of lake showed, that exposure dose rate varies in the limits of the natural radiation background (8-12 mkR/hours).

Inhabited locality Kora is situated in western shore of the settling pool. Due to enhanced radiation background, its inhabitants are suffered from permanent enhanced irradiation, poisoning by chemical and bacteriological toxicants, because an ordinary domestic and faecal drains from Aktau city is poured out to the lake.

Year by year, because of water vapors and a reducing of lake mirror the area of bottom ground sediments has been enlarging, as well as there is constantly increases the release of radioactive, chemically-toxic and contaminated by bacterium dust from dry surface of the beach strip.

CONCLUSION.

The Institute of nuclear physics NNC RK carries out intensive field and laboratory researches on analysis of radioecological conditions on radiation - dangerous objects in Western Kazakhstan. For realisation of these activities the Institute has the State licence, highly qualified scientific staff and modern hardware - methodical base.These researches were started on object GALITE ("Azgir") in 1995-96. On objects Region– 3, Mangyshlak (plateau Ustyurt) and KOSHKAR-ATA by employees INP such activities for the first time were conducted in 1999.

By results of researches (under the data up to 2000r.) it is possible to make following conclusions. According to data of radiometric survey no radioactive contamination was found at the territories of REGION-3 site. More updated data will be submitted by results of radionuclide analysis of ground sampling.

The radioecological situation in territory of object GALITE (" Azgir") has not undergone changes neither in the worst, nor in the best side. There were found some places, where the level of exposure doze rate is up to 1200 mkR/h and caesium-137 concentration in the soil riches to 4476 Bq/kg.

In the territory of Mangyshlak object are the relatively secure ecological conditions, except for the well mouth T6, where exposure rate is 2200 mkR/h.

Year by year the waste storage of technogenic activity KOSHKAR-ATA increases the release of radioactive, chemically-toxic and contaminated by bacterium dust to environment. The radio-ecological situation at KOSHKAR-ATA site is very dangerous for environment and people, so the realization of pressing rehabilitational measures is extremely necessary.

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