Remediation Activity at SUE SIA "Radon" - 9156

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ABSTRACT

As result of the changing economic situation in Russia in the end of 20th century many sites had financial problems, partially changed owners or even lost control. Very specific problems were seen at former industrial and municipal wastes dump sites where low level radioactive wastes buried in 1940s-1960s in accordance with old radiation protection standards.

To take into account the high population in the area of responsibility of SUE SIA Radon (population more than 50 million) every decontamination project is treated uniquely and requires special management, research, radiological surveys, engineering, monitoring, etc. One of the main limitations is to be in accordance with Russian regulations and safety standards.

A special division for decontamination service and emergency works was established in 1994 in Mos SIA "Radon". Currently,, the Center of Radioactive Waste Transportation and Emergency Service of Mos SIA "Radon" provides service in site decontamination, decommissioning of research and industrial facilities contaminated as result of former nuclear activity, developing of new techniques and equipment, modifying of well-known approaches (or creating new approaches) for decontamination and full scale remediation.

The experience of the Center since 1994 includes:

- More than 660 historical sites decontaminated;
- More than 26000 cubic meters of radwastes transported for treatment and storage;
- More than 1000 emergency calls;
- More than 10 industrial/research sites decommissioned

The paper will discuss the lessons learned from decommissioning activities in Moscow, Moscow Region and Central Region of the Russian Federation.

INTRODUCTION

The State Unitarian Enterprise Mos SIA "Radon" is responsible for radiation safety of the Central region of Russian Federation with population of more than 50 million people.
The are radioactive anomalies in Moscow and the Region due to:

- Lack of knowledge, law and strong sanitary and safety norms in 1940-1960's;
- Use of ashes with high content of natural radionuclides in building industry and industrial wastes;
- Lack of a special waste management service and practice until 1961;
- New anomalies and "lost" sites from uncontrolled reorganization of former Soviet governmental institutions and facilities to commercial as result of transformation of Russian economic system.

At the present time MosSIA "Radon" has very special experience in development and application in routine, well-known decontamination practices and new decontamination methods. In the area of its responsibility, Mos SIA "Radon" developes and applies typical decontamination plans which are very useful for most sites.

TYPICAL DECONTAMINATION PLAN

A typical decontamination plan includes:

- The characterization of area being decontaminated with results of engineering and radiation inspections;
- The approach for normalization of radiological conditions;
- Requirements for the works and the order of operations (subdividing of buildings to “contaminated” and “clean” zones, sanitary posts equipment , preparation of necessary communications and the equipment, a marking of routes of moving and places for temporary storage of radioactive wastes);
- The description of technologies, its order of application, materials, special equipment, and tools needed to complete the work;
- Main goals, criteria and limits of decontamination, planning of man-hours, accident plan, waste management strategy;
- The radiation control approach and maintenance of radiation safety
- Safety requirements
- Detailed plan of control measurements after end of decontamination.

One of the basic and most complicated points of the plan is the choice of optimal techniques and equipment for decontamination. The choice depend on the type of contamination, levels, scales, the nature and structure of contaminated material, final tasks of decontamination, criteria and limits of decontamination, design of the building, waste management rules, and the budget restrictions. The decontamination plan must be in accordance with the established rules and it is necessary to submit to customers, local administration and regional division of civil defense of the Ministry of Emergency, for their expertise and to receive the sanitary-epidemiologic conclusion. In the conclusion, it is stated which sanitary-epidemiologic rules and norms correspond to the developed plan.

PRE-PROJECT SURVEY

In most cases there are no records and reliable data which may use as the basis for development of the decontamination project. A full scale radiological survey of the contaminated area is the first stage in decontamination project development.

Radiological survey

The main goals of the pre-project radiological survey are to prepare a “passport” for the contaminated site which should include:

- A list of the owners/stakeholders, the address and a map, a local plan (with scale) and information about types of soils;
- Levels and allocation of contamination;
- The analysis of radiation situation for the territory with the purpose of an estimation of radiation danger on a site in view of a geological situation, anthropogenous intervention, etc;

The detailed radiation survey of a site of contaminated territory should include definition of depth and distribution of contamination by drilling, measurement of exposure rate of gamma radiation and sampling for spectrometer and specific activity measurements. The gamma- survey aimed for measurement and localization of areas with high levels of contamination. The radiation control is carried out with simultaneous use of radiometer and dosimeter devices for spectrometer and radiometric measurements of specific activity. The radiometer (SRP type) is used to detect the areas with a higher level exposure rate of gamma radiation and to find local (dot) sources of gamma radiation. Inspections are carried out by moving the gauge of the radiometer along profile lines of a rectangular network with a speed of 0.2 km/s at a distance no more than 0.1 m above a surface with continuous counting. MosSIA "Radon" has developed the requirements to provide the necessary quality of these inspections. One of the main requirements is the order and number of measurements.

Drilling

Drilling is needed to understand the distribution of the contamination in the ground and for preparation of a 3D model of the contaminated area. When looking at undersurface contamination (up to 1 m below ground level) it is enough to make bore-hole to obtain samples. For deeper contamination measurements a well must be drilled. Dose rate profiles are then determined by measuring with a gamma bore or logging equipment. The rules followed during the drilling process include:

- Preparation of the drilling site (removing of trees and bushes, leveling of posts for drilling machine);
- Drilling a network of wells which will provide an acceptable level of detail for the contaminated site, the contamination and it levels should demonstrate the presence of contamination under the surface; the angle of the slope should not too much for location of drilling machine; drilling depth clarifies itself by minimization of dose rate up to background;
- Contaminated soil sampling is carry out every 0.5 m. Work should stop when radiometer displays more than 50 mR/h and may begin again after modification of plan;
- It is desirable to use express spectrometry at site;
- Additional drilling necessary is defined on the basis of preliminary results;
- After characterization is complete the drilling equipment must be decontaminated.

The ground is transferred to a radioactive waste category when the dose rate in the bore hole (4 π-geometry) is over 30 mkR/h.

Sampling

Sampling of ground on a contaminated site for definition of specific activity is carried out at control points located in each node of a rectangular network with the step (distance between nodes) determined depending on the ground type and level of contamination. Usually the number of points within the limits of a surveyed site should be not less than five on sites with dose rates less 0,15 mkSv/h. All samples are subjected to gamma-measurement on “clear” territory located close to the sampling area but with a low background. Then the samples are taken to be analyezed via spectrometry in a mobile laboratory or in the factory laboratory

Mapping

The gamma- survey, drilling, sampling and spectrometry results are the basis for mapping. Using a map of the area it is contoured, gridded and results of the surveys are added to prepare of visible picture of the contaminated area to aid in understanding. The map includes all data received as result of survey, drilling, sampling and spectrometry. All anomalies with high contamination levels are visible on map. Also it is possible to set up border limits for decontamination and to calculate the average amount of radioactive waste that needs to be removed, to estimate doses for personnel, and to define needs for special techniques.

CASE STUDIES

Agricultural Research Field Volgino, Vladimir Region.

An agricultural research field Volgino (Figure 1 and Figure 2) is located in Vladimir region of Russia, 150 km east from Moscow. All-Union Research Institute of Agricultural radioecology (VNIISHRAE) conducted experiments with distribution of radionuclides between soil and different plants from 1972 till 1982. For this purposes special agricultural field has:

- Total activity: Sr-90 – 268.8 mCu, Cs-137 – 403.2 mCu, U-238 – 0.975 kg, Th-232 – 1.950 kg.
- Total area of contamination: 2200 m^2
- Penetration of contamination in soil: 0.3 – 0.4 m.
- Estimated volume of contaminated soils ~ 1500 m^3

As a result of a full-scale radiological survey conducted by Mos SIA “Radon” it was shown that at this field consist an experimental (artificial) contamination with different radionuclides and different depths of penetration in soil , 3 tanks with liquid radioactive wastes (LRW) and 2 burial sites contaminated with Cs-137 and Sr-90 with approximately10 m^3 LRW. The total gamma activity of the contaminated soil (1.0 m under surface) varied from 60 to 1250 mkR/h.

Fig 1. View of experimental fields

Fig2. Decontamination and pre-treatment of radioactive wastes

Waste Dumping Area near Solnechnoe (Solar) lake (Moscow region.)

The local Administration of Ramenskoe village found this contamination in June, 1985. The contaminated area is about 1.2 $*10^{-2}$ km^2 located 50 m to the south of lake Solar, on the territory of a former municipal waste dump site. Full-scale site characterization was provided by Mos SIA “Radon” in 1994 (sampling on a grid 2.0 x 2.0 m with bore-hole sampling and analysis and spectrometry of ground and water samples). The specific activity of Ra-226 was found to be $3*10^3$ to $5*10^5$ Bk/kg. The total volume of radioactive wastes was 2600 m^3. A gamma-survey of the site showed that contamination is local and concentrated at few places with contamination levels as low – intermediate with dose rates from 40 to 2000 mkR/h. The maximum level of dose rate was 3000 mkR/h at 0.7 m deep. Typically, contamination was distributed from 0.5 to 4.0 m deep with maximum up to 6.0 m.

The decontamination procedure for this site included:

- Detailed gamma-survey of all territory
- Development and certification of decontamination plan
- Pre-decontamination work (i.e. preparation of site to decontamination)
- Removal of local contamination using method of trenches or pits to less than 0.2 mkZv/h (p.5.3.2.of national safety standard NRB -99)
- Site remediation
- Final characterization

During the period 2002 - 2006 MosSIA " Radon " decontaminated, treated and delivered for long-term storage more than 160 m^3 of the radioactive wastes from this site. Work is currently in progress at this site.

Tayninskoe village (Moscow region)

Regular monitoring was conducted by Mos SIA "Radon" in September 2004 in the Tayninskoe village (Moscow Region) located between the outskirts of the village and the left bank of the Yauza river (Figure 3 and Figure 4).

Fig 3. Location of Tayninskoe village


Fig 4 Characterization of the area

This area is a water-meadow used by habitants as vegetable garden. The results of the radiation survey of total area 18500 m^2 found:

- Background of gamma-irradiation - 6 -10 mkR/h;
- 25 local contaminations with dose rate 29 - 220 000 mkR/h;
- All local contamination areas are small – no more 0.1 m^2.
- Depth of contamination is 0.1 – 0.8 m.
- Main contaminate - Ra-226

<u>Twelve of these contamination areas with dose rates of 120-220000 mkR/h were decontaminated immediately by Mos SIA "Radon"</u>

CONCLUSION

There is no trustworthy information about sites and facilities commissioned in the 1940-1950s in the Moscow Region including information:
- About initial design and its modern condition;
- Presence/absence and condition of communications;
- Contamination and its radionulide composition;
- About history and locations of accidental contaminations;
- Locations of unofficial, non-authorized dumps and burials of radioactive materials.

Therefore, each project is unique and it necessary to begin with a collection of archive data, interview with pensioners, a pre-project survey prior to decontamination of the site.

The lessons learned in State Unitary Enterprise Mos SIA " Radon " confirmed the general view that decontamination and decommissioning should be different for each different project, there is no universal techniques and methods. At the same time, it is necessary to pay attention to the presence of equal problems and solutions.

There are not correct records for at least 50 % of old (50 and more years) contaminated subject areas. Each building, room, glove box, hot cell is an "unknown subject" and it need to be fully monitored for contamination and building construction. Too much time is needed for development of decontamination projects when taking into account the need for searching and analyzing information available.

For contaminated territories, the waste should be separated into clean and contaminated as precisely as possible. Fragmentation of boxes, minimization of construction materials and other things on-site will allow the waste volumes that must be transported a long distance to be minimized.