THE COMMAND AND POST SIMULATION-EXERCISE METHODOLOGY DEALING WITH RADIOLOGICAL ACCIDENTS

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ABSTRACT

The EMERCOM of Russia regularly organizes simulation exercises, dealing with overcoming the radiological emergency consequences. The exercises include some stages, during those different methodological terms are examined: prediction and assessment of radiological situation, decision making on contrmeasures implementation, activation management bodies and civil defence forces, training the emergency authorities, experts, and resque teams, etc. One of the general part of the exercise preparation is working out the appropriate emergency scenario and strategy for the exercise. The paper considers the methodology for simulation exercises, giving focus to exercise that has been performed in Urals Region in September, 1995.

KEYWORDS

Radiation accident, simulation exercise, accident scenarios, the public-protection management, radiological situation, forecast and assessment, radiation survey, planning, forces and facilities, tornado impact.

Presentey the organization of large-scale Command and Post Simulation Exercises (CPSE), giving focus to forseeing emergency situations and eliminating their consequences, is common used world practice. A great care shares to large-scale radiation accidents resulted in transboundary transfer of radionuclides. It necessitates to organize international assistance and cooperation between national governing bodies and authorities,

on the one hand, and international organizations, experts, and rescue teams, on the another hand. The Ministry of Russian Federation for Civil Defence, Emergencies and Elimination of Concequences of Natural Disasters (EMERCOM of Russia) has carried out similar CPSEs consecrated at elimination of cousequences of radiological emergencies with various scenarios. Among them:

- accident with atomic submariue reactor at the Ship Remount Plant "Red Stone" near Vladivostok (April, 1994);
- accidents at the Kalinin NPP (November, 1994) and the Kola NPP (May, 1995) with international partisipation;
- tornado impact upon radwaste disposal "Karachay Lake" at the Nuclear Industrial Combine "Mayak" at Cheliabinsk District (September, 1995).

The Ministry of Russion Federation for the Atomic Energy (MINATOM of Russia) also carried out the international CPSE "Thunder'95" in Saiut-Petersburg (December, 1995).

At the beginning of the CPSE preparation the theme and training purposes of the exercise, the time, the site, and the range of participants are assigned. The next step is to work out the scenarios of accident, i.e. time of occurence, severity of impact, existing weather conditions, area demographics etc. Then the design, strategy, and order for CPSE performance are established.

The exercise may be performed both in real time mode involving all successitive stages of accident development, and in operative time mode with any "jumps" through astronomical time, which allow to give focus to different topics range from activation to carrying out missions of all members of the Russian System for Disaster Management (RSDM).

In real time mode the next forms of RSDM activity are training:

- prediction and assessment of radiological situation based on source terms and weather conditions;
- notification or warning of an accident both national (RSDM and govermment) management bodies and authorities, and international organizations according to International Conven-

tions;

- identifying requirements, mobilize and deploy resources to the affected area;

- activation of forces and facilities, cooperation between national and abroad experts and rescue teams;

- decision making for overcomming the emergency situation and reduceing the consequences of an accident, etc.

In operative time mode it is possible to train the kinds of actions, that usually carrying out later than astronomical time duration of the exercise. It may be planning and operations of activities for elimination of accident consequences like decontamination, application of hard engineering facilities, carefull assessment of radiological situation, inquiring of international assistance, etc.

In this connection CPSE usually includes some stages, during those different methodological approaches are examined and trained. Every stage appropriates certain period of time lasted after accident occurence, own sets of coutrmeasures implemented, and strategy for the management.

The developped approach to the international CPSE organization supposes next main measures:

- properly simulation exercise;

- business game with administrators, authorities, experts, massmedia and the public partisipation;

- practical realization of actions for public protection and overcoming of accident consequences;

- conferences, seminars, exhibitions, etc.

These measures enable: to traine the emergency managers, experts and rescue personnal for an emergency situation, to make exchange of fore experience and ideas, to discuss the arriving problems, etc.

The essential parts of the exercise preparation include carrying out simulation scenarios of major accident and emergency situation development, simulation radiological situation inside influented area, which allow to examine emergency planning and to traine the participants for decision making and

operation in emergency.

EMERCOM has carried out the large-scale CPSE at the Ural Region in September, 1995. The theme of the exercise was "Actions of the Regional Center Division, District Emergency Committees, and Headquarter for Civil Defence and Emergencies for the Public Protection and Life-support Management in a Case of Radiation Accident". The largest Nuclear Industrial Combine "Mayak" was chosen as a supposed site of the accident.

Taking into account the site and technology peculiarities of the combine several scenarios of probable major accident may be foreseen as a result of some initial events:

- explosion of a tank for high or middle level radioactive waste disposal;
- destroyment of a radwaste disposal as a result of external impact (for instance, tornado action);
- breakage of a dam of the Techa's cascade of weirs used as a low-level radwaste disposals.

Long time the technology used at the combine practised using of weirs and the Karachay Lake as a disposal of radioactive waste. So the sum activity stored in the Karachay Lake is assessed up to $1{,}2 \cdot 10^8$ Ci, mostly Cs-137 and Sr-90 with proportion 1,5:1. The distribution of radionuclides in the lake is characterized by the next data: 7% - in the water, 52% - in the movable bottom sediments, 41% - at the soil bed of the lake. The data for water contamination in the years 1970 and 1993 are listed in Table 1.

The Karachay Lake was selected as a hazardons object, which had been actioned by tornado impuct. The South Ural region refers to tornado hazardous zone of VB class. During the last 90 years thirteen tornados above F1 and F2 classes of Fujita-Persson scale were registreted there.

Simulation tornado parameters were choosed the same to the parameters of tornado that has been registered in the year 1971 at a distance of 40 km from the combine and appropiated to F2 class: funnel diameter 100 m, maximal circular speed 60 m/sec, and movement speed 20 m/sec. Similar tornado resulted in midd-

Table 1. Radionuclide composition for Karachay Lake water

Radionuclides	Radionuclides concentration, Ci/L	
	1970	1993
The sum of Alpha emitters	3,5·10-6	1,7·10-5
The sum of Beta emitters	1,1·10-2	6,1·10-3
Sr-90	7,0·10-4	1,9·10-3
Cs-137	6,4·10-3	2,8·10-3
Cs-134	3,7·10-4	1,2·10-3
Ce-144	1,7·10-4	< 3·10-5
Ru-106	2,9·10-3	3,4·10-5
T-3	3,2·10-5	8,4·10-5

le-degree destruction within a track of about 0,5x40 km2 area.

According to the scenario the tornado coused some destruction at the combine site, crossed the mirror surface of the Karachay Lake and absorbed grate quantume of radioactive water.

Then one part of absorbed water was thrown above cloud-stratum height (~1000 m), but another one was hanged within the vertical column (stem) near the tornado funnel. Besides the water with dissolved radioactive substances also the bottom sediments, disturbed with water movement, had been grasped by tornado. The data for activity of absorbed water and bottom sediments are given in Table 2. The sun volume of absorbed water reached up to 3400 m3.

At a result of tornado action the radioactive substances, thrown at a cloud stratum hight, would be dispersed in the atmosphere and coused the radioactive contamination of the environment upon the large area towards the wind direction, i.e. North-East.

Besides that, the tornado continued its movement towards Ozersk town and had weakened at its South-West border. The radioactive water, hanged within the stem, had fallen down in the

Table 2. Distribution of activity for radioactive substances, absorbed by tornado, Ci

Activity	Sr-90	Cs-137	Total
Activity of substances, thrown at a cloud stratum hight	72 000	142 000	214 000
Activity of substances hanged within the vertical stem	36 000	72 000	108 000
The sum activity	108 000	214 000	322 000

form of catastrophe downpour upon local territory and coused appearance of high-level contamination spot.

The character life-time of the tornado from crossing the Karachay Lake (8.50 a.m. local time) to weakening (9.10 a.m.) consisted above 20 minutes.

Therefore the background for the CPSE was characterized by middle-degree destruction in the villages inside the track of the tornado, radioactive contamination of tremendous territories, involved two districts of the South Urals (Cheliabinsk and Kurgan), and high-level contaminated spot of 2,5 km2 area at the South-West border of Ozersk town. The scheme of the contaminated area is shown in Figure 1.

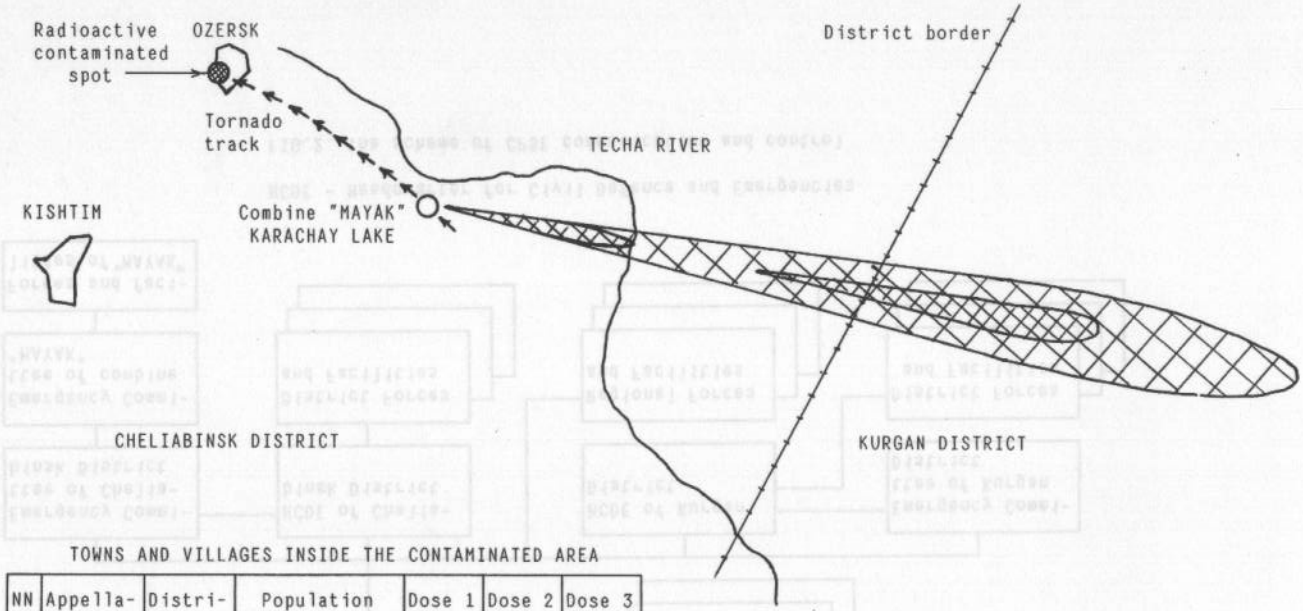
Taking into account great dimension of the influented area, the range of the participants, included authorities and emergency managers, forses and facilities of the EMERCOM'S Urals Regional Center, Cheliabinsk and Kurgan Districts, and combine "Mayak". The scheme of the communication and control for the CPSE is shown in Figure 2.

The dose exposure of the public and site personnel had to be formed by:

- external exposure from crossed radioactive cloud;
- internal exposure due to inhalation;
- external irradiation from ground radioactive fallout.

Predicted doses exposure are plased at the table, shown in Figure 1.

At the first stage of the CPSE, dealing with the planning for forces and facilities implementation on elimination of di-



TOWNS AND VILLAGES INSIDE THE CONTAMINATED AREA

NN	Appella-tion	Distri-ct	Population	Dose 1 mGy	Dose 2 mGy	Dose 3 mGy
1	Sosnovka	Chelia-binsk	2500	0.02	40	50
2	Burino	""	790	0.01	30	35
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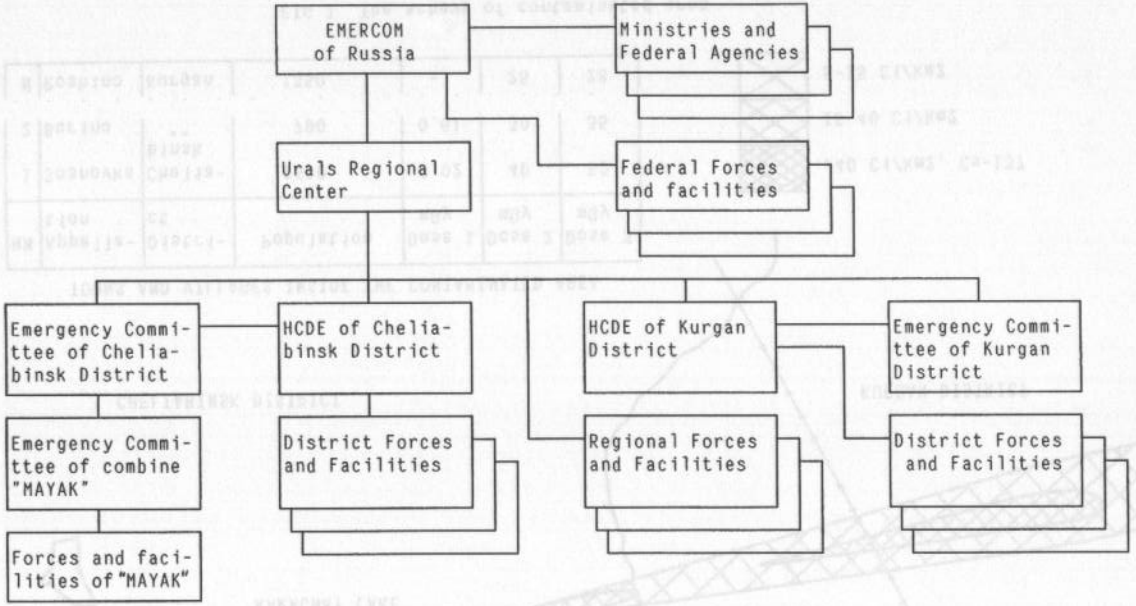
N	Roshino	Kurgan	1350	-	25	28

FIG.1. The scheme of contaminated area



HCDE - Headquarter for Civil Defence and Emergencies

FIG.2. The scheme of CPSE communication and control

saster consequences, the next terms were performed:

1. Activity of regional and local governing bodies, autnorities, and experts for prediction and assessment of radiological situation and decision making on elimination of tornado impact consequences.

2. Management for activation of territorial forces and facilities and planning of their activity.

At the second stage of the CPSE, giving focus to control the forces and facilities, applying to elimination of tornado impact cousequences, the next terms were performed:

1. Actions of the Urals regional governing bodies and authorities for more exact decision making on rescue and egineering operations performing.

2. Management for of rescue and engineering operations performing and elimination of tornado impact consequences.

During the CPSE performing some practical measures had been implemented corresponding to complication of emergency situation:

- performing of air-radiation survey by means of forces and facilities of Urals Region;
- performing of ground radiation survey by means of forces and facilities of RSDM divisions of Cheliabinsk and Kurgan Districts;
- surrounding of contaminated zone by means of militia forces;
- evacuation of population from contaminated area of Ozersk town;
- organization of movable life-support units (food, medicals and clothes);
- working of special units for decontamination of clothes, facilities, ingineering, etc;
- performing of roads decontamination by means of forces and facilities of combine "Mayak";
- performing of building and constructions decontamination by means of Ozersk fire-fighting service.

The international part of CPSE usually includs such questions like notification of emergency mangement bodies of foreign countries and international organization about accident, low aspects of foreign assistance management.

At the ending of the exercise the total is making up by the CPSE-chief and founded imperfections are discussed by the participants.

The significance of such exercises is obvions in order to examine the realism of emergency planning and to train the emergency managers in emergencies.