Cooperation
of the U.S. DOE and IBRAE RAN in Emergency Preparedness/Response Activities

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Contents

Introduction

On January 14, 1994, at the Moscow summit, the Agreement between the Government of the United States and the Government of the Russian Federation on "Cooperation in Research on Radiation Effects for the Purpose of Minimizing the Consequences of Radioactive Contamination on Health and Environment" was signed. The purpose of the Agreement is to facilitate joint cooperative research and exchange of information between the United States and the Russian Federation in the field of radiation impact on health and environment.

Within the frameworks of the Direction 3 "Information Technology and Decision Making Support for Radiation Accidents and Health Effects from Radiation Exposure", the Project Arrangement between the Department of Energy of the United States of America and the Nuclear Safety Institute of the Russian Academy of Sciences (IBRAE RAN) for Coordination of Emergency Preparedness/Response Activities was signed in 2000. By now, within the framework of the Project Arrangement, a wide cooperation has been established between IBRAE and the Office of International Emergency Management and Cooperation of U.S. DOE. The cooperation covers the following areas:

- Conduct of counter-emergency exercises and drills at radiation hazardous facilities aimed at practicing actions of management and personnel, improvement of notification procedures and interaction between all participants of emergency response;
- Development and modification of techniques intended for emergency response, including communication lines, mobile complexes, etc.;
- Training and advance training of heads and personnel of emergency rescue teams (ERT) using modern training methodologies, the international experience, computer-based simulators and other modern capabilities. Establishmnet of training centers;
- Development of specialized software;
- Improvement of interaction procedures between participants of emergency response, including expert support to decision-making on population and environment protection;
- Information of population and mass media on radiation risks, protection and safety;
- Development of risk assessment methodology for chemically and radiation hazardous facilities based on international standard ISO 14001.

The Bratislava initiatives of the Presidents of the Russian Federation and the United States of America to make the two countries and their citizens safer and more prosperous provide cooperation expansion, in particular, in the field of emergency response capabilities to deal with a nuclear or radiological incident, including development of additional technical methods to detect nuclear and radioactive materials that are, or may be, involved in the incident.

To execute the Bratislava initiatives, the frameworks of cooperation between the U.S. Department of Energy and IBRAE have also been expanded, and, in 2006, the project on establishment of and equipping the Training Center of the Emergency Technical Center of Rosatom in St. Petersburg was launched. In the course of the project implementation, new training aids, techniques of search and detection of radioactive sources of various types were developed; exercises and drills were conducted, including a joint exercise of the Russian and American rescuers.

The results of the joint DOE and IBRAE RAN activity are used to perfect the work of services involved in emergency response at nuclear and radiation hazardous facilities (NRHF),

of emergency technical centers and rescue teams of Rosatom, of crisis centers and scientific and technical support centers.

The State Corporation “Rosatom” considers the work on perfection of emergency preparedness and response as a very important task. This activity is regarded as an essential element to increase the safety of the objects of atomic energy use. The Department of Nuclear and Radiation Safety (DNRS) of the State Corporation “Rosatom” provides the management of all works carried out by IBRAE RAN that are aimed at increasing the preparedness of emergency rescue service of the State Corporation “Rosatom” to respond to radiation emergency events.

The achieved results and accumulated experience of the joint DOE-Rosatom-IBRAE cooperation form the basis for efficient and fruitful continuation of works both in the framework of the Agreement on Cooperation on Radiation Effect Research and under the Working Subgroup on Nuclear and Radiological Emergency Response of the U.S. and the RF Bilateral Presidential Commission Working Group on Nuclear Energy and Nuclear Security (WG Kirienko-Poneman).

Source control projects

One of the most important research directions was enhancement of risk assessment and its application for hazardous industrial facilities, including nuclear- and radiation-hazardous facilities.

Works on risk assessment were implemented in 2000 through 2010. Four projects involving facilities with various activities and hazard sources were completed over these years.

The first project on risk assessment and risk management was carried out at a sewage facility of Apatity in the Murmansk Region in 2000-2002. The main hazard source at the facility was chlorine, which was used for water preparation for households and industry. The choice of the facility was based on two factors – wide use of chlorine in the nuclear industry and at other facilities, and international recognition and wide use of international chemical standards.

The project was implemented in coordination with the specialists of Russian Center "Khlorbezopasnost" and specialists of EMERCOM of Russia. Risk assessment methodology draft was developed at the first stage of the work. The document was aimed at the use of ISO 14001 standard at various industrial facilities with various hazard sources.

The methodology was supplemented and corrected in further works.

The second project was carried out in 2003-2004 at the largest research and development center of Russia – "SSC NIIAR" (Dimitrovgrad, Ulyanovsk Region). The specific facility in question was the Fuel Research Department (FRD).

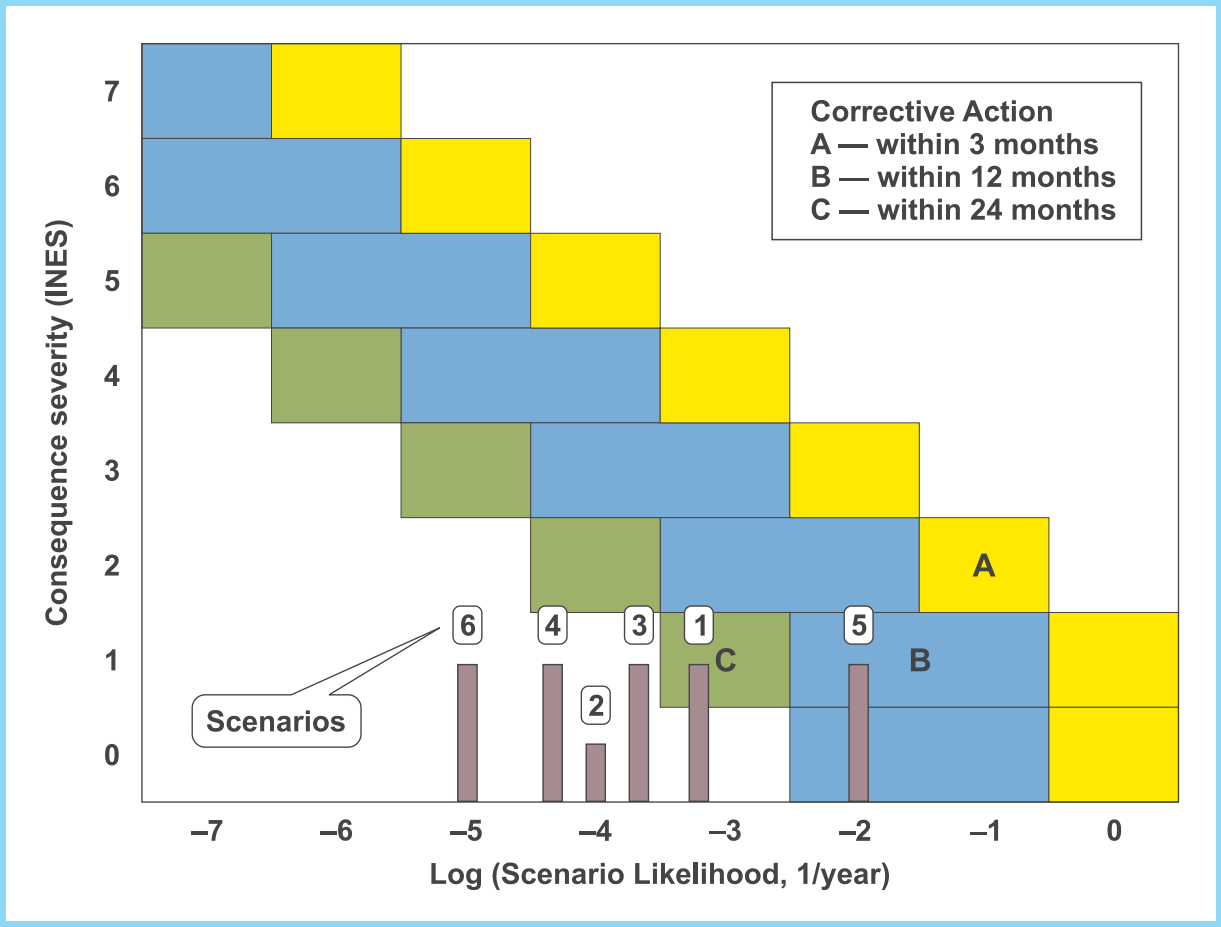
Priority matrix of single actions (risk matrix) was developed for nuclear and radiation-hazardous facilities in the course of the works on ranking recommendations and planning measures on safety maintenance (enhancement). General approaches to development of the matrix are applicable for all types of hazardous activities. Nevertheless, the events (incidents)

Chlorinating utility of SUE "Apatityvodokanal" is a typical water treatment facility. Over 7000 such facilities are operated in Russia (as of 2001). One-time storage of chlorine at the facility does not exceed 20 t

and their consequences for nuclear technologies have a specific character that needs to be taken into account. Risk matrix development included:

- identification of appropriate range of event (incident) probabilities;
- consideration of various examples of event categorization and selection of a scale for event ranking;
- identification of priority corrective actions on enhancing safety depending on the results of the risk assessment.

The risk matrix for FRD of SSC NIIAR shows that the facility is characterized by an acceptable level of safety. There are no scenarios which require implementation of urgent (within 3 months) corrective actions. The most critical scenario from the point of view of safety is scenario 5. Corrective actions for this scenario may be assessed as planned measures to be implemented within a year. Scenarios (6, 4, 3, 2) are located in minor risk area, where the implementation of additional corrective actions does not guarantee a risk reduction



Water leak from the pool – initial events

1 — Valves of the storage pool systems not closed as a result of a personnel error
2 — Rupture of a pipeline due to a personnel error
3 — Corrosion of pipeline materials
4 — Welding joints failure
5 — Loss of airtightness of cooling and purification system packing
6 — Rupture of a pipeline due to an external impact

FRD of SSC NIIAR carries out full range of studies of FA and fuel elements of Russian commercial and research reactors. Biological protection and technological equipment of the seven hot cells allows study of samples with activity up to 3.7 PBq

The next source control project (2005-2008) was carried out at two major industrial facilities in the Northwest Russia: Shiprepairing Center "Zvezdochka" (Severodvinsk, Archangelsk Region) and FSUE "Atomflot" (Murmansk). The study was aimed at assessing risks of hazardous works on NS decommissioning. The processes of unloading, transportation and temporary storage of SNF of the decommissioned NS were investigated. Work on risk assessment, development and ranking recommendations was carried out in accordance with the risk assessment methodology developed earlier in 2000-2004.

In 2008-2010, the work was continued and focused on the problem of risk assessment for transportation of radioactive substances by motor transport in Russia. SSC NIIAR was selected as the model facility for application of risk assessment in transportation of radiation-hazardous materials. The facility is one of the three largest manufacturers of radioactive sources and materials in Russia, supplying sources to both domestic and international customers. Data on other Russian organizations manufacturing and transporting radioactive materials were used to develop accident scenarios and to make qualitative and quantitative assessments.

Shiprepairing Center "Zvezdochka" – the leading Russian shipyard. Nuclear- and radiation-hazardous works carried out at the facility are mainly connected with the program of decommissioning NS withdrawn from the Navy

The risk assessment methodology document was developed as a result of the implementation of all Source Control projects. The document includes the detailed description of the main stages of risk assessment and ranking of corrective actions in accordance with their priority and term of implementation.

All documents developed in the framework of the projects, including the risk assessment methodology document, were handed over to the specialists of the facilities for practical use. Interested specialists of the facilities were trained on the methods of risk assessment.

Risk assessment was conducted for each of the facilities in coordination with the specialists of the facility, followed by recommendations on risk management. Results of risk assessment demonstrated that all facilities were characterized by an acceptable level of safety, requiring implementation of planned measures in the framework of annual safety assurance programs. The developed recommendations could be used by the management of the facility to develop a risk management program, which is to be implemented in the framework of a management system based, for example, on the international ISO 14001 standard.

A practical experience of the risk assessment gained during the works played a positive role on the safety culture of the facilities. Implementation of recommendations developed during the project implementation will promote the improvement of the safety of facility operation and environmental safety of the surrounding territories.

The results of works can be used to prepare the scenarios of exercises and drills. For example, the scenario of "Arctic-2008" exercise at SC "Zvezdochka" was based on the findings of the risk assessment project.

"Atomflot" is the permanent base of Russian nuclear icebreakers and nuclear maintenance vessels

Establishment and development of the Training Center "Emergency Response" at the Moscow Institute for Advanced Training (MIPK)

The goal of the project is training and advanced training of the management and specialists of the State Corporation "Rosatom", as well as other ministries and agencies, in emergency response on the basis of the existing international standards. The project is aimed at raising the effectiveness and quality of the training process based upon the modern scientific, methodological and technical achievements.

One of the leading advanced training centers of Rosatom, MIPK, carried out training and certification of the management and emergency rescue teams. It was chosen as a base for establishment of a training center (TC).

Opening of Training Center "Emergency Response" at MIPK

Discussion of activities on establishment and development of MIPK Training Center

The project on establishment of the "Emergency Response" Training Center was started at MIPK in 2003.

One of the main directions of the "Emergency Response" TC activities is advanced training of the management and specialists of the nuclear facilities in responding to natural and man-caused emergency situations.

The following categories of specialists are trained in the field of emergency response at MIPK:

- Management of facilities and organizations of Rosatom;
- Management of emergency and technical centers and rescuer units;
- Management of emergency rescue teams of Rosatom;
- Management and specialists of facility emergency situation commissions;
- Management and specialists of nuclear and radiation safety services of the facilities;
- Experts of Rosatom Emergency Situation Comissions.

The main directions of emergency response training of management and specialists include:

- Nuclear and radiation safety in the nuclear industry, prevention and mitigation of emergency situations.

- Emergency and rescue service of Rosatom. Legal background for functioning of emergency rescue teams. Goals, tasks, structure and its place in the state system for prevention and mitigation of emergency situations.
- Regulations and rules of radiation safety.
- Prompt scientific and technical support of the actions of emergency and rescue services on mitigation of emergency consequencess.
- Safety assurance in transportation of hazardous materials.
- Medical emergency response in case of radiation accidents at nuclear power plants and nuclear facilities.
- Characteristics of radiation hazard factors at the Rosatom facilities. Typical plans of measures to protect personnel at Rosatom facilities.
- Procedures of population notification and decision-making on evacuation.
- Organization and conduct of works in contaminated territories.
- Radiation safety assurance. Individual protection equipment.
- Informing population and media in an emergency situation.
- Social and psychological aspects of organization and management of emergency rescue teams.

Conduct of training courses

The main task of the established center is the practical implementation of modern training experience using latest developments in information technology.

The training programs and training computer systems are based on the following:

- Study and analysis of the requirements of the management in the field of emergency response;
- Experience of operation of the crisis centers at Rosatom facilities, “Rosenergoatom” Concern, IBRAE RAN, as well as foreign and international organizations;
- Lessons learned in exercises in the field of emergency response;
- Practical experience of protective and remediation activities (Chernobyl, South Ural, etc.) and their perception by the population;
- Effective use of modern information technology and communications.

These materials were used to develop the following tools for the TC and the Rosatom facilities:

- computer systems to train planning and carrying out measures on localization and mitigation of accident consequences;

- computer systems, simulators and databases for training and verification of knowledge of regulations and rules in radiation and nuclear safety, emergency response procedures;
- training and methodological materials (lectures, training aids, other materials);
- specialized programs for training and certification of the management of emergency rescue teams and appropriate quality management programs.

Special attention in training the actions on prevention and mitigation of consequences of emergency situations is paid to:

- solution of situation tasks of emergency response;
- modern capabilities of scientific, informational and technical support of counter-emergency measures by emergency technical and crisis centers;
- use of the latest information technology and communications for integration of experts of the local crisis centers of the Rosatom facilities and technical support centers into the decision-making process.

Discussion of the project by the Russian and U.S. specialists

Management members and specialists were trained in approaches to management of emergency response and methods of environmental management including application of international environmental standards of the ISO 14000 series.

The training process involved the leading specialists of the nuclear branch, “Concern Rosenergoatom”, Russian Academy of Sciences, other ministries and agencies.

The main stages of the project included:

1. Development of organizational structure of the Training Center “Emergency response”.
2. Carrying out design works on planning the center on the basis of specially prepared rooms of the Moscow Institute of Advanced Training.

   The following rooms were designed and refurbished:
   - training class for 21 students, a situation hall and a technical room;
   - training class for 20 students, and a teachers' room for the instructors of the center;
   - conference hall for 80 students, and 2 technical rooms;
   - auxiliary rooms.
3. Laying communications required for the functioning of the center (power supply, communications, furniture, air conditioning, etc).
4. Equipping the center with the modern software and hardware.

5. Installation of specialized software for internal and external networks to ensure effective use of training programs.
6. Development of training materials for lecture courses for the instructors of the branch rescuer training system and the rescuers (lecture materials, training aids, presentations, etc).
7. Development of the center website. Training materials developed at MIPK, Rosatom and IBRAE RAN, as well as other organizations participating in the training process, were uploaded to the site. Certification programs and appropriate presentations are also available on the site.

Situation drills were held for some courses for assessment of the consequences of a radiation accident using the hardware and software resources of the MIPK Training Center for the specialists in emergency response.

In total, 17 training and advanced training courses were held in 2004-2010. They were attended by more than 450 managers and leading specialists of the emergency response system and Rosatom facilities. 12 situational drills were held in the framework of the courses, including those that were conducted using simulators.

The infrastructure of the center and the experience gained in training allowed organizations to train and certify the managers of emergency and rescue teams of the facilities at TC MIPK at a regular basis.

Such experience can be recommended to be used for other training centers of Rosatom specializing in the field of emergency response.

Software for assessment of radiation situation

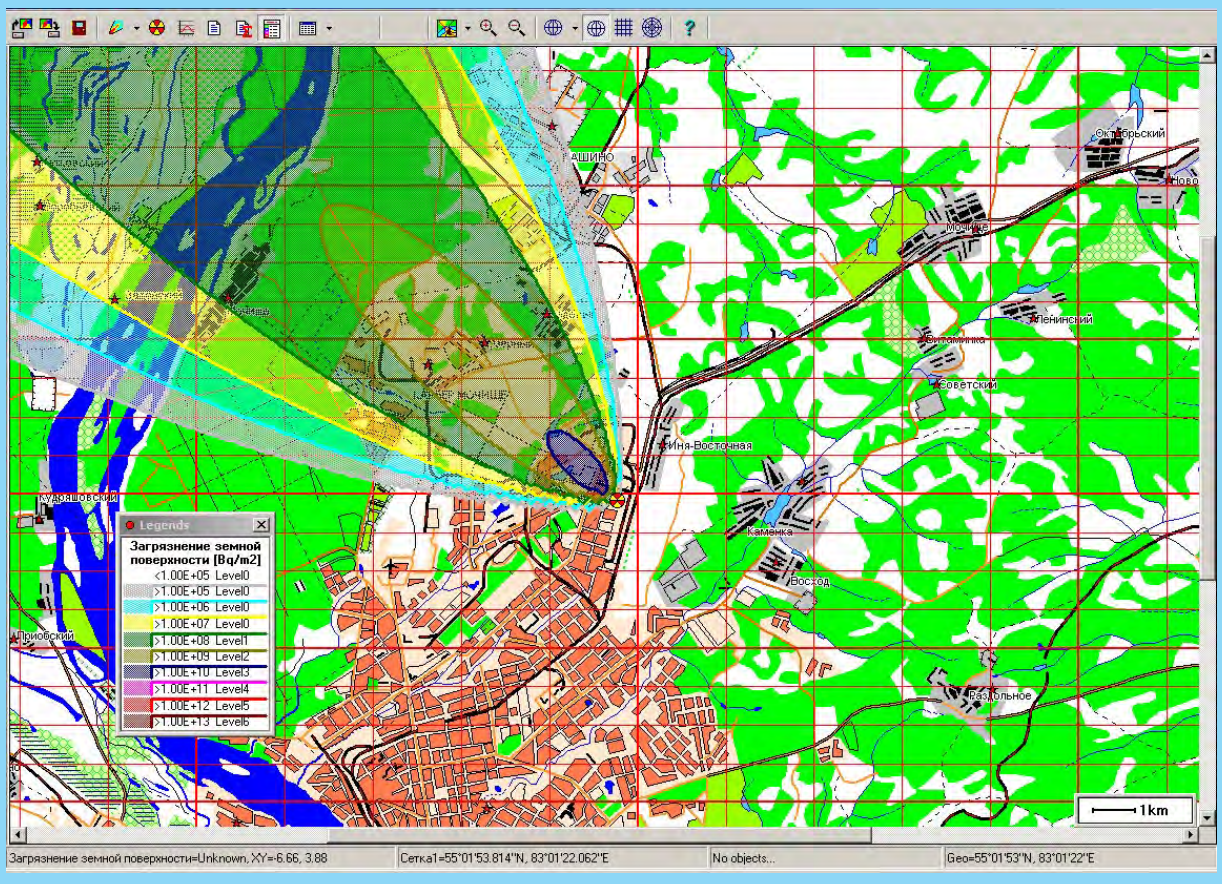
Started in 2005, the works on development and installation of software for simulation of radioactive substances transport in atmosphere in case of incidents and accidents (TRACE and NOSTRADAMUS) were conducted for the facilities of Rosatom and Ministry of Industry and Trade (the former Rosprom) performing works on NS decommissioning, SNF and RW management. The software is supplied to the facility units participating in emergency response – emergency rescue teams, nuclear and radiation safety services, local crisis centers, etc. The systems allow the personnel of radiation safety services of the facilities and local crisis centers of the facilities to carry out prompt forecasts of the radiation consequences in case of emergency releases and provide support to decision-making on population protection measures at the early stage of an accident.

Specialized express geographic information forecasting system TRACE allows simulating radioactive releases into the atmosphere from radiation-hazardous facilities, analyzing the possible consequences of releases, and preparing topical maps for support of decision-making in emergency situations.

The main features of the TRACE system:

- The computer code is based on the Gaussian model of atmospheric transfer, which has a recommended applicability range of 10-20 km;
- The release is considered to be volley (immediate);

Simulation of radiation situation using TRACE software



- The main advantage of the model is its simplicity and quickness, the calculation takes several seconds, therefore TRACE is used for initial (conservative) express-assessment of the radiation situation and radiation consequences.

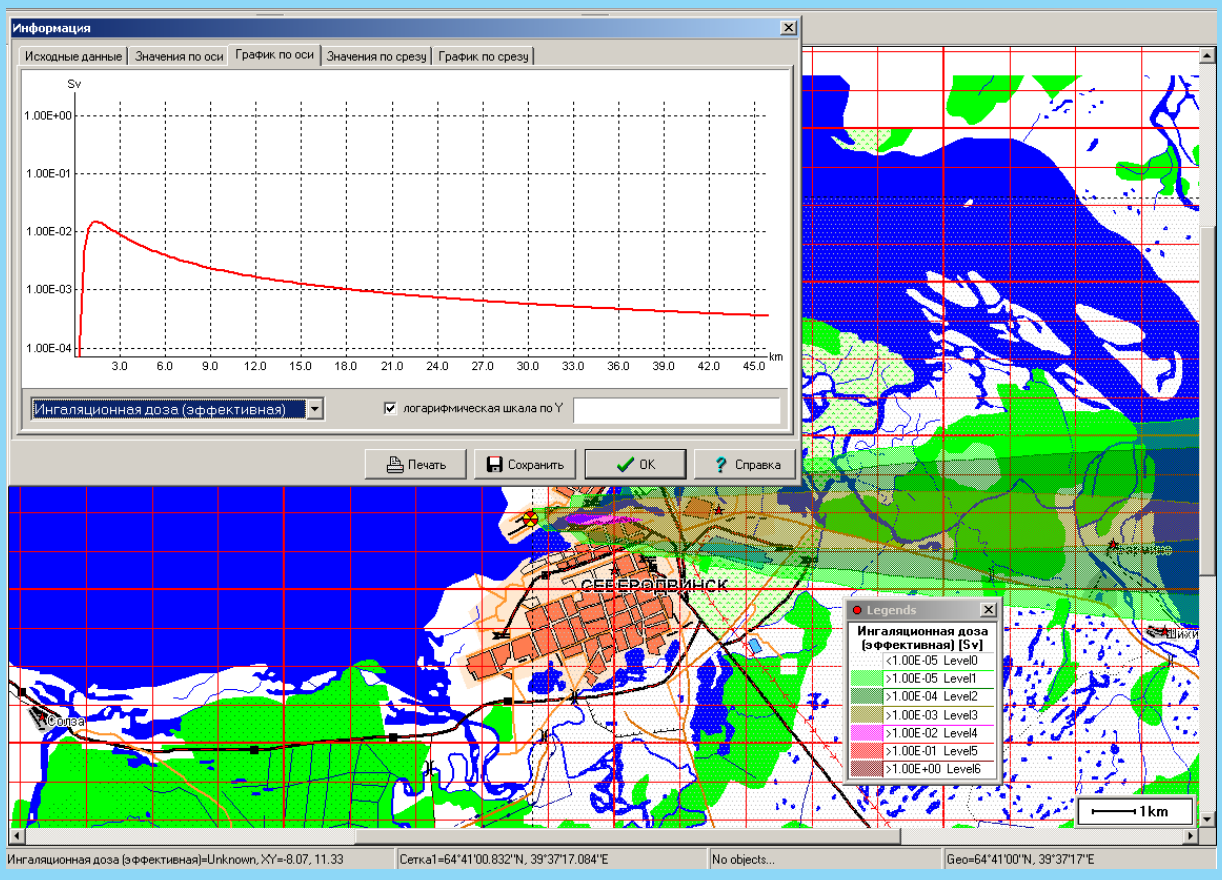
The NOSTRADAMUS system is intended for a forecast of radiation situation in case of dynamic releases of radioactivity in aerosol and gaseous forms into the atmosphere and its subsequent fallout in changing weather conditions. Lagrangian 3D stochastic model is implemented in the system. The model has the following advantages over the Gaussian techniques:

- ability to calculate contaminant transfer at the distances of hundreds kilometers;
- account for heterogeneity of the wind field, its change with time and account for local precipitation;
- possibility to make calculations for sources of any configuration and form (point, areal, volumetric) and parameters changing with time;
- account for landscape impact on spreading of contaminant.

Activities on adaptation of TRACE and NOSTRADAMUS for specific facilities included:

- preparation of electronic geographic maps of the regions of facility location;
- preparation of information about the type of landscape (landscape map) for the regions of facility location;
- preparation of databases on the settlements in the regions of facility locations;

Example of assessing consequenses for conventional radiation accident using TRACE software

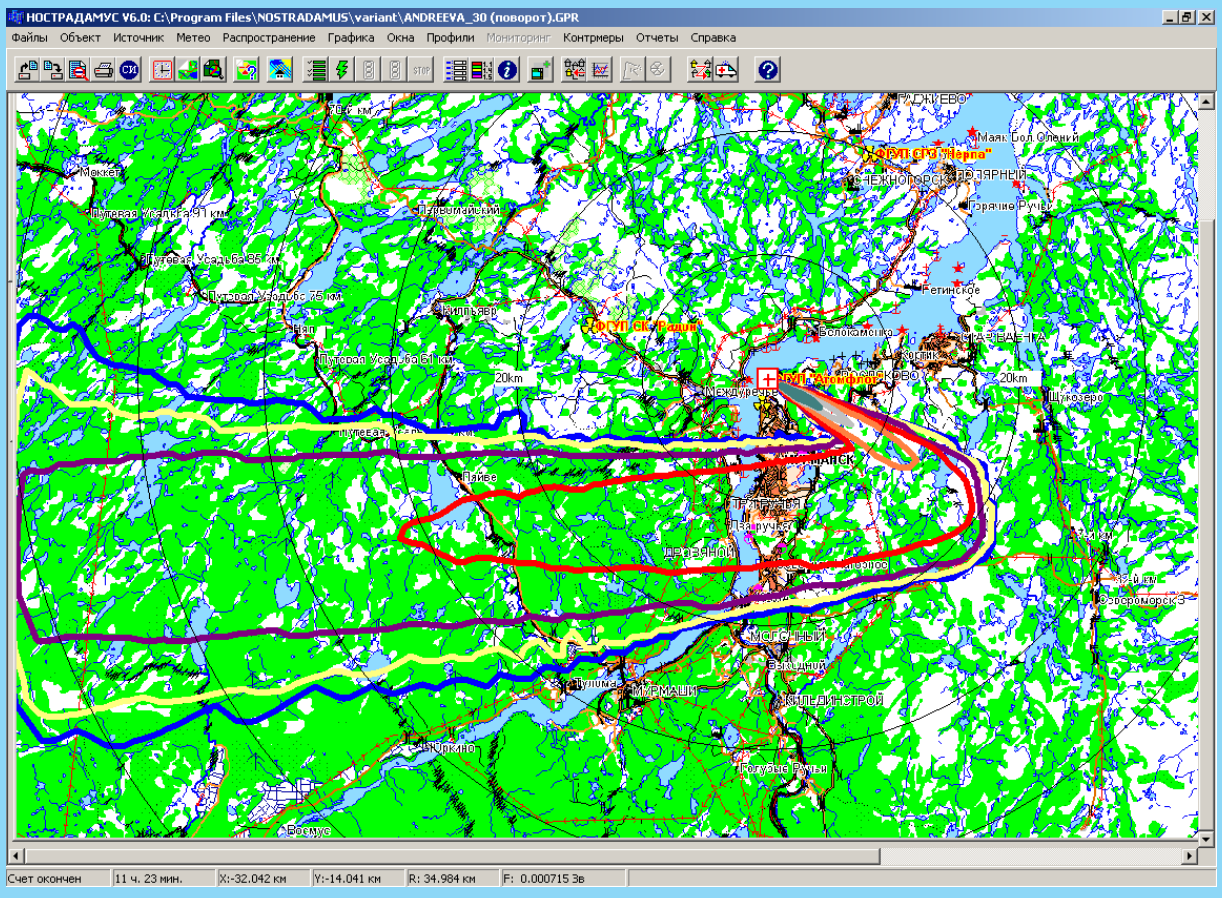


- analysis of technological processes, hazard sources; selection of basic emergency scenarios and consequence assessment;
- preparation of initial data for test calculations;
- test calculations;
- training the personnel of local crisis centers;
- preparation and supply of technical documentation and user manuals.

Up to now, the TRACE and NOSTRADAMUS software were supplied to the following facilities:

- Siberian Chemical Combine, Seversk, Tomsk Region;
- Mining and Chemical Combine, Zheleznogorsk, Krasnoyarsk Krai;
- State Scientific Center of the Russian Federation “Research and Development Institute of Nuclear Reactors”, Dimitrovgrad, Ulyanovsk Region;
- Production association “Mayak”, Ozersk, Chelyabinsk Region;
- Uralsk Electric Chemical Combine, Novouralsk, Sverdlovsk Region;
- Electrochemical Plant, Zelenogorsk, Krasnoyarsk Krai;
- Angarsk Electrolysis Chemical Combine, Angarsk, Irkutsk Region;
- Shiprepairing Center “Zvezdochka”, Severodvinsk, Archangelsk Region;
- FSUE “Atomflot”, Murmansk, Murmansk Region;
- “Nerpa” Shipyard, Snezhnogorsk, Murmansk Region;

NOSTRADAMUS software



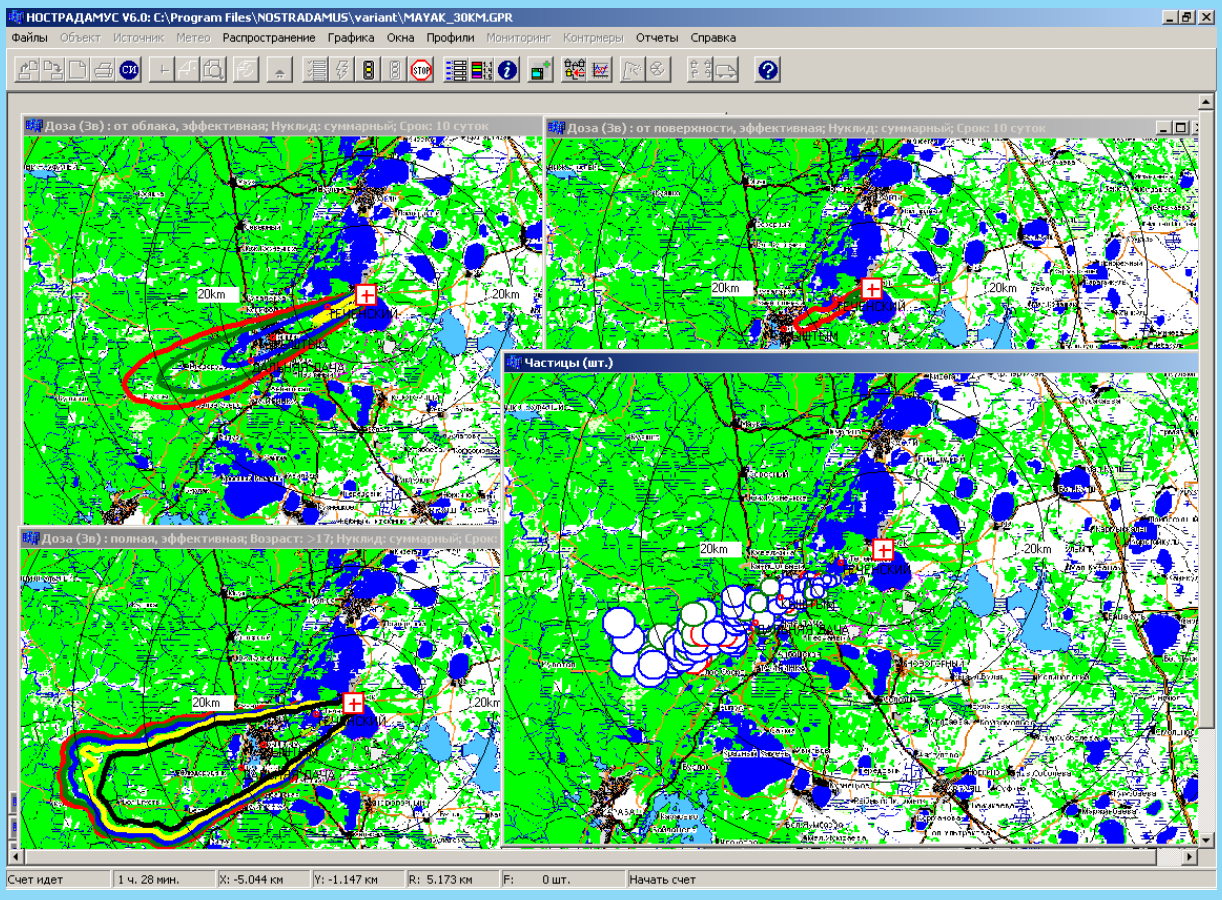
- Priargunsk Production Mining and Chemical Association, Krasnokamensk, Chita Region;
- Chepetsk Mechanical Plant, Glazov, Republic of Udmurtiya;
- Novosibirsk Plant of Chemical Concentrates, Novosibirsk.
- Research and Development Institute “Luch”, Podolsk, Moscow Region.
- Research and Development Institute of Instrumentation, Lytkarino, Moscow Region.

Establishment of computer forecasting systems, their adaptation to specific NRHF and equipment of radiation safety (RS) services of the facilities with such systems enhances the effectiveness and quality of drills and exercises.

Results obtained during the work are used to calculate radioactive consequences of accidents for the population, thus enhancing the preparedness of the personnel of facilities to mitigation of radiation accidents in the field.

Practical application of forecasting systems was demonstrated during exercises and drills that were carried out at NRHF. In particular, the systems were widely used in the series of exercises “Arctic” in 2008, 2010 and 2012.

Forecast of radioactive substanses spred-out in the atmosphere using NOSTRADAMUS software



Simulation systems

The goal of the work is to develop simulation systems for conduct of drills and exercises, and their implementation at the facilities.

The systems were developed for dynamic simulation of initial radiation measurements within the first day after the accident at a nuclear facility for the conditions of long-term release of an arbitrary radionuclide composition. The systems are based on the geoinformation technology, radiological model and statistical measurement simulation module. The selected model simulates fallout dynamics and dose rate in real-time mode for constant weather conditions during the passage of the cloud. The model was selected in accordance with the basic task – obtaining data for exercises that will offer conditions close to real challenges for experts and decision-makers.

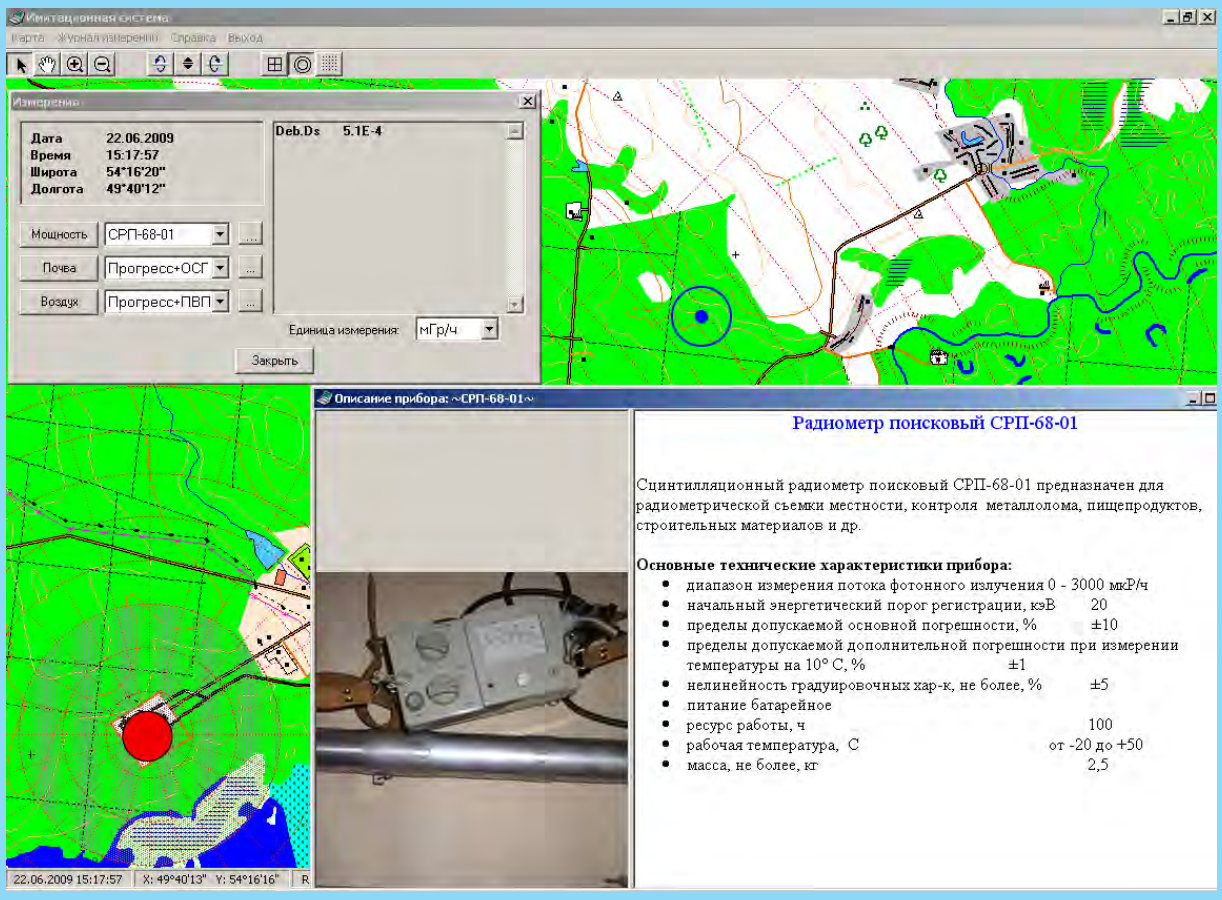
Simulated radiation situation parameters:

- external dose rate;
- surface soil contamination;
- volumetric activity of radionuclides in the air.

The following was performed in the framework of the project:

- Analysis of potential emergency situations accompanied by releases of radioactive materials into the atmosphere for each specific facility;

Imitation system for dynamic simulation of the primary measurements of radiation situation

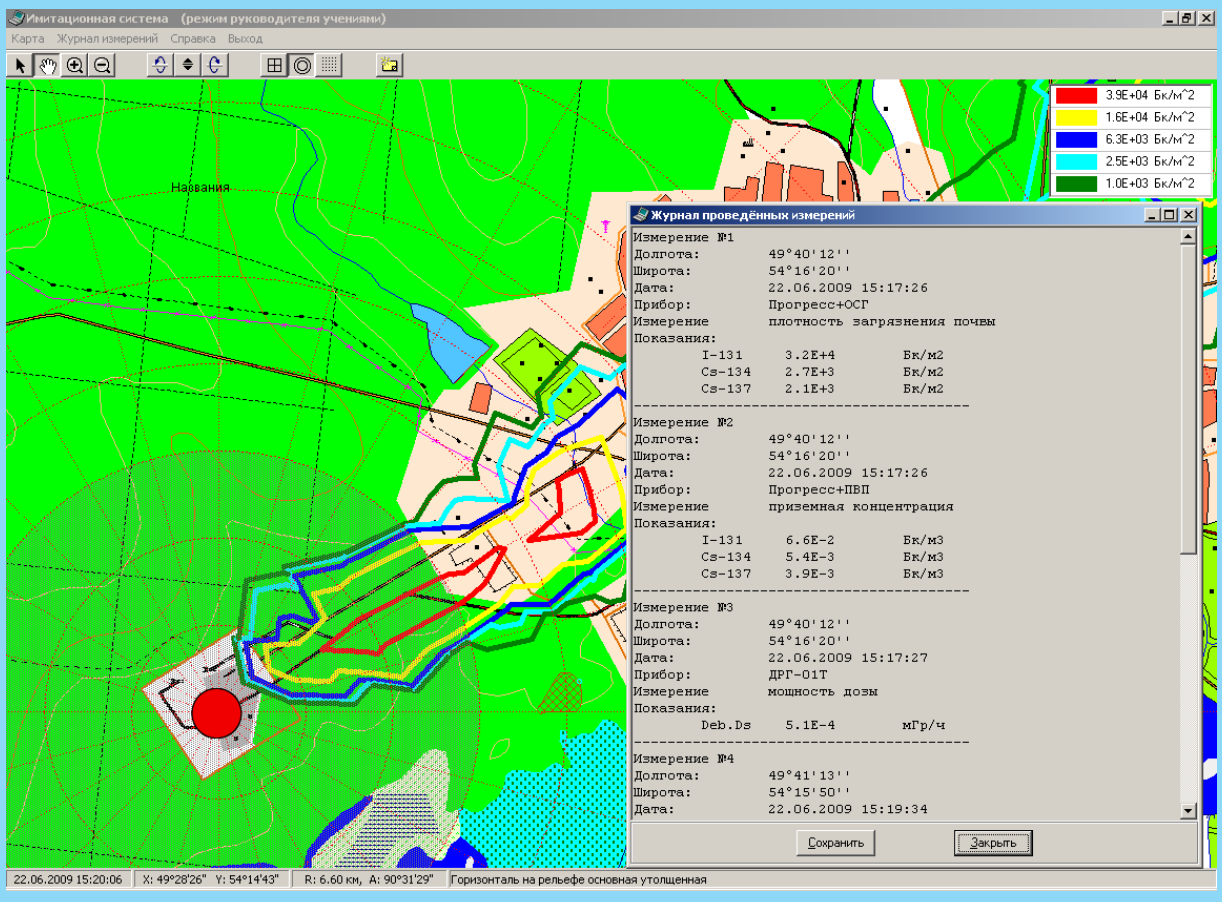


- Adaptation of software for the characteristics of radiation accident scenario at the facility taking into account the dynamics of radioactive release changes and weather conditions, specified in the exercise scenario;
- Modernization of the geoinformation system and preparation of the electronic maps of the region of the exercises;
- Modernization of the attributive database of radiation surveillance devices used by the radiation surveillance teams of each facility;
- Training of personnel participating in the exercise and exercise management.

The result of works for each of the projects is a computer system allowing the personnel to simulate the data of field measurements for a vector map substrate and selecting various radiation scenarios and measurement instrumentation. The results obtained in the project enhanced the level of preparedness of emergency and rescue units of the facilities to mitigate the consequences of radiation accidents by practicing radiation surveillance activities.

The level of preparedness of these services in the field of radiation surveillance planning and conduct increased substantially, as did the skills of carrying out field measurements using dosimetric and radiometric sensors. Application of these systems allowed increasing the effectiveness and quality of carrying out drills and exercises, bringing the situation for the experts and decision-makers closer to a real one.

Simulation of measurement



This system is applied both for personnel training in training courses and tabletop exercises, and for full-scale exercises with deployment of mobile radiation surveillance teams and practical training of radiation surveillance.

By now, the following facilities were equipped with the simulation systems:

- Siberian Chemical Combine, Seversk, Tomsk Region;
- Mining and Chemical Combine, Zheleznogorsk, Krasnoyarsk Krai;
- State Scientific Center of the Russian Federation “Research and Development Institute of Nuclear Reactors”, Dimitrovgrad, Ulyanovsk Region;
- Uralsk Electric Chemical Combine, Novouralsk, Sverdlovsk Region;
- “JSC “Mashinostroitelny Zavod”, Electrostal, Moscow Region;
- “JSC SC “Zvezdochka”, Severodvinsk, Archangelsk Region.

Portable hardware and software system for radiation situation analysis

Development and implementation of a portable system for radiation situation monitoring for regional emergency and rescue tems of Rosatom and emergency and rescue teams of radiation-hazardous facilities participating in NS decommissioning and management of SNF and RW was the goal of the project. The system is intended for analysis and forecasting of radiation situation in case of emergency release of radionuclides into the environment, as well as recommendations on mitigation of radiation incident consequences for environment.

Hardware and software of the portable system enable performing the following actions in field conditions:

- Simulation of dose loads for the population and emergency personnel in case of release of radionuclides to the atmosphere;
- Calculation of external and internal exposure doses due to radioactive sources of arbitrary geometry;
- Field measurements of radiation background (including on-line plotting on the map) in order to verify and correct the forecast;
- Ensuring reliable voice communication and high-speed data exchange with a remote crisis center;
- Preparation of the required working and reference documents, forecasts and recommendations, and their transfer to the higher level organizations responsible for emergency response.

Portable hardware and software system for radiation situation analysis

Activities on the task included development of seven portable systems for radiation situation analysis for the following emergency rescue teams:

- Emergency Technical Center of Rosatom, St. Petersburg (ETC Spb) of the Siberian Chemical Combine;
- Emergency rescue team of the Northern Federal Radioactive Waste Management Facility (SevRAO);
- Emergency rescue team of the Mining and Chemical Combine;
- Emergency rescue team of the Research and Development Institute of Nuclear Reactors;
- Emergency rescue team of the Shiprepairing Center "Zvezdochka";
- Emergency and rescue team of the Far East Federal Radioactive Waste Management Facility (DalRAO);
- Emergency rescue team of the "Zvezda" Shipyard.

The main stages of the works:

1. Preparation of the required information on reference accidents and incidents at radiation-hazardous facilities, electronic maps and data on the main radiation hazards;
2. Identification of the elements and configuration of software and hardware of the portable system;
3. Procurement of licensed software and hardware for portable hardware and software systems;
4. Development of specialized software and hardware systems for each ERT;
5. Configuration and testing of systems;

Compact laptop with GPS and gamma-sensor

6. Training of ERT specialists in operation of the developed portable software and hardware systems;
7. Trial operation of mobile systems:
   - development of the scenario for testing hardware and software in field conditions;
   - reworking software and hardware of the mobile software and hardware system according to the results of trial operation.

Each of the established portable hardware-software systems is a mobile workstation for a radiation safety specialist based on the field laptop version and is used for support of the specialists of professional emergency and rescue teams of the federal level and irregular emergency rescue teams. The system includes all required reference databases on radiation-hazardaous facilities of a specific region, bank of electronic maps of the region, computer systems of prompt forecasting and measurement of the radiation situation in the emergency area, a global positioning sensor, and a high-speed data transfer system.

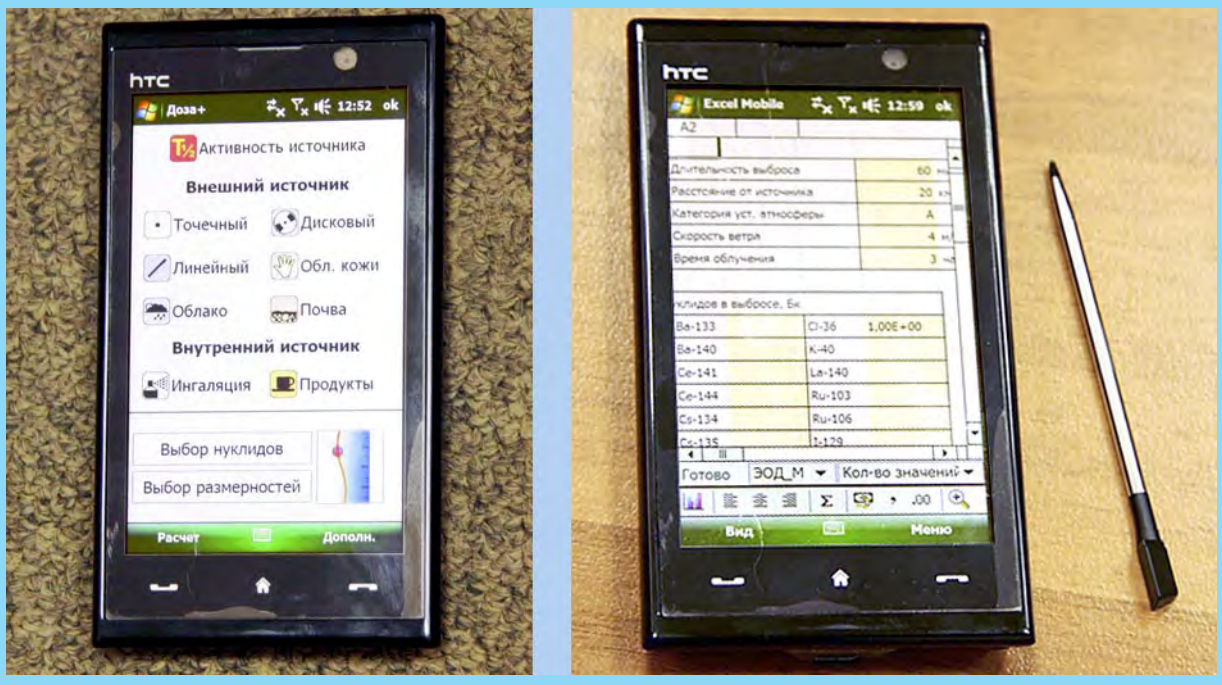
A portable software and hardware system represents a smaller version of a stationary information and analytical crisis center implementing a number of main functions in the immediate vicinity of the accident location.

Microprocessor based field expert support system

Microprocessor based field expert support system was developed in 2010-2011. The system ensures a simple and convenient acquisition and transfer of data using wireless communication, performs calculations and solves expert problems in field conditions.

The system was designed to provide the scientific and technical support and to assist in emergency preparedness and emergency response in case of radiation accidents and incidents at nuclear facilities. It is intended for a radiation safety and radiation protection experts.

Microprocessor based software system for support of radiation safety and emergency response experts



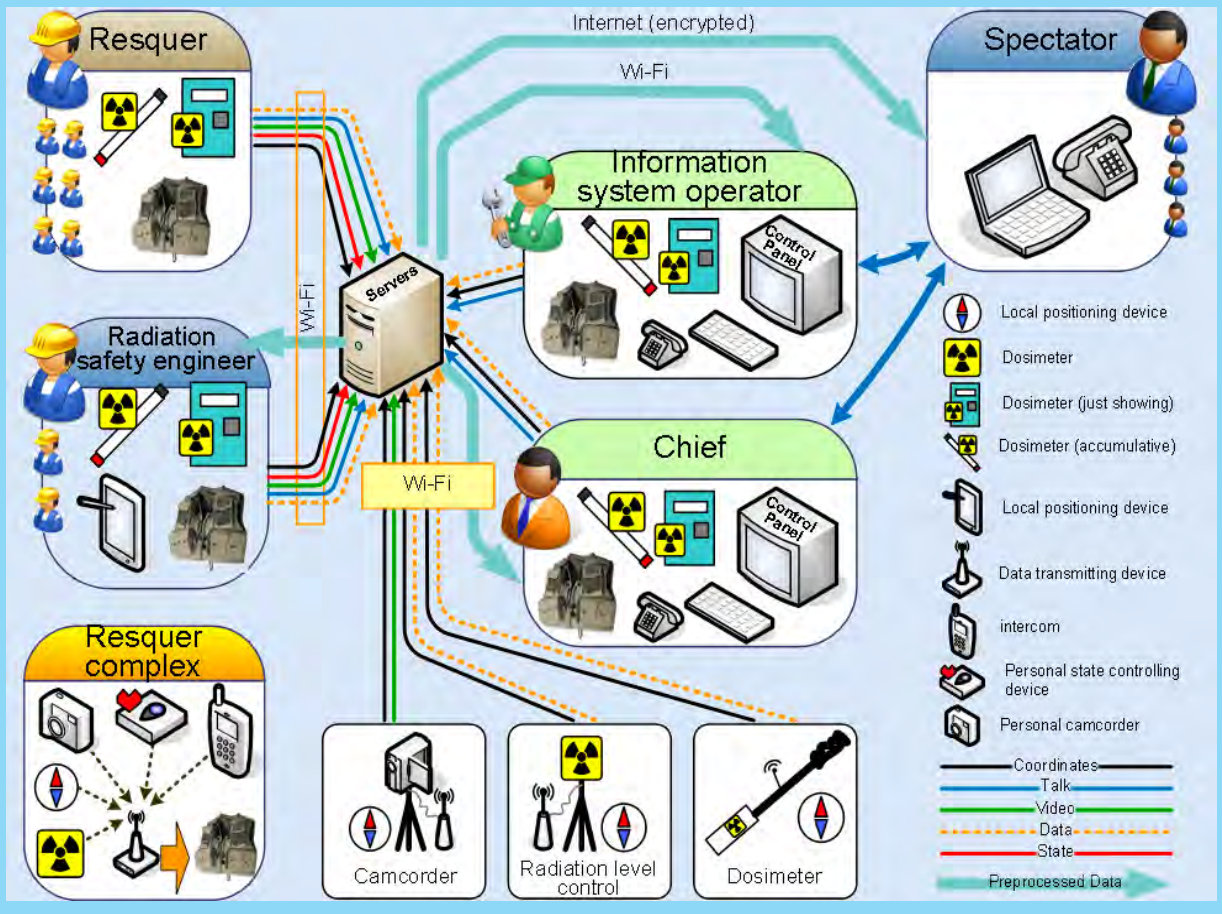
The microcomputer allows displaying the radiation situation data at the emergency site in on-line mode. It has a pre-installed software for assessment, analysis and forecast of the radiation situation and possible dose loads on human, express calculations for development of recommendations on priority measures for personnel and population protection. The system can be employed as an information, communication and software expert support kit both in exercises and drills and in case of real radiological emergencies.

Development of prototype of information support and communication systems to be used by rescuers in emergency works ("Smart Rescue Team")

The system is designed to provide the head of emergency works, ERT personnel, and radiation safety experts with prompt information and quality communication in a real time mode, allowing effective management of works, monitoring the safety of their participants and integrating and transmitting data to other units involved in mitigation of the emergency situation.

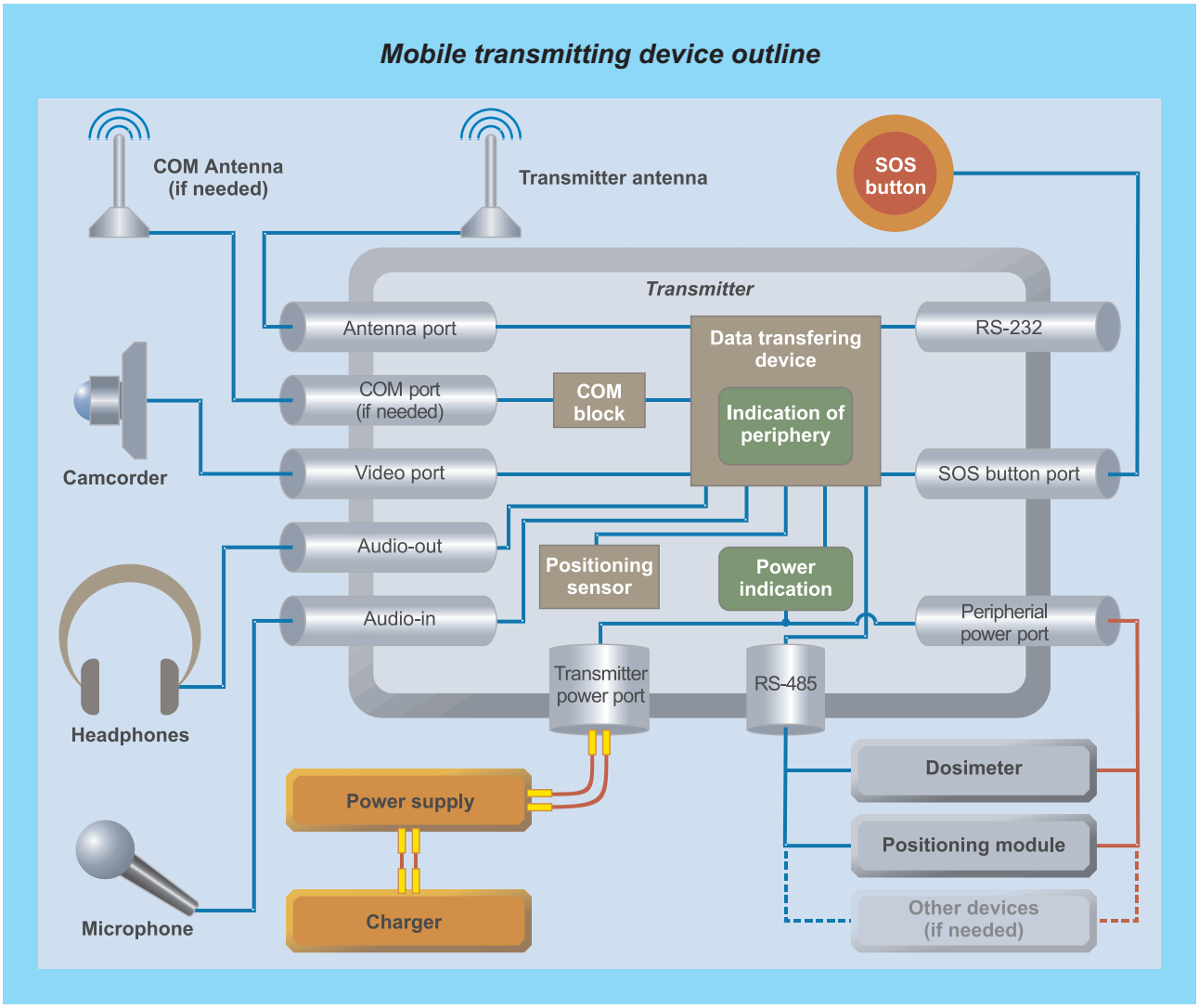
The system shall provide a remote voice communication for coordination of actions and information exchange between all participants of emergency and rescue works, transmission and viewing video images in a real time mode using portable video recording equipment. Each ERT rescuer shall have personal portable or stationary dose measurement meters. At the same time, the automated transfer of acquired information in real time mode shall be

Information flow diagram of the Smart rescue Team system



organized, including the information on dose characteristics of radiation fields and individual personnel exposure doses. The information shall be integrated in the common information environment allowing prompt access to the information for the head of works and other coordinating units.

Currently, the design of an autonomous system of communication and data transfer, including monitoring data and the measured radiation situation parameters, has been completed, along with a mock-up of the rescuer equipment.



Exercises and drills

Since 2002, IBRAE RAN organized a number of large scale exercises at NRHF of Russia, including facilities involved in NS decommissioning and management of SNF and RW.

Emergency exercises and drills are the highest and the most effective form to train management and emergency response forces in ES mitigation, including localization of accidents (emergency situations) and mitigation of their consequences.

Goals of exercises and drills:

- Raising the level of preparedness of the emergency situations commissions and emergency rescue teams of the facilities to mitigation of radiation accidents;
- Improvement of practical skills of officials representing facilities and ministries to manage forces and assets in mitigation of accident consequences;
- Verification of workability of emergency plans and decision-making procedures;
- Practical application of the technological procedures with emergency installations;
- Improvement of procedures of interaction between participants of emergency response of facility, regional and federal levels;
- Exercise notification procedures, including international notification;
- Emergency information of population.

Main attention in exercises organized by IBRAE RAN in cooperation with DOE in 2002-2012 was paid to interaction of the participants of emergency response at local, regional and federal levels. An important task of the exercises was an improvement of practical skills of field personnel and management of the facility on identification and categorization of an emergency situation and engagement of the "Plan of measures for protection of personnel in case of an accident at the facility".

The exercises test the preparedness of the facility, local and federal authorities to assessment of the consequences and mitigation of the accidents including preparedness of hardware, software and availability of the required documentation.

The exercises were used to test the issues of notification and transfer of primary information to SCC of Rosatom, CC of Rosenergoatom Concern (for an exercise at NPP) and technical support centers, as well as their interaction. The procedures for notification of IAEA and the neighboring countries are also tested.

In addition to application of practical activities, there is an element of research in the exercises. Recommendations for improvement and development of separate elements of emergency response infrastructure and organization of response on the whole, including modernization and planning of measures for protection of personnel and population are developed taking into account the experience and lessons learned.

During the preparation of the exercises, IBRAE RAN experts develop technological and radiation scenarios, provide consultations and scientific and technical support. Efficient exchange of data between the participants of emergency response using various communication systems was organized at all exercises.

Tabletop exercise at Bilibino NPP in August 2002

(EGP-6 reactor, a simulated accident with a release of positive reactivity caused by unauthorized extraction of two emergency rods out of the core and failure of the emergency protection system)

Representatives of Minatom, Roshydromet, Gosatomnadzor, Rosenergoatom Concern, representatives of federal and territorial authorities, TCC IBRAE RAN, specialists of Bilibino

NPP took part in the exercise. From the U.S. side: representatives of Department of Energy, Department of Environmental Protection of the state of Alaska, Division of Emergency Response of the Alaska Administration, Pacific Northwest National Laboratory, University of Alaska.

The main practical results:

- During preparation of the exercise, Rosenergoatom Concern organized a stable video conferencing communication and a system for ARMS data transfer between Bilibino NPP and the Crisis Center of the Concern.
- A software system for assessment of consequences was installed at the NPP. The specialists of the NPP were trained to use the system.

Tabletop exercise at Bilibino NPP in August 2002

Tabletop exercise at BOR-60 fast reactor of SSC NIIAR in December 2003

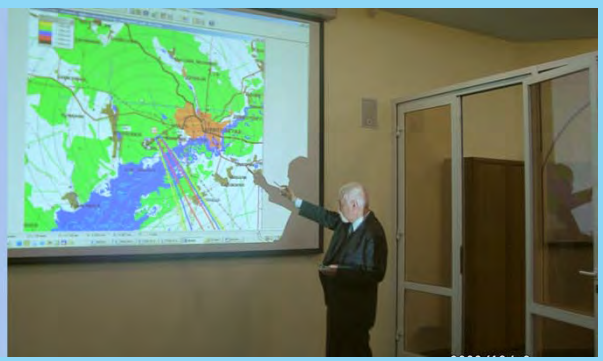
(simulated accident — loss of airtightness of the 1st circuit pipeline at the unprotected section of the pipeline)

Representatives of Minatom, SCC of Minatom, TCC IBRAE RAN, emergency and technical centers (St. Petersburg and Novovoronezh), personnel of SSC NIIAR, observers from the U.S. Department of Energy took part in the exercise.

The main practical results:

- A specialized system for transfer of technological parameters from BOR-60 research reactor to the emergency Crisis Center in Dimitrovgrad was set up during preparation of the exercise;
- The user station transferring ARMS data to the SCC of Rosatom was upgraded.

Tabletop exercise at BOR-60 fast reactor of SSC NIIAR in December 2003



Tactical exercise “Arctic-2005” at FSUE “Atomflot” in July 2005

(simulated accident — fall of a counterweight of the portal crane on the accumulation pad structure, damaging stored TUK-18)

Representatives of the Murmansk Shipping Company, Rosmorrechflot, Rosatom, SCC of Rosatom, TCC IBRAE RAN, ETC (St. Petersburg and Siberian Chemical Combine), ERT of SevRAO, ERT of PA “Mayak”, FMBA, personnel of FSUE “Atomflot”, U.S. DOE observers, observers from Nordic counties took part in the exercise.

The main practical results:

- The exercise on mitigation of radiation accident consequences of such scale at the facility carrying out maintenance of nuclear icebreakers of Russia (including SNF management) was conducted for the first time.
- Notification procedures and emergency plans of the facilities in terms of action procedures for the emergency rescue teams of the facility, as well as staffing and functions of the ES commission.
- A software system for assessment of consequences of accidents was installed at the facility. The personnel received training.

Tactical exercise “Arctic-2005” at “Atomflot” in July 2005

Tactical exercise “Arctic-2008” at “SC “Zvezdochka” in July 2008

(simulated accident — fall of a reloading container loaded with SNF at the pier near the coastal unloading facility during unloading SNF from a NS reactor compartment)

Representatives of Rossudostroenie (Rosprom), DNRS of “Rosatom” State Corporation, IBRAE RAN, Belomorsk Naval Base, FMBA, Main Department of EMERCOM in the Archangelsk Region took part in the exercise.

The observers were also representated by foreign organizations — U.S. Department of Energy, emergency response organizations of Sweden, Finland and Norway.

The main practical results:

- The exercise “Arctic-2008” held at SC “Zvezdochka” showed the necessity to enhance the radiation monitoring equipment of the emergency rescue teams of the facility.
- Implementation of the project “Modernization of equipment at SC “Zvezdochka”, started after the exercise, allowed updating measurement devices and instrumentation of emergency rescue teams of SC “Zvezdochka” to increase the effectiveness of personnel actions

at the facility in carrying out measurements and identification of radiation situation under radiological emergency conditions.

- The lessons learned during the exercise at "Zvezdochka" were used in organization of works on modernization of the systems of emergency response to radiation accidents at the facilities carrying out NS decommissioning, management of SNF and RW in Northwest Russia.

Tactical exercise "Arctic-2008" at SC "Zvezdochka" in July 2008

Exercise "Arctic-2010" at the head subsidiary of JSC "SC "Zvezdochka" — "Nerpa" Shipyard in July 2010

(simulated accident - incident caused by a rupture of a technological pipeline during works on bleeding the gas from the high pressure tanks of a decommissioned NS)

Management, specialists and experts of the following organizations and facilities took part in the exercise: "Nerpa" SY, State Corporation "Rosatom" (DNRS, FSUE "SCC of Rosatom", FSUE "SevRAO"), Main Department of EMERCOM of Russia in the Murmansk Region, SA "Murmansk DHMS", Regional department No. 120 of FMBA of Russia, ESC of Snezhnogorsk administration, Central medical and sanitary department No. 120 of FMBA of Russia, Centre of hygiene and epidemiology No. 120 of FMBA of Russia, TCC IBRAE RAN, EMRDC of Burnazyan FMBC, FMBA of Russia, SPA "Typhoon".

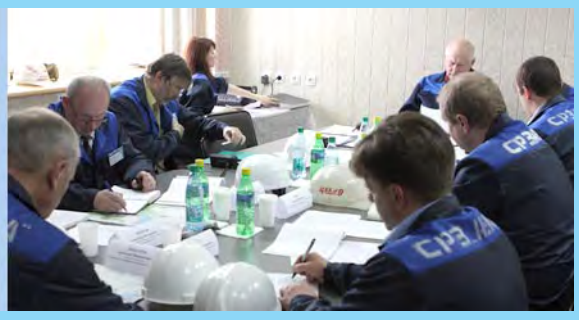
Foreign observers — members of EPPR Working Group of the Arctic Council — included representatives of USA, Sweden, Norway, and Finland.

The main practical results:

- For the first time, simulation of the facility data, data of territorial ARMS and mobile laboratories was performed and used during the exercise to ensure the required scale of the exercise. This make the played scenario closer to real emergency situation and allows most efficient training of the personnel.
- A remote video monitoring of the section of the pier, where the activities on mitigation of the emergency situation were carried out by the personnel of ERT of "Nerpa" SY was organized during the exercise. This allowed the observers to follow the development of the scenario in more details.
- One of the main practical results of the exercise was recommendation to renew the dose measurement equipment used by ERT of "Nerpa" SY. As a result, a new project "Enhancement of the emergency response system of "Nerpa" SY" was initiated. In the frame-

work of this project, “Nerpa” SY is supplied with radiation monitoring equipment and specialized software for the radiation safety tasks.

Tactical exercise “Arctic-2010” at “Nerpa” Shipyard, the Main Subsidiary of JSC “SC “Zvezdochka”



Exercise “Novovoronezh-2011” at Novovoronezh subsidiary of FSUE “Emergency and technical centre of Minatom of Russia” in June 2011

(simulated accident - transport accident and long-term impact of fire on a transport container loaded with radioactive materials)

Management, specialists and experts of the following organizations and facilities took part in the exercise: State corporation “Rosatom” (Novovoronezh subsidiary of ETC SPb, ETC SPb, SCC of Rosatom), TCC IBRAE RAN, Medical and Sanitary Department No. 33 of FMBA of Russia, EMRDC of Burnazyan FMBC.

Representatives of regional and local authorities, EMERCOM of Russia in the Voronezh Region, Emergency and Rescue Centre of Novovoronezh participated as observers.

The main practical results:

- Engineering and technical actions on emergency rescue and other urgent works were practiced: radiation surveillance, decontamination of territory and equipment, urgent deployment of a sanitary checkpoint, base camp, mobile command post and mobile communications post.
- Actions of the medical emergency and rescue units on providing first aid to the injured during the transport accident were carried out at a very high level (in accordance with the assessment of the observers form Burnazyan FMBC);

Tactical exercise “Novovoronezh-2011” at Novovoronezh subsidiary of ETC SPb in June 2011

- Actions of a remote controlled robotic system for localization of the radiation source and its loading into transport container were practiced and also received a high appraisal.

Exercise "Arctic-2012" at the Saida Bay Branch of the North-West Center on Radioactive Waste Management "SevRAO" — FSUE "RosRAO" Subsidiary of the State Corporation "Rosatom" in June 2012

(simulated accident - incident related to destruction of one of the reactor compartments stored at the solid radwaste storage pad and partial release of radioactive substances into the environment)

Management, specialists and experts of the following organizations and facilities took part in the exercise: State Corporation “Rosatom” (North-West Center on Radioactive Waste Management “SevRAO” — FSUE “RosRAO” Subsidiary, DNRS, FSUE “SCC of Rosatom”, FSUE “SevRAO”, FSUE “Emergency Technical Center of Minatom of Russia” (St. Petersburg)), ESC of Government of the Murmansk and Archangelsk Regions, Main Department of EMERCOM of Russia in the Murmansk Region, Department of the Civil Defense, Emergency Situations and Fire Safety of the Murmansk Region, Murmansk Department of Hydrometeorological Service, Regional department No. 120 of FMBA of Russia, ESC of Aleksandrovsk administration, TCC IBRAE RAN, EMRDC of Burnazyan FMBC, FMBA of Russia, SPA “Typhoon” of Roshydromet.

Foreign observers included representatives of USA, Norway, and Finland (members of EPPR working group of the Arctic Council) and France.

The main practical results:

- The fire extinguishing system of the Saida Bay ERT was demonstrated to be used for prevention of fire spread towards the fire-hazardous elements at the site.
- A scientific and technical support on prompt radiometric and spectrometric mapping of the emergency site was rendered by the Emergency Technical Center (St. Petersburg).
- Presentation of the simulated ARMS data was organized using i-pads.
- Video-transmission of the ERT actions on mitigation of the emergency situation to observers was organized. A possibility to move the cameras was provided.
- A necessity to enhance the level of equipment of the site (communication, dosimetric and spectrometric equipment) was identified.

Exercise "Arctic-2012" at the Saida Bay Branch of the North-West Center on Radioactive Waste Management "SevRAO" in June 2012

Enhancement of radiation monitoring and emergency response system in the Northwest Russia

Modernization of equipment and methodological tools of emergency rescue team at SC "Zvezdochka"

The findings of the tactical exercise “Arctic-2008”, that was conducted at SC “Zvezdochka” in summer of 2008 in accordance with Annex 7 to the Agreement, Task Order 16 “Exercise on assessing of consequences and responding to a radiation emergency in the North-West region of Russia” to train the actions of ERT of SC “Zvezdochka”, stated the need to modernize the equipment of ERT.

In the framework of the project, the emergency and rescue teams of SC “Zvezdochka” were supplied with individual dose monitoring equipment, as well as radiometric, dosimetric and spectrometric radiation surveillance equipment. The equipment was tested and sent to the facility. Subsequently the operative personnel of the radiation safety department were trained to conduct radiation monitoring using radiation surveillance instrumentation.

The supplied equipment for ERT of SC “Zvezdochka”:

- dosimeters-radiometers with a number of detector modules allowing carrying out the dose and radio metering tasks in everyday situations and in case of radiological accidents;
- direct-indicating electronic gamma-radiation dosimeters for monitoring of the dose load on the personnel, designed for harsh operating conditions, including the conditions of radiological accidents;
- automated system of individual dosimetry based on thermoluminescent detectors, supplied with software for mathematical processing of dosimeter readings and keeping a database of dose loads on the personnel. The dose measurement range allows their use in emergency conditions;
- portable (carried in a bag) spectrometers for spectral gamma and neutron scanning of the environment with indication of geographic coordinates (GPS), monitoring of radioactive sources movement, as well as radiation mapping.

Automated individual dosimetry kit

Tests of dose metering equipment for ERT of SC “Zvezdochka”

Enhancement of the "Nerpa" SY emergency response system in accordance with the lessons learned in "Arctic-2010" exercise

The findings of the exercise “Arctic-2010” that was conducted at the Shipyard “Nerpa” — Head Subsidiary of SC “Zvezdochka” in June 2010 in accordance with Annex 7 to the Agreement, Task Order 22 “Exercise on assessing consequences and responding to radiation emergency in the North-West region of Russia “Arctic-2010” and aimed at exercising the actions of ERT of the “Nerpa” Shipyard, stated the necessity to partially upgrade the equipment used by ERT, namely:

- Dosimetery personnel of the “Nerpa” ERT used the radiation monitors that do not store the results of measurements. These meters cannot measure alpha-radiation that was required in the simulated accident in accordance with the scenario of the exercise “Arctic-2010”.
- To perform the emergency spectrometric analysis, the modern spectrometric equipment is required.
- Individual protection equipment is to be renewed.

As a result of collaborative efforts of the IBRAE RAN and “Nerpa” Shipyard experts, a list of required dosimetric and spectrometric equipment, individual protection equipment was developed. The project on modernization of the “Nerpa” ERT equipment was launched.

The list of equipment was approved by the service of civil defense and emergency situations that is responsible for emergency response at the “Nerpa” Shipyard.

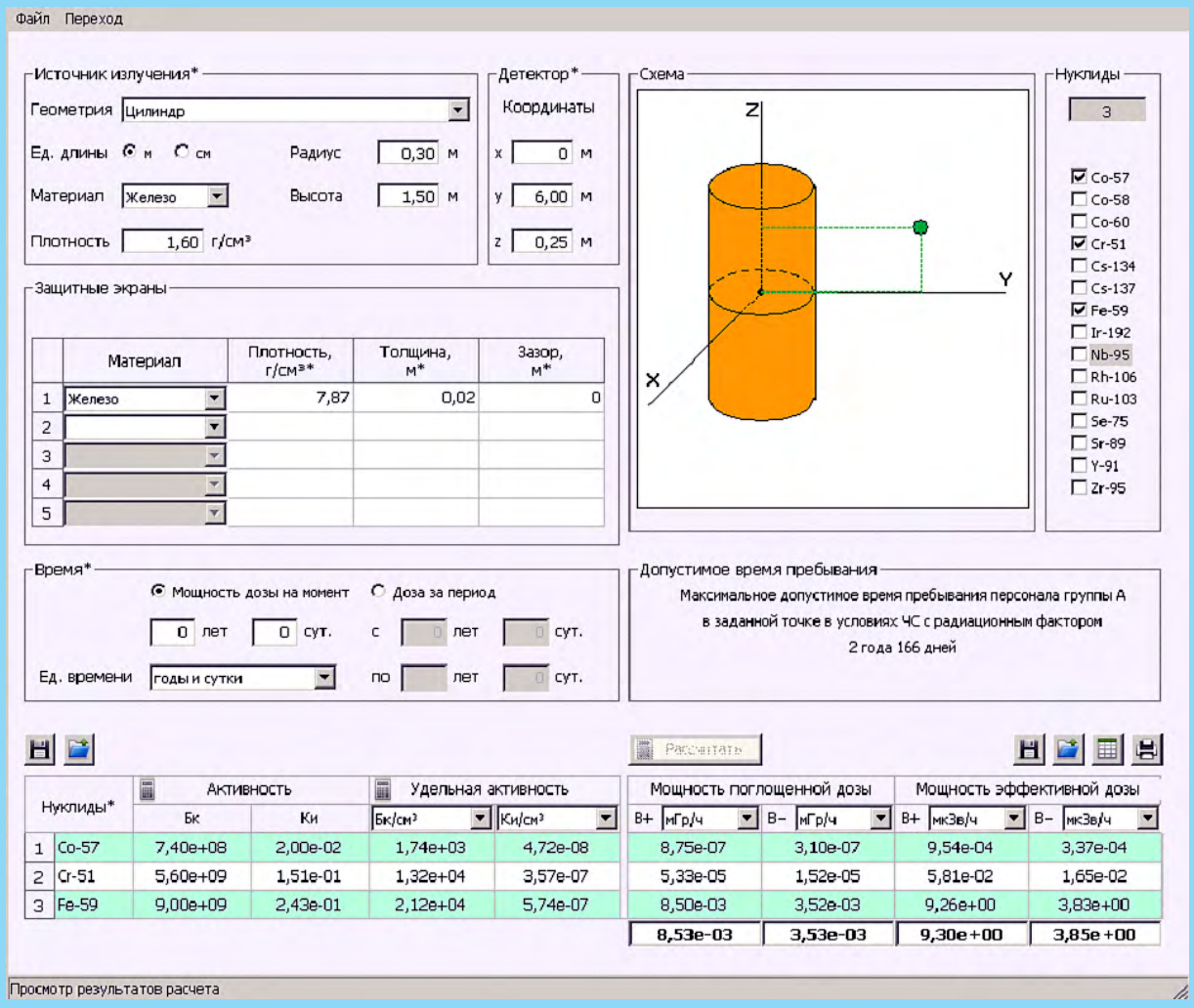
The project foresees personnel training in application of the supplied equipment.

Equipment for enhancement of the emergency response system at the "Nerpa" Shipyard

Another lesson learned from the exercise “Arctic-2010” was a conclusion about necessity of fast and simple codes for assessment of gamma-radiation fields from sources of various geometries with and without shielding. The calculations are performed with or without accounting for a scattered radiation. The calculation algorithm is based upon the method of source splitting onto elementary cells of corresponding dimensions and digital summing of the contributions from all cells. The user-friendly interface allows visualizing the initial geometry of the source and presenting the results of calculations in accordance with the requirements defined by the user.

It was decided to develop and supply to the “Nerpa” ERT the corresponding specialized software.

Screenshot of the software for calculation of gamma-radiation fields from sources of various geometries



Establishment of Training Center for the specialists of emergency and rescue teams of EMERCOM of Russia and other agencies based on IBRAE RAN training center

Works on enhancement of the training basis for training the personnel of emergency and rescue teams of EMERCOM of Russia and other agencies in the field of radiation safety provision in the course of emergency operations, rescue and other urgent works, and radiation surveillance are completed at the IBRAE RAN training center.

The Training Center was equipped with modern visualization and 3D imaging equipment that allows using the modern training computer programs in the training process. Computer training on practicing ERT actions in radiological emergency conditions and carrying out emergency, rescue and other urgent works is in this case an effective mean of training "newcomers" and enhancing the qualification of experienced specialists. Application of 3D visualization of the actions of ERT personnel in planning and conduct of emergency, rescue and other urgent works allows enhancing team actions of the personnel and decision-making of the unit heads under conditions of radiological emergencies. Combination of a realistic 3D working environment, communications between the management and personnel of the unit, the capability of informational interaction and coordination of actions between the unit members allows increasing the effectiveness of the personnel training process by adding a factor of joint actions in a counter-emergency response.

3D simulator for training of ERT personnel actions on detection of radioactive contamination and conduct of radiation surveillance

The Center was equipped with radiation monitoring meters thus allowing students to practice the radiation surveillance skills.

In addition to the mentioned above, informational support of the training process was provided by development of an electronic library of regulatory documents and materials of the training courses.

Pilot training courses and practical seminars were conducted using the developed computer simulators.

3d helmet and laptop with 3d image

Scientific and technical support of the emergency response system

One of the main tasks of IBRAE RAN Technical Crisis Center is a scientific and technical support of the federal executive authorities in decision-making on population and territory protection measures in case of a radiation accident. Since 1997, TCC provides support to the Situation Crisis Center of Rosatom, Information and Analytical Center of Rostechnadzor, Crisis Situations Management Center of EMERCOM of Russia, Governments of the Murmansk and Archangelsk Regions.

The National Center for Crisis Situations Management (NCCSM) was established at EMERCOM of Russia in 2008. The Center was assigned with the functions of everyday management body of the Russian state system for prevention and mitigation of emergency situations, including the issues of response to radiation accidents.

National Center for Crisis Situations Management of Emercom of Russia

The main tasks of NCCSM of EMERCOM of Russia are the following:

- acquisition, processing and provision of on-line information on emergency situations to the RSES management body, organization of monitoring and forecast of emergency situations, as well as accounting of forces and assets engaged in mitigation of emergency situations;
- expeditious management of activities of units to implement measures on emergency prevention and mitigation of emergency situations;
- coordination of activities of everyday management bodies of the federal executive authority bodies in case of an emergency situation threat;
- information interaction with crisis centers of foreign countries.

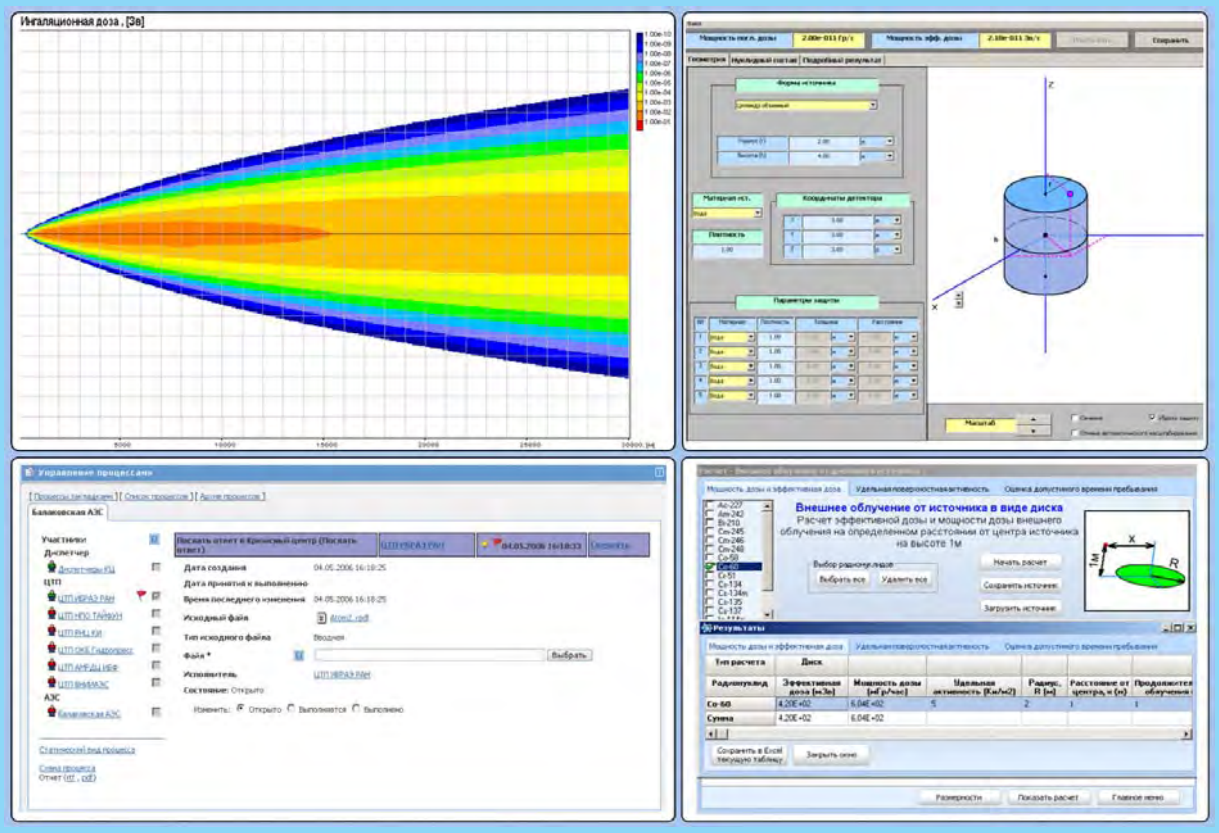
Establishment of a new department within EMERCOM of Russia had required modernization of the existing system of scientific and technical support related to radiation acci-

dents. There was a need to upgrade the organizational, regulatory, informational, software and hardware support of the operating on-duty shift of NCCSM regarding the issues of decision-making support on protection of population and territories in radiation accidents.

This project was aimed at enhancing the existing capabilities of TCC IBRAE RAN as a scientific and technical center rendering support to NCCSM of EMERCOM of Russia on responding to radiological emergencies at the facilities of nuclear energy use including those that do not subordinate to Rosatom.

Implementation of the project included development of databases on potential hazard sources and scenarios of potential radiation accidents at facilities of nuclear energy use. The existing software systems for assessment of the consequences of radiation accidents for various scenarios of radiological emergencies at hazardous facilities, including emergencies in the urban environment, were upgraded and new ones were developed. Main efforts were aimed at development of codes capable to increase the speed of on-line assessments and forecasts of radioactive contamination consequences for territories and population. Also, a computer system providing remote access to information resources of TCC IBRAE RAN for remote users was developed. All systems were tested and installed at TCC IBRAE RAN.

Software for assessing radiation event consequnces



Informational and reference materials for the experts responsible for development of recommendations on protection measures for population and territories and for decision-makers were also developed. These materials can be used by the experts of TCC IBRAE RAN and the monitoring and forecasting centers of EMERCOM of Russia. The materials contain infor-

mation allowing assessment of contamination sources, forecast of emergency situation evolution and its consequences, identification of the required protection measures and assessment of their effectiveness, etc.

Typical instructions on the actions of on-duty shifts in case of radiation accidents were developed in accordance with IAEA recommendations in order to ensure fast and efficient interaction of the emergency response participants.

Training materials to train the personnel of the centers and conduct of drills and exercises, were developed.

Agreement between EMERCOM of Russia and IBRAE RAN on interaction in case of radiation accident and in everyday activities on maintaining preparedness and enhancement of the emergency response system in Russia was signed. Technical document describing the procedure of scientific and technical support of EMERCOM by TCC IBRAE RAN was developed and enforced.

Establishment and development of the Training Center at the Emergency and Technical Center of Rosatom

The project covers training and advanced training of the personnel of emergency rescue units of Rosatom in the field of emergency response. The project on establishing and equipping the Training Center (TC) of the Emergency Technical Center (ETC) of Rosatom in St. Petersburg was implemented in 2006-2008. The project resulted in development of new training simulators, methodologies for search and detection of various types of radioactive sources, conduct of drills and exercises, including joint activities of the Russian and American rescuers.

The main goal of the project was establishment of a modern training center using the up-to-date scientific and resource basis. ETC was established for supporting exercises and drills and training the personnel of emergency rescue service of Rosatom. In contrast to TC established at MIPK, the center is designed to carry out training of both the management of emergency rescue teams, and specialists in emergency rescue works.

The main directions of activities under the project:

- Preparation of the TC training rooms, their equipment with modern software, hardware, and communications.
- Development of computer simulators and simulation systems for drills and exercises in the field of search, emergency and rescue works.
- Development of technologies to train rescuers to carry out radiation monitoring and search, including activities in urban conditions using real radioactive sources-simulators in the field conditions and at the specialized benches.
- Support of the training process using various engineering and technical equipment.

The training rooms prepared to support the training process at TC are as follows:

- Training class designed for theoretical and practical training in the field of emergency response and mitigation of consequences of emergency situations.
- The simulator training class intended for practicing the radiation monitoring skills, search and identification of radioactive sources using computer simulators.

Training rooms prepared to support the training process at TC

- The testing area intended for practicing application of radiation surveillance instrumentation, search and identification of radioactive sources using real radiation sensors and radioactive source simulators.
- Class for training the skills of application of specialized emergency equipment (engineering and technical equipment, life support equipment, individual protection equipment, etc.).

Designs were developed for all listed rooms and they were fully equipped with hardware and software. All rooms are now in operation.

The computer simulators are intended for practicing the following training tasks:

- conduct of radiation surveillance of territories;
- identification of areas with the highest risk for the population;
- detection of radioactive sources;
- assessment of contamination levels and isotope composition;
- identification of exceeding the allowed intervention levels;
- transfer of acquired data to the crisis center;
- monitoring of dose loads.

Manuals and training aids, along with training programs, were developed for each of the simulators.

The simulators completely describe operation of the real equipment and instruments used at the Emergency Technical Center in radiation surveillance, monitoring and search for sources.

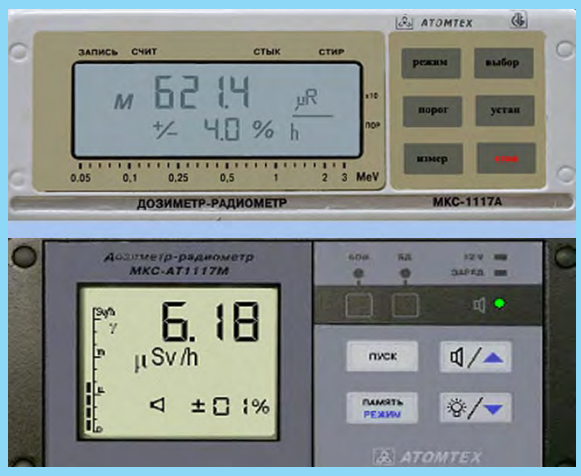
Description of the simulators installed at the workstations in training classes at the ETC Training Center is given below.

Training simulator for search of radioactive source using dose metering devices, including searching in the urban environment

The simulator was developed for training the skills required for detection of radiation sources. The position of the source and its main characteristics can be identified using the selected meter. At the same time, the dose load should constantly be monitored in order to ensure minimum possible dose of the own exposure.

Simulator of field measurements

Measurement instruments interface

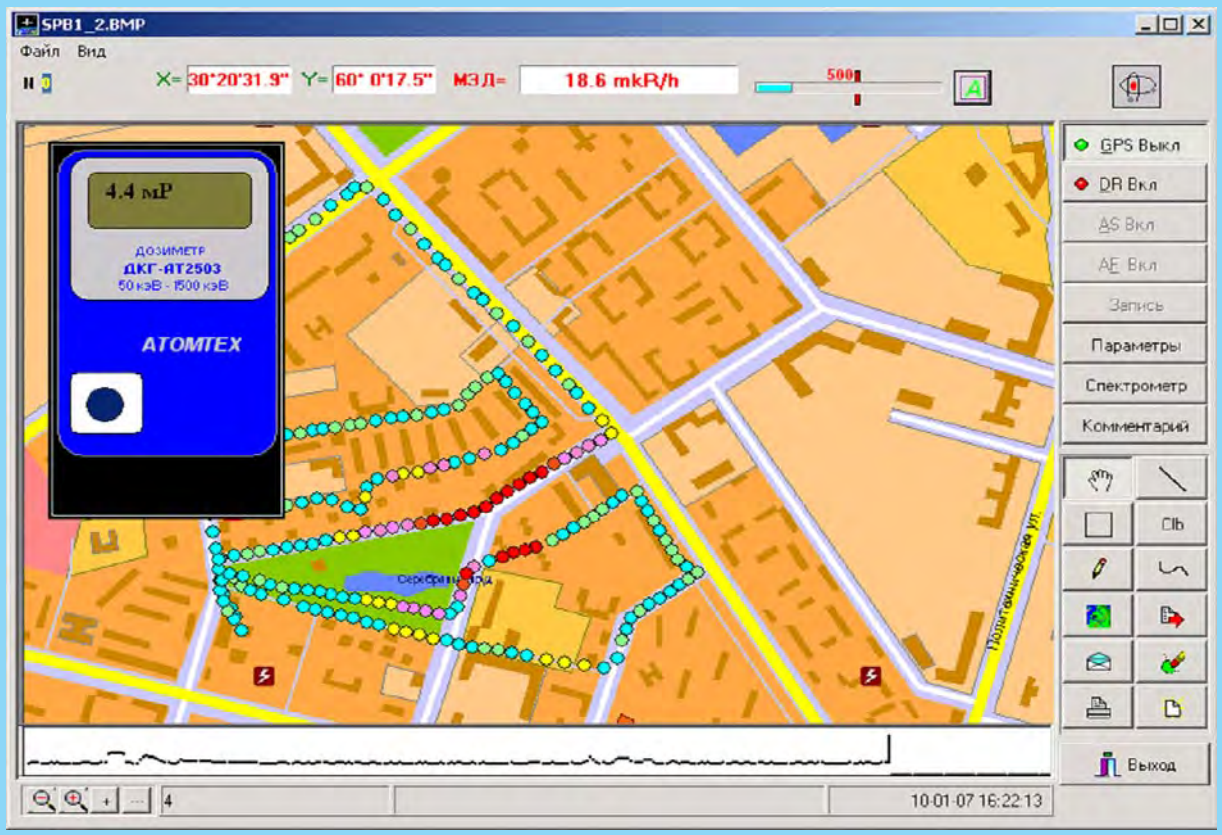


Training simulator for monitoring of territories and search for sources using mobile systems

The tactics of using mobile radiation surveillance systems strongly depends on the specific situation and selection of optimum performance modes (the route, speed, data transmission method, etc.) and should be selected by the members of emergency team at the emergency site. Also, the personnel working in contaminated territory should observe the rules of own safety and avoid excess exposure and contamination.

The training simulator of a mobile radiation surveillance system is intended for working out various options of using such systems.

Screenshot of the training simulator for monitoring of territories and search for sources using mobile systems



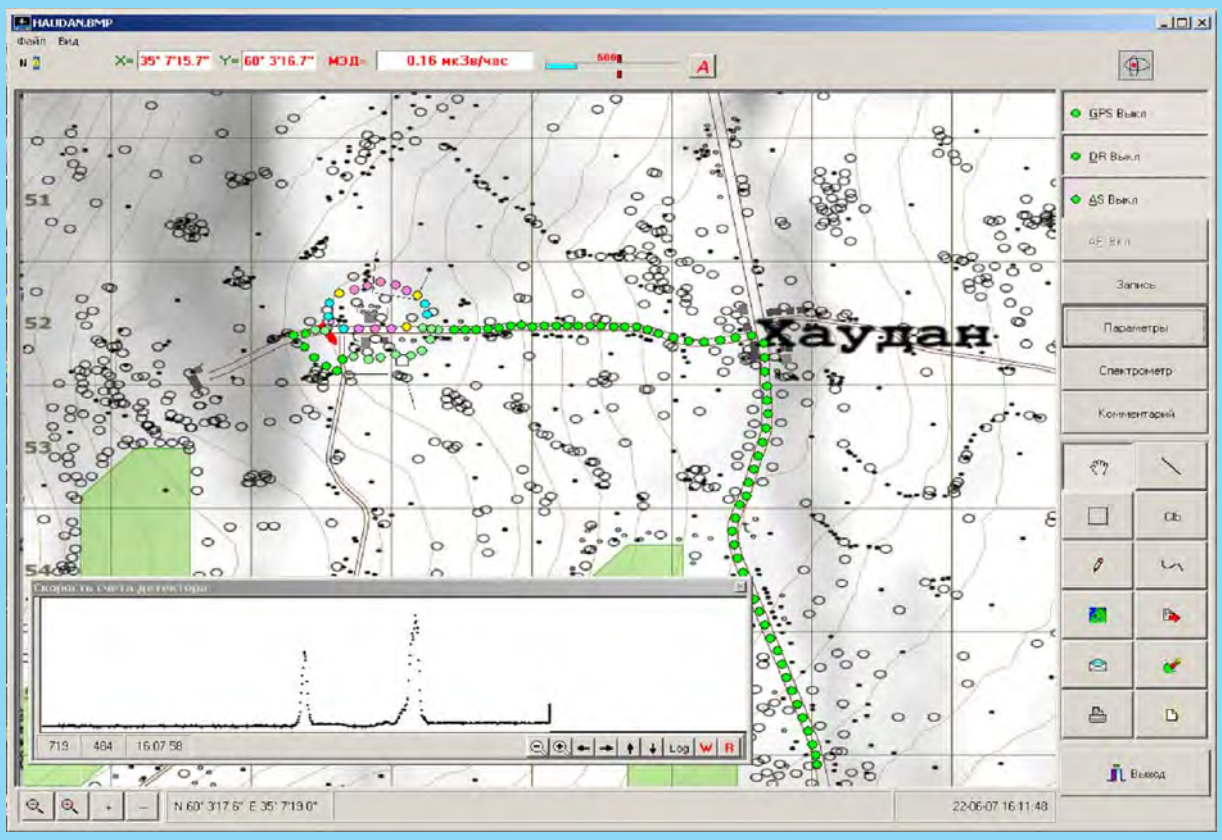
Training simulator for conduct of radiation surveillance and monitoring of territories using portable systems

The simulator allows application of radiation surveillance elements within an area with linear dimensions up to several hundreds meters using the selected meters and perform the following tasks:

- identify the areas with the highest level of contamination;
- locate the local radiation source;
- determine the level of contamination in these areas;
- draw up the map of the territory contamination;
- assess the need for countermeasures in accordance with the allowed intervention levels;

- monitor the dose loads, track the point of return and avoid overexposure of the personnel.

Screenshot of the portable system program in the mode of radiation situation mapping and source search



Simulator for search of sources using scanning devices

The simulator is designed for training of operators in using scanning equipment for search of local gamma-radiation sources. The simulator uses the scanning equipment to enable search of a local gamma-radiation source using scanning equipment, determine its coordinates and estimate its main characteristics.

The scanning equipment includes a large volume NaI detector with a rotating horseshoe collimator. The data acquisition system allows recording the detector count rate in five energy ranges and 32 sectors of collimator scanning area.

Functional simulator on application of emergency plans for protection of personnel and population in case of a radiation incident, including an emergency during transportation of radioactive materials

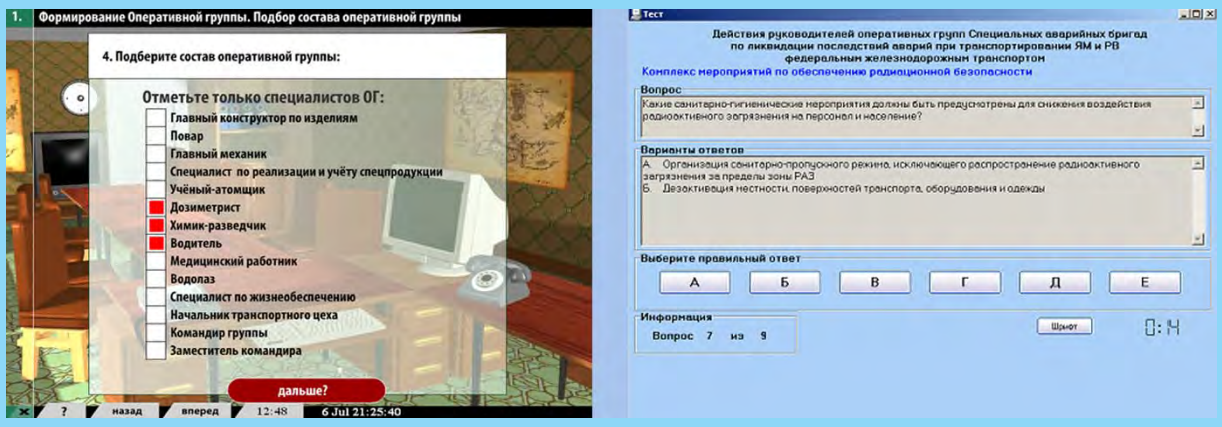
The simulator is intended for practical training to activate emergency plans for protection of personnel and population in case of a radiation accident at a radiation-hazardous facility or during transportation of radioactive materials.

The simulator models the sequence of actions of emergency rescue team leader required for activiation of the plan for protection of population and environment. Algorithm of leader's actions after receiving the initial message about the accident was developed based on the results of analysis of instructions and plans of various Rosatom facilities and emergency

cards for transportation of various cargoes. This algorithm is used as a standard in the simulator.

Another direction of research was related to development of technologies to train the skills of carrying out radiation monitoring and search, including actions in urban conditions using real radioactive sources-simulators in the field conditions and at specialized benches.

Functional simulator on application of emergency plans for protection of personnel and population



Development of a gamma-spectrometer bench to study the effects distorting the shape of spectra in laboratory measurements

The spectrometer bench for studying the effects distorting the shape of spectra in laboratory measurements is intended for training the skills of spectrometric analysys with account for all possible causes of measurement errors.

Gamma spectrometer bench

Development of technology to train individual monitoring skills using radioactive contamination emulators

Radioactive contamination emulators were manufactured. These sources are used in training at the testing area. The emulator sources can be applied in training in the following fields:

- application of portable devices for measuring ionizing radiation (dosimeters, radiometers, spectrometers);
- use of individual protection equipment and assessment of the level of its contamination;
- surveillance of rooms and territories in order to locate areal and point contamination sources;
- defining a character of contamination (fixed, not fixed, depth of propagation in the soil);
- assessment of simulated contamination parameters using high resolution spectrometric systems.

Training manuals were prepared for each of the listed training activities.

Work at the testing area with radioactive contamination emulator sources

Study of the effects distorting the shape of spectra in in situ measurements using soil simulators

The simulator operation is based on one of the widely used methods for assessment of gamma-radionuclides content in the soil — *in situ* gamma-spectrometry method. The method allows obtaining data about territory contamination without sampling or laboratory analysis. Reliable results can be obtained, if the depth distribution of radionuclide in the soil is taken into account. The soil simulators are applied to study the effect of this factor.

Special areal gamma-radiation sources made of thin fibre with dimensions of 2×2 metres were manufactured to simulate the contaminated soil of various nuclide depth distribution. These fibres have 100 cells located in checkerboard order with dimensions of 200×200 mm each containing specially manufactured

GR-3019 detector with a refrigerator on a special tripod

Eu-152 sources of equal activity. The overall activity of Eu-152 in each fibre is about 800 kBq, which is a rough equivalent of territory contamination to a level of 5 Ci/km^2.

The bench includes a GR-3019 gamma-spectrometer with a coaxial detector of ultra-pure germanium in a portable refrigerator. The detector is mounted on a special tripod so that the crystal is elevated 1 m above the surface. *InSpector* analyzer manufactured by Canberra is used in the electronic head of the spectrometer.

Specialized software for detailed study of spectra processing and analysis were developed for controlling the spectrometer.

Training simulator of portable and vehicle radiation surveillance systems

The simulator of a vehicle radiation surveillance system ensures training of specialists in application of radiation surveillance methods and simulates a system used at ETC.

The design of the portable system allows using the built-in gamma-radiation dose rate sensor or an external surface contamination sensor. The surveillance process is monitored using a mini-display built into the operator glasses. The GSM modem built into the system is used for exchange of data with the control system.

The simulator operating principle is similar to the operating principle of the mobile radiation surveillance system simulator, i.e., the system records actual coordinates and parameters of the radiation situation and adds the values simulated by the program in accordance with the trainer's assignment. When the system is working with gamma-radiation readings, the simulator also simulates the readings of an individual dosimeter, thus allowing assessment of accumulated external exposure dose and the turn back point.

Training programs on application of engineering equipment were developed in the following areas:

- application of engineering emergency and rescue equipment (hydraulic instruments, lifting devices, access instruments, etc.);
- practical application of the methods of restoring control over an ionizing radiation source (manipulators, grapples, remote observation systems, etc.);

Vehicle radiation surveillance simulator

Simulator of a portable system

- handling damaged transport packages and containers;
- deployment and operation of life support facilities (tents, decontamination posts, power generators, field kitchens, etc.);
- operation of robotic equipment (the program is realized at the subsidiary of ETC SPb — Emergency Technical and Training Center of Robotics).

Conduct of meetings, drills and exercises is an integral part of training of the management, experts and rescuers of emergency rescue teams. Such drills help to rise the qualification and preparedness of ERT to act in case of a radiation incident.

Software, hardware and engineering equipment developed in the framework of the current project is widely used to reach the objectives of the exercises and drills. Training and drills can be carried out not only for the rescuers of ETC and Rosatom, but also for other federal bodies (e.g., EMERCOM, FMBA, etc.).

Development of training basis of the emergency and rescue service of Rosatom continued in 2010. The goal of the works was development of a system for regular training of rescuers of ERT, Rosatom and other agencies on the basis of ETC SPb.

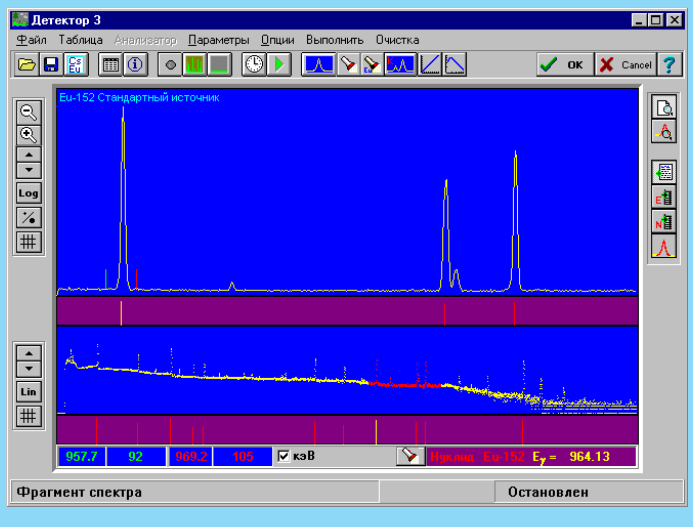
Works were conducted on enhancement of the expert training methodology in the field of gamma-spectrometric analysis and identification of nuclides in complex conditions. The basics of the system for expert support of the first responders were developed. This includes tools for identification of nuclide composition of radioactive materials, analysis of complex radionuclide mixtures and assessment of levels of hazard.

Lectures and laboratory exercises for training in gamma-spectrometric analysis were prepared. Computer applications for simulation of instrumentation spectra were developed and adapted. The concept of spectral information exchange and applications for conversion of spectral data of various formats was developed.

Pilot training courses for specialists — experts in the field of spectrometric analysis were held. The proposed methods and developed benches and simulators of the ETC SPb Training Center were used during the courses. Also, the theoretical drills on the basics of emergency response and emergency radiation monitoring, drills on search of sources in urban conditions using real mobile and portable systems and simulated radiation sources aimed at training the strategy and tactics of decision-making and actions on identification of sources were conducted.

Training materials for training of ERT personnel were developed for CIPK (Obninsk) with account for experience of established MIPK and ETC centers. The IAEA guides in the field of emergency response (Safety Standards, TECDOCs, EPR-series, etc.) were used for developed training materials.

Universal software application providing all functions of the gamma-spectrometric analysis



Emergency Public Information

Experience of the past nuclear and radiation accidents testifies that the public information is one of the major and most complicated problems of emergency response. If the information interaction is organized correctly, the serious consequences for people's health can be avoided even in case of major accidents. Contrary, an insignificant deviation from a regular operation of a potentially hazardous nuclear facility, that is not representing, according to competent experts, any threat to population, can lead to serious social and psychological consequences, if it is perceived by people as a real radiation accident.

Works in the field of emergency public information (EPI) have been carried out since 2003. The main goals of the works include:

- improve EPI-component of the state system of emergency response in case of radiological accidents;
- increase coordination between emergency responders, primarily between nuclear operators, EMERCOM services and local authorities, when preparing official information on emergency radiation risk issues;
- develop professional skills of EPI officers.

To achieve the goals, most efficient EPI approaches developing by US NRC, US EPA, IAEA and WHO are adapted for the Russian circumstances presented to the Russian emergency responders. Teaching and training aids were prepared and training courses and drills for EPI officers of federal CD&ES management bodies of EMERCOM of Russia at regional level, and PR-services of Rosatom facilities and other radiation-hazardous enterprises were conducted.

Apart from the skills of effective crisis communication, EPI officers need to know scientific facts on radiation risks related to normal operation of nuclear facilities and possible accidents and basics of radiation protection. Therefore, the information brochures and teaching aids were developed for PR-departments of responding organizations in "nuclear regions" of Russia that cause major public concerns such as the South Urals, North and Far East. The brochures and multimedia programs are based on most recent results of analysis of the nuclear facilities impact on environment and population and reflect:

- environmental situation in the regions of location of nuclear- and radiation-hazardous facilities;
- radiation risks estimates under normal operational conditions and comparison radiation risks with chemical risks related to traditional industries of the regions;
- possible risks of emergencies and their radiological consequences;
- description of the regional systems of emergency response;
- basics of radiation protection.

Issued brochures and CDs:

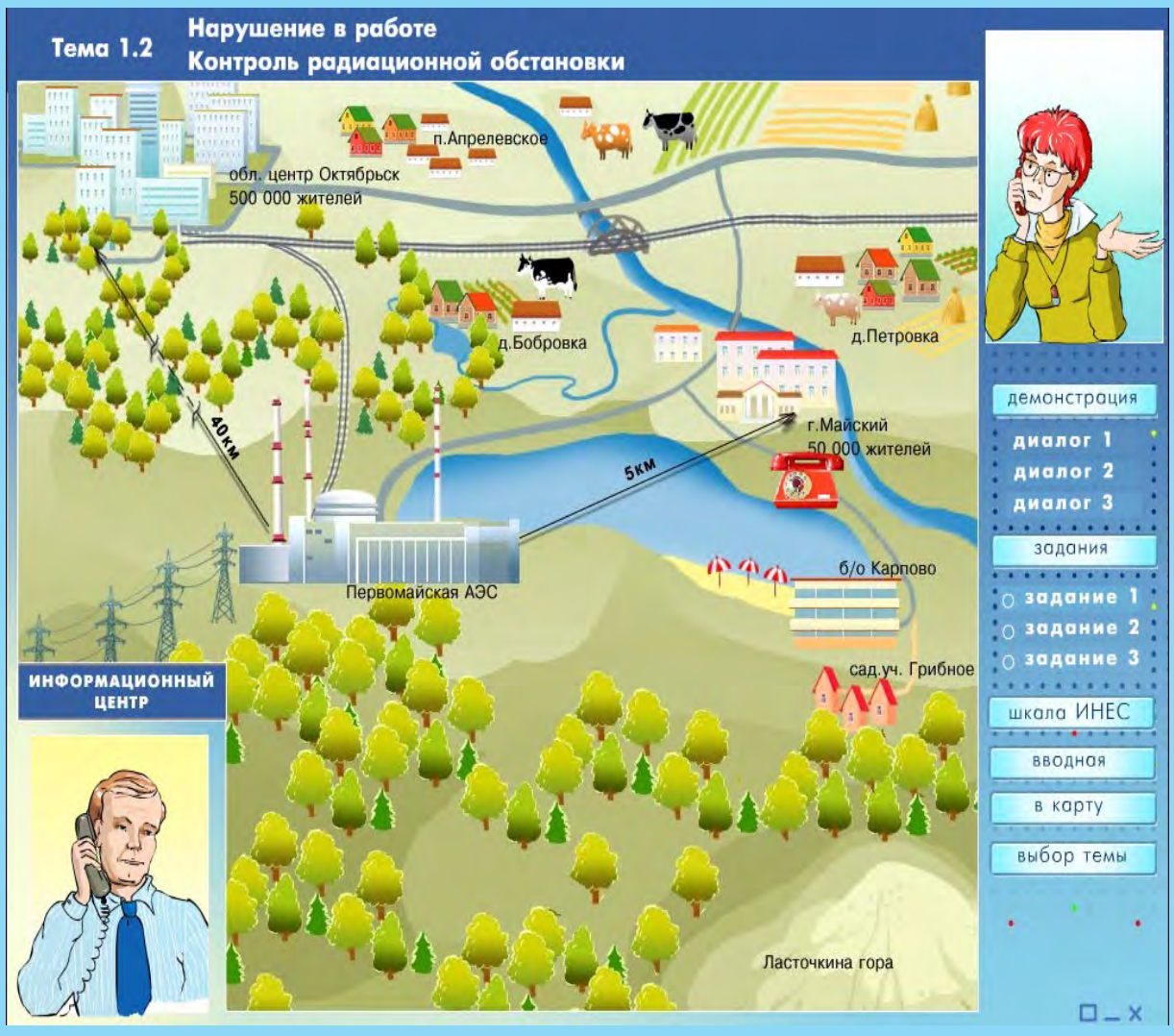
- "Industrial Urals. Nuclear technology and environment" (brochure +CD);
- "Industrial North. Nuclear technology and environment" (brochure+CD);
- "Far East. Nuclear technology and environment" (brochure + CD) ;
- "ABC of radiation protection" (brochure);
- "Keeping the public informed in radiological emergency" (brochure);

- Training aid “Risk communication in case of radiological emergencies” (textbook);

Printed issues on public information

- Computer simulator for hot line operators in case of incidents at NPPs (on CD);

Screenshot of the computer simulator on public information



- Computer business game “Master of crisis communication”(on CD);

Computer business game “Master of crisis communication”. Characters of the game:

Alexander, press-release writer working for Public Information Center at a hypothetic NPP

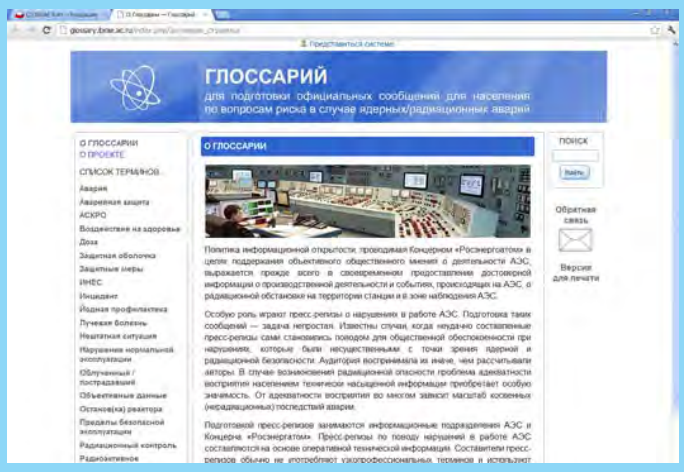
Vera, internet journalist working for the regional mass media

- Glossary for preparing official messages for the population in case of nuclear/radiation accidents (brochure + web publishing).

Glossary for preparing official messages for the population in case of radiation accidents

Brochure cover

Web page



Compendium of good practice in emergency public information in case of nuclear/radiation emergency is based on lessons learned from the past accidents including the Fukushima-Daiichi accident of 2011. It is devoted to technology of press-release writing in early phase of radiological emergencies and contains good and bad examples of press-releases published after real accidents and those prepared for emergency exercises.

The prepared brochures and training aids on radiation protection and emergency communication, as well as the computer simulators and business games were officially recommended by the Department of information and public relations of the “Rosenergoatom” Concern for the personnel of the public information centers at Russian NPPs and used in development of an advanced training course for the EMERCOM officers.

Training of the nuclear specialists in development, implementation and audit of environment management systems of ISO 14001 standard

A series of training courses for the management and leading specialists of Rosatom and facilities of the branch on improving of the environment management was held in 2003-2006 by IBRAE RAN with active support of the specialists of the U.S. Department of Energy. The courses were aimed at training of environment management specialists, and application of practical skills required for development, implementation and audit of environment management systems at the facilities of the branch in accordance with the requirements of ISO 14001 standard. Discussions held at the courses, covering various aspects of environment management at the level of the facility and industry, demonstrated that the facilities are highly interested in these problems. The training courses facilitated the active interest of the Russian nuclear facilities in application of the latest management techniques in the field of environmental safety and environment management.

The following training courses were developed and conducted:

- "ISO 14001. International environment management standard" (2003, IBRAE RAN);
- "Implementation of ISO 14001 standard at the facilities of Federal Atomic Energy Agency" (2004, MIPK "Atomenergo");
- "Implementation of ISO 14001 standard at the facilities of "Rosenergoatom" Concern" (2005, MIPK "Atomenergo");
- "Internal audit of environment management systems at Rosatom organizations" (2006, MIPK "Atomenergo");

Publications of training courses

The courses included lectures on various aspects of implementation and functioning of environment management systems, exercises, as well as reports of the representatives of nuclear industry facilities on practical experience of implementation of environment management systems. The exercises included tasks close to real challenges in development and implementation of environment management system and its audit. The exercises were based on specially developed models of a nuclear power plant and a nuclear fuel cycle facility. These models included information about the facility, its management structure, customers and suppliers of goods, character of processes, impacts on the environment and personnel, condition of environment in the vicinity of the site, qualification and experience of the personnel, management of RW and SNF, interaction with federal and local authorities, population, media, etc.

The main goals and tasks for this direction of works were:

- Analysis of practical issues of development and implementation of environment management systems and audit of environment management systems;
- Development of training materials for the courses, adaptation and inclusion of examples and exercises based on professional knowledge of IBRAE RAN specialists, as well as experience of Rosatom, facilities of the branch and the U.S. Department of Energy in the field of implementation of environment management systems.
- Training of management and environment protection specialists of Rosatom and the facilities of the branch in practical methods of development and implementation of environment management systems in accordance with ISO 14001 standard, and audit of environment management systems in accordance with the ISO 19011 standard.
- Practical experience gained at the courses helped to update the training materials and develop manuals for the instructors, which were implemented at the Training Center of MIPK “Atomenergo”.

Representatives of Rosatom and about 30 facilities of the branch attended the courses, along with specialists of the U.S. Department of Energy, IBRAE RAN and organizations of other agencies.

Upon completion of the training courses, the students were certified and recieved the official advanced training certificates of MIPK “Atomenergo”.

Participants of the training courses

Integration of the decision-making support system RECASS NT in case of emergency situations with similar systems in USA, Europe and Japan

One of the important lessons learned after the Chernobyl accident was intensification of activities on development of radiation safety systems in many countries. As a result of such activities, national systems ensuring the radiation monitoring, emergency response and radiation safety, are currently functioning in many countries.

An important part of such system is a decision-making support system (DMSS) for emergency situations at radiation-hazardous facilities (RHF), which is to ensure the analysis of the radiation situation resulting from the accident and forecast of its evolution, as well as development of recommendations on protection of RHF personnel, population, and environment affected by radioactive releases.

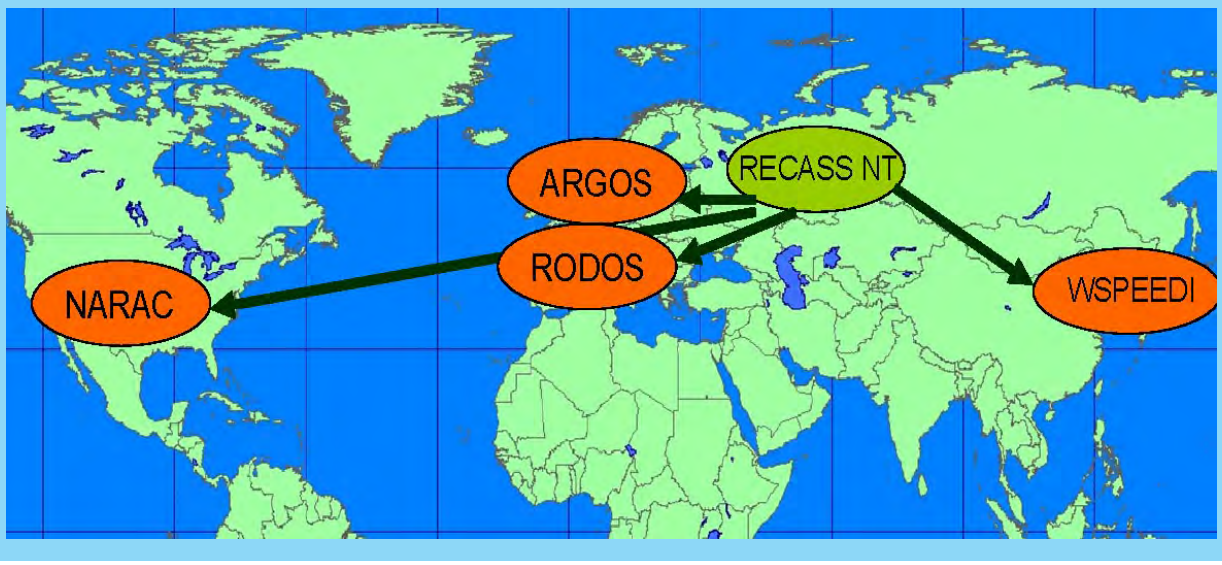
The most developed DMSS in foreign countries include RODOS (some European countries), NARAC (USA), WSPEEDI (Japan), ARGOS (Denmark, Canada, etc.).

The RECASS NT system for informational support of decision-making in emergency situations at radiation-hazardous facilities was developed by Scientific and Production Association "Typhoon" of Roshydromet after the Chernobyl accident and is being updated regularly. The main purpose of the RECASS NT system is analysis and forecast of the situation in case of emergencies at radiation-hazardous facilities (at the early stage of the accident), calculation of doses and developmet of recommendations on conduct of protective measures for the population, as well as transboundary transport assessment.

Integration of the RECASS NT system with similar systems listed above is aimed to achieve the following objectives:

- practical improvement in management of transboundary situations at radiation-hazardous facilities by identifying data and the required decision-making information;
- development (and testing) of procedures and methods required to assure timely and adequate data and information flows between the DMSS users.

Decision-making support systems for emergency situations at radiation-hazardous facilities



Various software tools were developed for RECASS NT system enabling operative on-line data and information exchange with DMSS of various countries. These data are required for analysis and forecast of emergency situations leading to release of radioactive contaminants to the environment, calculation of doses and development of countermeasure recommendations.

Such exchange allows better assessment of the emergency situation on the whole, including agreed assessments of the situation, coordination of urgent countermeasures, etc.

Works on integration were started in 2003.

Three stages of works can be distinguished in the framework of the project:

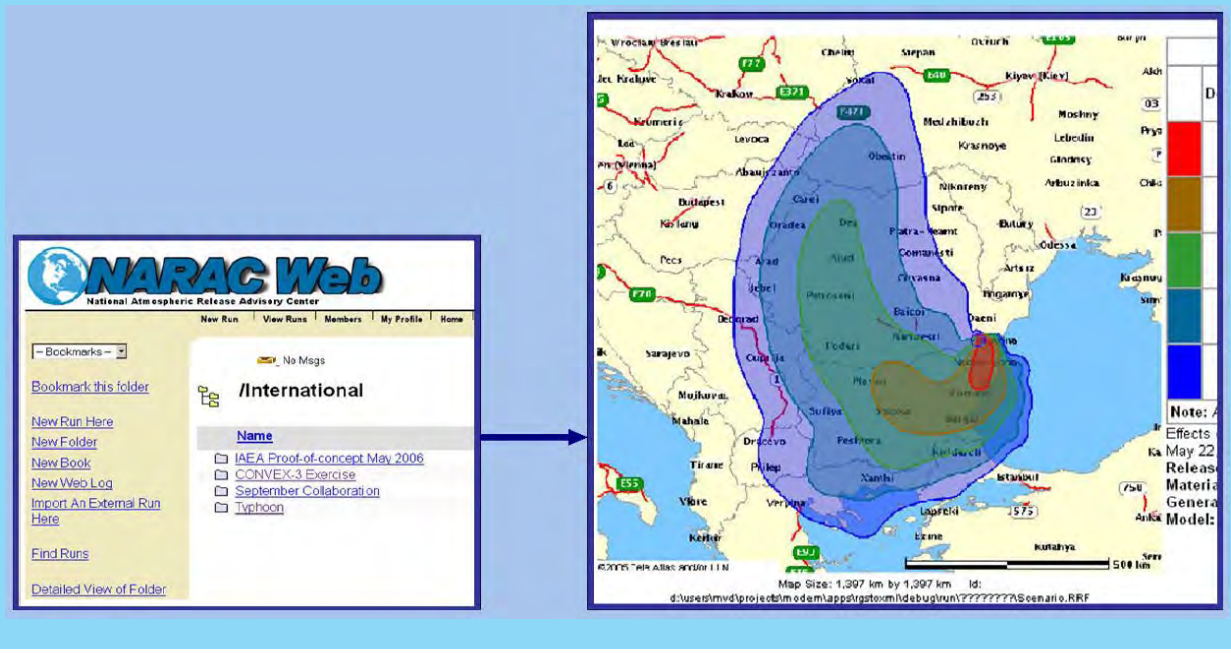
- First — 2003-2006 —development of agreed formats for storage of various types of data and information to be exchanged between DMSS, establishment of software in the framework of RECASS NT for processing of these formats and interaction with other DMSS.
- Second — 2007-2009 — development of functionality of the RECASS NT system, based on the experience of interaction with DMSS of other countries, testing interaction with various DMSS using the results of the first stage.
- Third — 2010-2012 — development of a software tool for calculations of air contamination and dose loads on the population.

The main results of the first stage (2003-2006)

One of the main results of the project in 2003 was categorization of data and information considered by the decision-making systems in emergency situations at radiation-hazardous facilities to be exchanged between the systems.

In 2004, the works were aimed at development of software ensuring presentation of calculation results on a common web-site. This activity in 2004 resulted in development of software in the framework of RECASS NT system allowing conversion of the results of the calculations and their transmission to the IXP NARAC Web.

Example of presentation of the results of RECASS NT calculations on IXP NARAC Web



In 2005, specialists of SPA “Typhoon” developed and implemented a system for exchange of data monitoring results between RECASS NT and NARAC systems. The procedure was based on periodic extraction of the data from the system databases to the FTP server of SPA “Typhoon”.

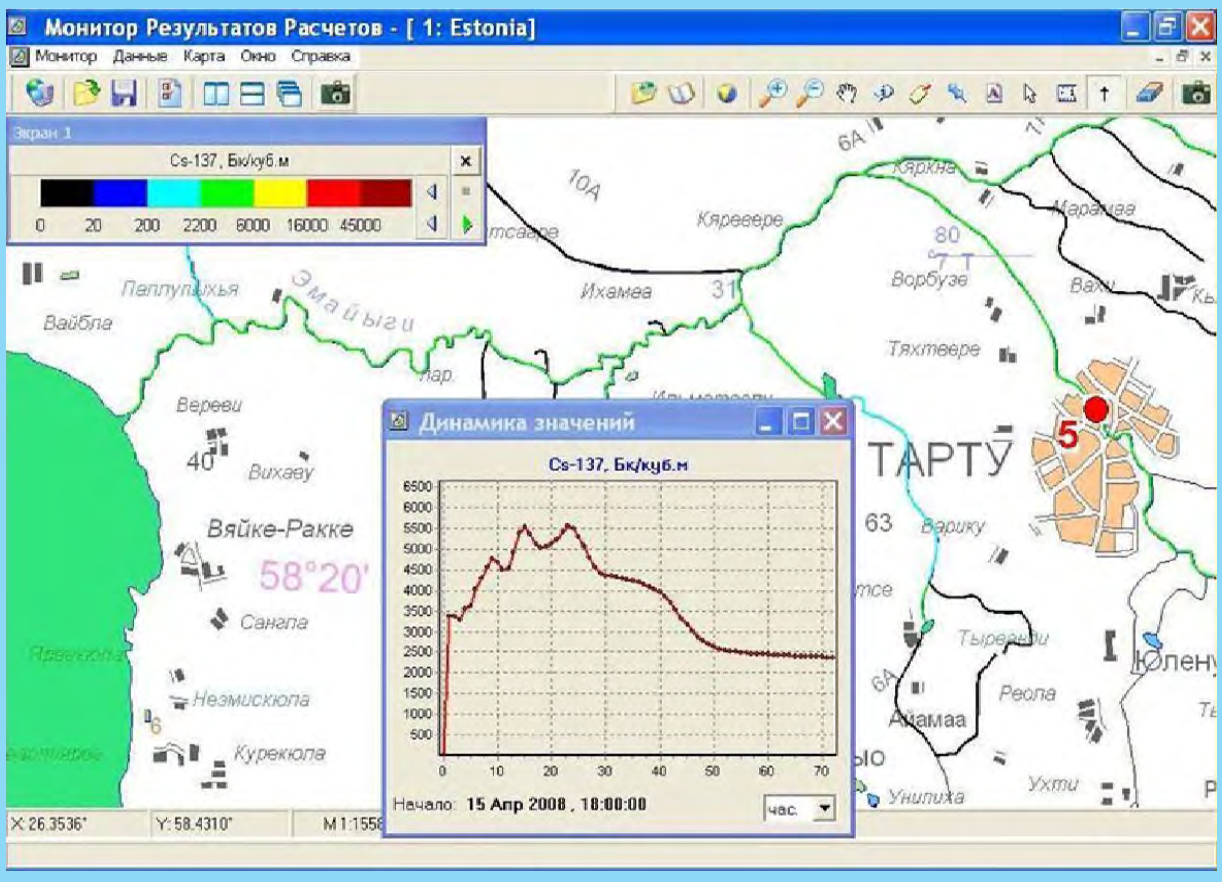
In 2006, the works were continued, and the module for results presentation was developed. The module converts the internal format data of RECASS NT to a widely used netCDF format.

The main results of the second stage (2007-2009)

Hydrological subsystem was updated for the RECASS NT system, thus enabling forecasting of radioactive contaminants spreading in water networks, which is an important task for assessing transboundary transport.

Another important result of the works at the second stage was development of an algorithm for restoring the source parameters on the basis of radiation monitoring data in the near zone. Radiation monitoring data include measurements of dose rate and concentration of separate radionuclides performed at stationary monitoring posts and using mobile meters. In 2009, this algorithm was implemented in the RECASS NT system and tested for local monitoring data in the vicinity of NPP and results of measurements obtained by a mobile radiation surveillance laboratory.

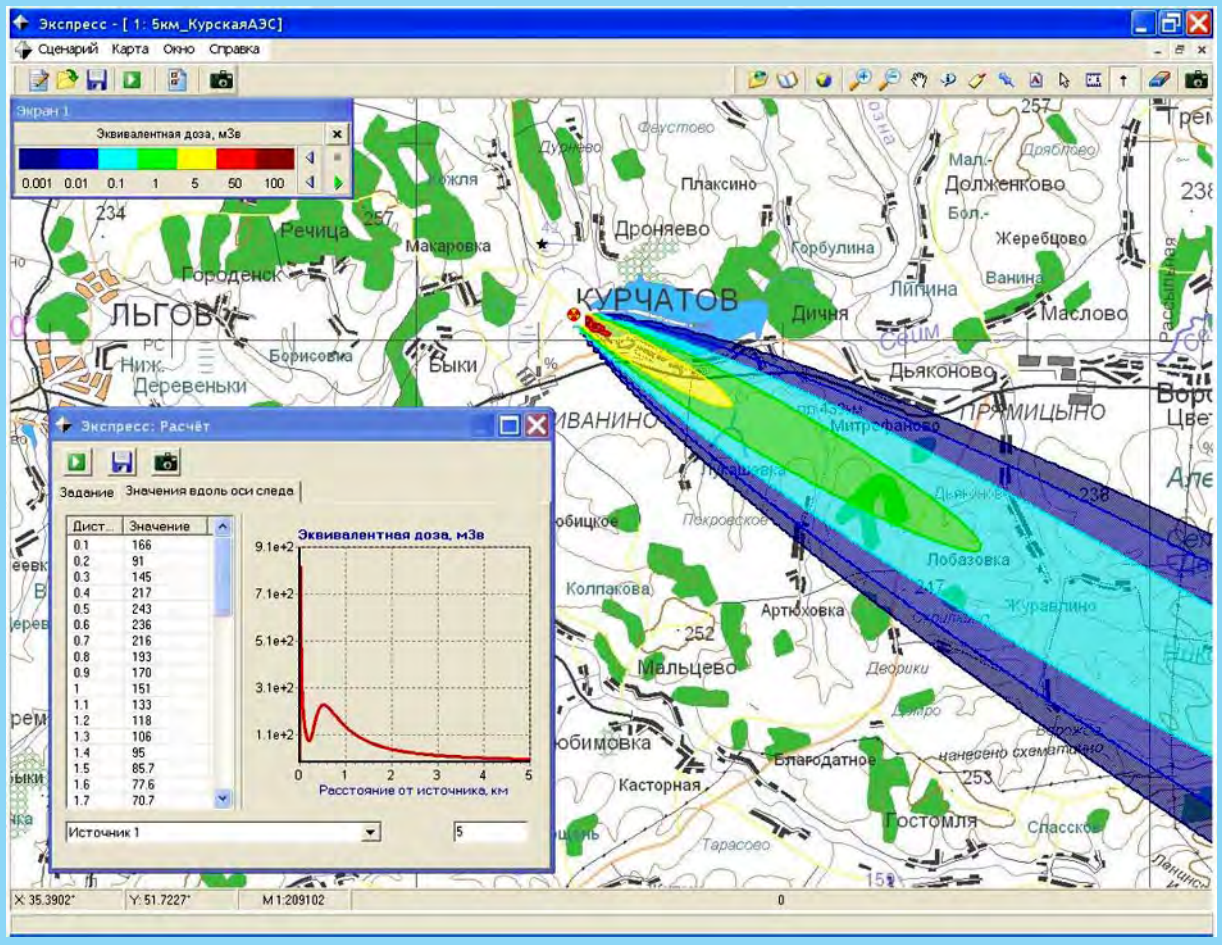
Example of using the hydrological chain for assessment of water bodies contamination in Baltic countries in case of an accident at the Leningrad NPP



The main results of the third stage (2010-2012)

Software tool EXPRESS was developed in 2010-2012 as a component of the RECASS NT system for preliminary calculations of air contamination and dose loads on the population for emergency atmospheric radioactivity releases. EXPRESS program software ensures easy entry of various accident scenarios, implementation of prompt simplified calculations for the early stage of the accident and display of the calculation results. These features of the software make it a convenient tool for use in training of experts to analyze radioactive atmospheric emergency releases.

Display of calculation results of the EXPRESS software in the RECASS NT system



In 2011-2012, the project on development of an improved technique and a software tool to assess possible emergency NPP releases on the population and the environment in the distant zone from the emergency site was implemented.

An improved technique for a conservative estimation of radiation effects on the population and the environment in the distant zone (50, 100, 500, 1000 km) in case of a large scale accident at a nuclear power plant was developed. The technique is based on performing of a series of calculations for a given scenario against the real weather data for a long period (several years) and selection of the maximal impact for this period. The transport model was developed using the Monte-Carlo method. The developed software was integrated into the RECASS NT system.

The meeting of the Russian-American working group on nuclear and radiological emergency response

(July 13-18, 2009, Angarsk Electrolysis Chemical Combine (AECC), Angarsk, Irkutsk Region)

The meeting was held in the framework of implementation of initiatives of the Presidents of Russia and the USA at Bratislava summit (2005). Representatives of the National Nuclear Security Administration of U.S. Department of Energy, State Corporation "Rosatom", IBRAE RAN, OJSC "Atomenergoprom", OJSC "AECC", ETC SPb attended the meeting.

The meeting agenda included a scientific and practical seminar on the obtained results and insights to further cooperation in the field of prevention and response to radiation incidents.

The key achievements and results were addressed, namely: organization and conduct of a series of exercises, trainings, and drills at nuclear facilities, training of the personnel of Rosatom facilities and conduct of training courses, establishment and modernization of training centres, source control and risk assessment in IRS handling, development of computer and training systems for radiation situation assessment and simulation of radiation situation measurements, portable hardware and software systems for support of emergency and rescue teams of Rosatom facilities in field conditions, development and issue of publications describing the experience of safe use of nuclear technologies in various regions of Russia, as well as brochures on informing the population about radiation accidents.

The second part of the meeting was devoted to a demonstration drill of the OJSC "AECC"special response forces. In accordance with the scenario, a turnover of carriage with a transportation casks containing uranium hexafluoride took place at the facility's railway station. One of the transportation casks was damaged, which resulted in scattering of UF_6 powder. Specialized emergency AECC brigade arrived and promptly started assessing the radiation situation and implementing measures on mitigation of the consequences of the transportation incident. The observers gave a high appraisal of the level of preparedness of the rescue teams, skills and professionalism of the personnel, reliability of the notification systems, high level of organization and coordination of actions of AECC services in emergency situations.

Participants of U.S.-Russian scientific and practical seminar on nuclear and radiological emergency response

Delegations of IBRAE RAN, State Corporation "Rosatom", DOE receive instructions on the emergency exercise

Joseph Krol, Associate Administrator for Emergency Operations, NNSA, speaks about the results and experience gained in cooperation of DOE, State Corporation "Rosatom" and IBRAE RAN

Vincent McClelland, Director of IEMC office, NNSA, analyzes the results of Russian-American activities in the field of emergency preparedness/response to radiation events

After the exercise, the U.S.-Russian delegation visited the Special Construction and Technological Bureau (SCTB) of OJSC "AECC", which specializes in manufacture of advanced dose-metering equipment.

Bilateral minutes on cooperation of the two countries in the field of emergency preparedness and response to radiological accidents and incidents was signed at the meeting. The minutes reflects all main measures on assuring further interaction in the activity on preparedness to mitigate radiological accidents and incidents consequences (drills and exercises). A set of projects in the framework of cooperation between U.S. DOE, State Corporation "Rosatom" and IBRAE RAN was also developed.

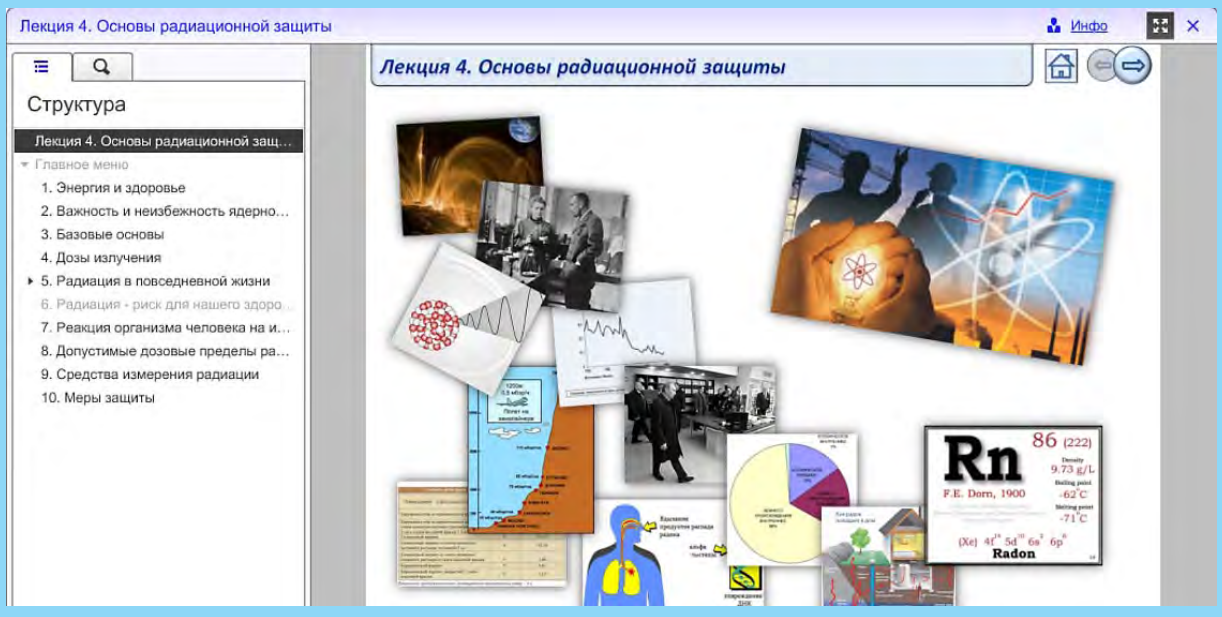
Training videos for ERT of Rosatom and EMERCOM

The objective of this project is to prepare educational training video materials on radiation safety and emergency response in case of radiation accidents. The videos are intended for ERT members of Rosatom and EMERCOM of Russia.

Demonstration of ERT equipment

The list of video data materials includes more than 300 films in the field of use of atomic energy that are stored at enterprises, in the scientific organizations, centers of technical support, etc. Selection of films about the various types of facilities using atomic energy, various emergency situations, videoconferences, seminars in the field of emergency response, films about exercises and drills is of primary interest of this project. The works on the project include: inventory of video data, digitization of videocassettes, categorization of records, creation of topical collections on various aspects of emergency response, preparation of training video disks and catalogues, approbation of materials at emergency rescue services of Rosatom and EMERCOM of Russia.

Multimedia lecture "Basics of radiation protection"



The basic topics of educational video data:

- Basic principles of radiation safety.
- Sources of emergency radiation hazards at RHF.
- Accidents and incidents at RHF in Russia and other countries.
- Forces and assets of radiation emergency response.
- Exercises and drills on radiation emergency response.

Each topic contains not less than two-hour class of video data. Systematization of other initial materials that are used for preparation of training materials was completed. The total available slides (photo, drawings, tables, schedules, cards, interactive applications, etc.) with corresponding references exceed 5000 items.

The project foresees creation of electronic library of limited edition textbooks, monographs, handbooks, and reviews on nuclear industry topics.

Analysis of IAEA documents of the series “Nuclear Education and Training” was carried out in order to use the IAEA recommendations for development of training materials in radiation safety and emergency response.

List of projects implemented under U.S. DOE-IBRAE RAN cooperation

- ANNEX 1 Conduction of scientific-technical works and organization of the general administration and scientific-technical support for the "Apatitvodokanal" (Apatity Water Utility) Pilot Project under the purview of the JCCRER.
- ANNEX 2 Realization of the scientific-technical works on organization and conduction of table top exercise at the Bilibino NPP.
- ANNEX 3 Development and conduct of training courses on emergency response for Minatom SCC personnel.
- ANNEX 4 Development of the Project Management Plan for the Phase II, Source Control Pilot Project at a facility handling radioactive and/or nuclear materials under the purview of the JCCRER.
- ANNEX 5 Development of public information materials on environmental safety and radiation protection of population in regions with nuclear installations.
- ANNEX 6 Training Center for advanced training of specialists of Minatom of Russia and other Russian Ministries in emergency preparedness and emergency response.
  - TASK ORDER 1 Phase I, Establishment of the MIPK Training Center.
  - TASK ORDER 2 Development and presentation of a one day training course on basics of ISO 14001 standard applied to facilities of Minatom of Russia.
  - TASK ORDER 3 Development and Presentation of a 3-day Training Course on Implementing ISO 14001 Standard at Facilities of the Federal Agency for Atomic Energy of Russia.
  - TASK ORDER 4 Development of the training and methodical base of the MIPK Training Center.
  - TASK ORDER 5 Training of nuclear industry specialists of Russia in basics of ISO 14001 Standard.
  - TASK ORDER 6 Further Development of the Training and Methodical Base of the MIPK Training Center.
  - TASK ORDER 7 Phase IV, Establishment of the MIPK Training Center.
  - TASK ORDER 8 Development of the MIPK Training Center.
  - TASK ORDER 9 Development of supporting computer tools for the MIPK Training Center.
- ANNEX 7 Conducting of drills, trainings and exercises on emergency preparedness and emergency response at radiation hazardous facilities.

  TASK ORDER 1 Exercise "NIIAR-2003".

  TASK ORDER 2 Exercise at the Smolensk NPP – 2003.
  - TASK ORDER 3 Roshydromet support systems for decision making in emergency Harmonization the support system for decision making RECASS NT in case of emergency situation with similar systems of USA, Europe and Japan.
  - TASK ORDER 4 Development and upgrade of software for local crisis centers of Minatom facilities.
  - TASK ORDER 5 Future harmonization of the decision support system RECASS NT in case of an emergency situation with similar systems of USA, Europe and Japan.
  - TASK ORDER 6 Exercise "Transportation accident".
  - TASK ORDER 7 Exercise at Beloyarsk NPP–2004.

- TASK ORDER 8 Exercise on assessing consequences and responding to radioactive contamination of territory in Moscow city.
- TASK ORDER 9 Harmonization of the decision support system RECASS NT in case of an emergency situation with similar systems of USA, Europe and Japan, phase III.
- TASK ORDER 10 Development and upgrade of software (TRACE_WIN and Nostradamus) for crisis centers of Minatom facilities.
- TASK ORDER 11 Phase IV Harmonization of the decision support system "RECASS NT" in case of an emergency situation with similar systems of USA, Europe and Japan.
- TASK ORDER 12 Portable Analysis Capability (laptop based).
- TASK ORDER 13 Adaptation of "Nostradamus" and "Trace_WIN" software for FSUE "ME "Zvezdochka", FSUE "Atomflot" and FSUE "SRZ Nerpa".
- TASK ORDER 14 Adaptation of "Nostradamus" and "Trace_WIN" software for three radiation-hazardous facilities of Rosatom.
- TASK ORDER 15 Development and adaptation of simulation system to be used in practical exercises of emergency rescue team experts in radiation safety and radiation survey.
- TASK ORDER 16 Exercise on assessing consequences and responding to radiation emergency in the North-West region of Russia.
- TASK ORDER 17 Phase V Harmonization of the decision support system "RECASS NT" in case of an emergency situation with similar systems of USA, Europe and Japan.
- TASK ORDER 18 Portable System for Analysis of radiation situation.
- TASK ORDER 19 Development and adaptation of simulation system to be used in practical exercises of emergency rescue team experts in radiation safety and radiation survey, phase II.
- TASK ORDER 20 Development and adaptation of simulation system to be used in practical exercises of emergency rescue team experts in radiation safety and radiation survey, phase III.
- TASK ORDER 21 Adaptation of "NOSTRADAMUS" and "TRACE_WIN" software to the specific features of Russian nuclear- and/or radiation-hazardous facilities.
- TASK ORDER 22 Exercise on assessing consequences and responding to radiation emergency in the North-West region of Russia "Arctic-2010".
- TASK ORDER 23 Modernization of equipment and methodological tools of emergency rescue team at SC "Zvezdochka".
- TASK ORDER 24 Organization and conduct of scientific practical seminar on emergency preparedness and response with the follow-up analysis of lessons learnt "BAYKAL-2009".
- TASK ORDER 25 Harmonization of the decision support system "RECASS NT" in case of an emergency situation with similar systems of USA, Europe and Japan, Phase VI.
- TASK ORDER 26 Development of prototype of information support and communication systems to be used by rescuers in emergency works ("Smart Rescue Team").
- TASK ORDER 27 Development of a comprehensive microcomputer-based system to support the experts at the site of accident.
- TASK ORDER 28 Exercise at Novovoronezh subsidiary (NS ETC) of ETC of Rosatom.
- TASK ORDER 29 Enhancement of the "Nerpa" SY emergency response system in accordance with the lessons learned in "Arctic-2010" exercise.
- TASK ORDER 30 Exercise "Arctic-2012".

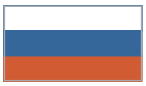
- TASK ORDER 31 Development of program module (integrated in the decision support system “RECASS NT”) to assess maximum radiation effect in far-out zone in case of an accident at NPP.
- TASK ORDER 32 Exercise on assessing consequences and responding to radiation emergency in the North-West region of Russia “Arctic-2014”.

- ANNEX 8 Development and improvement of emergency response system elements in the ministries, agencies and organizations participating in the activities related to prevention, elimination and minimization of radiation accident consequences.
  - TASK ORDER 1 Organization of on-line scientific and technical support to MDCDES Monitoring and Forecasting Center (MFC) by the Technical Crisis Center (TCC) of IBRAE RAS for population protection in case of emergency situation at nuclear and radiation hazardous facilities of Moscow city.
  - TASK ORDER 2 Development of Textbook on Population Behavior in Case of Radioactive Contamination.
  - TASK ORDER 3 Creation of hypertext database of normative documents on emergency response.
  - TASK ORDER 4 Scientific, Technical and Organizational Support to activity involving prevention and response to radiation emergency issues in the Arctic and Sub Arctic regions.
  - TASK ORDER 5 Development of Brochure on Far East Region of Russia.
  - TASK ORDER 6 Public Emergency Information Tutorial.
  - TASK ORDER 7 Planning Public Communication in Case of Radiation Emergency or Events Perceived by the Public as a Radiation Emergency.
  - TASK ORDER 8 Development of the system for scientific and technical support to National Crisis Situation Management Center of EMERCOM rendered by TCC IBRAE RAN.
  - TASK ORDER 9 Development of technical Conceptual Design for enhancing the system of radiation monitoring and emergency response at radiation hazardous facilities in the Far East Region.
  - TASK ORDER 10 Computer simulation game on emergency public information.
  - TASK ORDER 11 Glossary for emergency risk communication in case of a nuclear/radiation accident.
  - TASK ORDER 12 Establishment of a training center for the specialists of emergency rescue teams of EMERCOM of Russia and other agencies based on IBRAE RAN training center

    TASK ORDER 13 Preparation of training videos for ERT of Rosatom and EMERCOM
  - TASK ORDER 14 Compendium of good practices in emergency public information applicable for nuclear/radiation accidents
- ANNEX 9 Development of the Source Control Project Management Plans for FSUE “Atomflot” and FEF “Zvezdochka”.
- ANNEX 10 Training Center of the Emergency Technical Center of Rosatom (St. Petersburg).
  - TASK ORDER 1 Creation and development of the ETC Training Center, Phase I.
  - TASK ORDER 2 Creation and development of the ETC Training Center, Phase II.
  - TASK ORDER 3 Development of the ETC Training Center, Phase III.
  - TASK ORDER 4 Development of training base for Rosatom's emergency rescue teams using the experience of establishment of Training Centers at MIPK (Moscow) and ETC (St. Petersburg)

Abbreviations

AECC	Angarsk Electrolysis Chemical Combine
ARMS	Automated Radiation Monitoring System
BESC	Branch Emergency Situation Commission
CC	Crisis Center
CD&ES	Civil Defence and Emergency Situations
CIPK	Central Institute for Advanced Training
DHMS	Department of Hydrometeorological Service
DMSS	Decision-making Support System
DNRS	Department for Nuclear and Radiation Safety of Rosatom
DOE	Department of Energy
EMERCOM	The Ministry of the Russian Federation for Civil Defence, Emergencies and Elimination of Consequences of Natural Disasters
EMRDC	Emergency Medical Radiation Dosimetry Centre
EPPR	Emergency Preparedness, Prevention and Response
ERT	Emergency Rescue Team
ES	Emergency Situation
ESC	Emergency Situation Commission
ETC SPb	Emergency Technical Center of Rosatom (St-Petersburg)
FA	Fuel Assembly
FMBA	Federal Medical-Biological Agency
FMBC	Federal Medical Biophysical Centre
FRD	Fuel Research Department
FSUE	Federal State Unitary Enterprise
IAEA	International Atomic Energy Agency
IBRAE RAN	Nuclear Safety Institute of the Russian Academy of Sciences
IEMC	Office of International Emergency Management and Cooperation
IRS	Ionizing Radiation Source
MD	Main Department
MIPK	Moscow Institute for Advanced Training
NCCSM	National Center for Crisis Situation Management of EMERCOM
NNSA	National Nuclear Security Administration
NPP	Nuclear Power Plant
NRHF	Nuclear- and Radiation-Hazardous Facility
NS	Nuclear Submarine
OJSC	Open Joint Stock Company
PA	Production Association
RHF	Radiation-Hazardous Facility
RS	Radiation Safety
RSES	Russian State System of Prevention and Mitigation of Emergency Situations
RW	Radioactive waste
SC “Zvezdochka”	Shiprepairing Center “Zvezdochka”
SCC	Situation Crisis Center of Rosatom
SCTB	Special Construction and Technological Bureau
SNF	Spent Nuclear Fuel
SPA	Scientific Production Association
SEB	Special Emergency Brigade
SSC RF NIIAR	State Scientific Center of the Russian Federation “Research and Development Institute of Nuclear Reactors”
SUE	State Unitary Enterprise
SY	Shipyard
TC	Training Center
TCC IBRAE RAN	Technical Crisis Center of IBRAE RAN



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