



**Ministry of Industry and Trade  
of the Russian Federation**



**Government  
of the Archangelsk Region**



**Energy Safety Analysis Centre  
of IBRAE RAN**

## **Enhancement of the Radiation Monitoring and Emergency Response System in the Archangelsk Region**

The Project was implemented within the framework of the Agreement  
“On Multilateral Nuclear Environmental Program in the Russian Federation”

Funded by the “Northern Dimension” Environmental Partnership Support Fund

The European Bank for Reconstruction and Development is the Administrator of the Fund

## Project Recipients



MD EMERCOM on the Archangelsk Region  
CSMC of EMERCOM on the Archangelsk Region



Government  
of the Archangelsk Region



FSBA "Northern DHEM"



JSC "NIPTB "Onega"



JSC "CS "Zvezdochka"



Administration  
of Severodvinsk



JSC "PA "Sevmash"



FSUE "Krylov CNII"

Within the framework of the Project, the Government of the Archangelsk Region was represented by: Agency of Natural Resources and Ecology, Agency of State Fire-fighting Service and Civil Protection of the Archangelsk Region, State Public Institution of the Archangelsk Region "Centre for Ensuring Civil Protection Activities", State Budgetary Institution of the Archangelsk Region "Rescue Service", State Public Institution of the Archangelsk Region "Centre for Environmental Management and Protection", State Budgetary Education Institution of Professional Training of the Archangelsk Region "Training Centre for Civil Defense, Emergencies and Fire Safety".



*All the residents of the Archangelsk Region can feel themselves perfectly safe living near the enterprises that glorified the Archangelsk land as a cradle of nuclear submarine fleet of Russia. The Project allowed implementation of the most perfect tools at all levels. This ensures the safety of the population, the personnel of the enterprises and environment in case of any incidents related to use of nuclear energy.*

*Governor of the Archangelsk Region  
I. A. Orlov*



*Territorial automated radiation monitoring systems represent an important element of monitoring the safe use of nuclear energy. The State Corporation "Rosatom" is supporting the development of such systems and will do so in the future.*

*The State Corporation "Rosatom" currently provides access to the data on the radiation situation in the vicinity of its nuclear-hazardous facilities in a real time mode. The similar mechanisms are currently considered for publication of the data from the territorial monitoring systems, including those intended for informing the population of the Archangelsk Region.*

*Director General of the State Nuclear  
Energy Corporation "Rosatom"  
S. V. Kirienko*



*The tasks of enhancement of the system for population protection in radiological emergencies have been resolved within the framework of the Project. The response systems at facility, municipal, territorial and federal levels were upgraded taking into account the Russian and international experience. We are rendering the scientific support for the established system.*

*Director of IBRAE RAN  
Corresponding Member of the Russian Academy of Sciences  
L. A. Bolshov*



*Development of the territorial monitoring and emergency response systems was named a priority task at the first stages of developing the strategic master-plan for comprehensive decommissioning and remediation of territories in Northwest Russia. This will ensure the safety of the population in the regions where the works are conducted, will enhance their transparency thus forming a positive perception of the works among the population.*

*Academician of the Russian Academy of Sciences,  
Scientific supervisor of the works on development  
of the Strategic master-plan for comprehensive decommissioning  
and remediation of territories in the Northwest Russia  
A. A. Sarkisov*



## Introduction

Extensive works aimed at decommissioning of a large number of radiation-hazardous naval facilities are being carried out in the Northwest Russia. An important part of these activities is nuclear, radiation, and environmental safety assurance.

One of the key elements of the system for safe decommissioning of radiation-hazardous facilities is preparedness to respond to possible radiological incidents and accidents.

Availability of the modern emergency response system in the Murmansk and Archangelsk Regions ensures protection of the population and territories in case of radiological emergencies at facilities related to nuclear submarine decommissioning, spent nuclear fuel and radioactive waste management.

The Projects on enhancement of radiation monitoring and emergency response systems in the Murmansk and Archangelsk Regions were listed as the top priority projects in the Strategic Master Plan for decommissioning of NS and other radiation-hazardous facilities of the Northwest Russia. The Plan was developed in accordance with the initiative of the “Northern Dimension” Environmental Partnership (NDEP) Support Fund.

The project “Enhancement of the radiation monitoring system of the Murmansk Region” was successfully implemented in 2005–2008. The results of the project received a high appraisal of the IAEA Mission on assessment of emergency preparedness in the Region, as well as of Russian and international experts.

The project “Enhancement of the radiation monitoring and emergency response system in the Archangelsk Region” (Project) commenced in March 2009 on request of the Government of the Archangelsk Region. The works were funded by the NDEP Support Fund via the European Bank for Reconstruction and Development. The Project was implemented by the Energy Safety Analysis Centre of IBRAE RAN. The overall duration of the Project was 30 months. The works included integration of the systems in the Murmansk and Archangelsk Regions.

The main goal of the Project is an essential improvement of the radiation monitoring and emergency response system to mitigate emergencies at the radiation-hazardous facilities in the Archangelsk Region.

The Project is aimed at enhancing the preparedness of the emergency response forces and assets, minimisation of the consequences of possible radiological accidents, increasing the effectiveness and efficiency of decision-making and realisation of population and environment protection measures, as well as informing the population.



*The accident at the nuclear power plant “Fukushima-1” in Japan showed that the emergency preparedness to respond to any potential accidents and coordination of activities are required along with increasing the reliability of the facilities that use nuclear energy. The Project allowed enhancing the qualitative level of preparedness in the Archangelsk Region to respond to any nuclear related incidents. The systems established within the framework of the Project could be enhanced in the future and applied for prevention and mitigation of other technogenic and natural emergency situations.*

*Deputy Governor of the Archangelsk Region  
on infrastructure development  
A. V. Alsufiev*

### The main directions of works under the Project:

- establishment of the territorial automated radiation monitoring system (ARMS) and modernisation of facility's ARMS, including mobile radiometric laboratories;
- establishment of an information and analytical system of response to radiological emergency situations within the Archangelsk territorial subsystem of prevention and response to emergency situations, covering the Government of the Archangelsk Region, territorial bodies of EMERCOM of Russia, regional CD and ES bodies and the Administration of Severodvinsk;
- establishment of local crisis centres of JSC "CS "Zvezdochka" and JSC "PA "Sevmash", enhancement of emergency response system at the level of facilities;
- setting up communication systems for transfer, acquisition, processing, storage and presentation of data for participants of emergency response at the facility, regional and federal levels;
- development of software and hardware systems for expert support of decision-making on personnel, population and environment protection activities;
- establishment of the on-line expert support system at the Technical Crisis Centre of IBRAE RAN and the Branch Situation Crisis Centre of the Ministry of Industry and Trade of the Russian Federation at the FSUE "Krylov CNII";
- establishment of specialised training centre and training of specialists;
- integration of the monitoring and emergency response systems of the Murmansk and Archangelsk Regions.

### After completion of works within the Project, the additional works were performed in 2012 in accordance with the recommendations of the Russian and foreign experts:

- equipping of Training Centre with specialised educational aids, and training of the personnel of the organisations — participants of emergency response system;
- preparation and conduct of exercise to practice the interaction between participants of emergency response system taking into account the recommendations developed by the IAEA mission experts;
- development of proposals to enhance the created system of radiation monitoring and emergency response.



*Regional monitoring and emergency response systems are being established in a number of regions of the Russian Federation within the framework of the Federal Targeted Program "Nuclear and Radiation Safety for 2008 and up to 2015".*

*While implementing the Project, we paid attention not only to expansion of such systems to other territories, but also to their integration at the Centres for crisis management of the Regional centres of EMERCOM (at the level of federal districts) and at the National Crisis Situations Management Centre of EMERCOM of Russia (at the federal level).*

*Deputy Director of IBRAE RAN  
for science and long-run development  
R. V. Arutyunyan*

# Project Management Commission

Commission under the Governor of the Archangelsk Region for management of the Project was established for coordination of works and control of all aspects of the Project implementation. The Commission includes all representatives of end users. The Commission is headed by V. V. Shishov, the Deputy Governor of the Archangelsk Region on natural resources and ecology.



*Project Management Commission meetings*

## Project Implementation Team

The Project implementation team was formed in accordance with the order of the ESAC IBRAE RAN Director General. The team consists of the head of the team, two deputies, and leaders on various directions of works. The team's function is to ensure effective management of works and control over the implementation of the Project.



*I. A. Osipiyants and K. V. Ogar  
at the meeting with the Commission members*



*The team members are discussing the status of works under the Project.  
I. G. Akimova, E. V. Antony, L. G. Shpinkova, S. N. Krasnoperov,  
K. V. Ogar, D. A. Pronin, V. P. Kiselev, S. A. Shickin, S. L. Gavrilov*



*ESAC IBRAE RAN staff members participating in the Project implementation*

# Information and Analytical System of Response to Radiological Emergency Situations in the Archangelsk Region

IAS was established within the framework of the Project as an element of the Archangelsk territorial subsystem of the unified state system for prevention and response to emergency situations.

While establishing the IAS, the distinctive features of response to radiological incidents were taken into account, including the need for operative interaction of a wide range of competent organisations, engagement of scientific potential for qualified assessment of the situation, training and advanced training of specialists taking into account a specificity of each organisation.

IAS functioning is supported by:

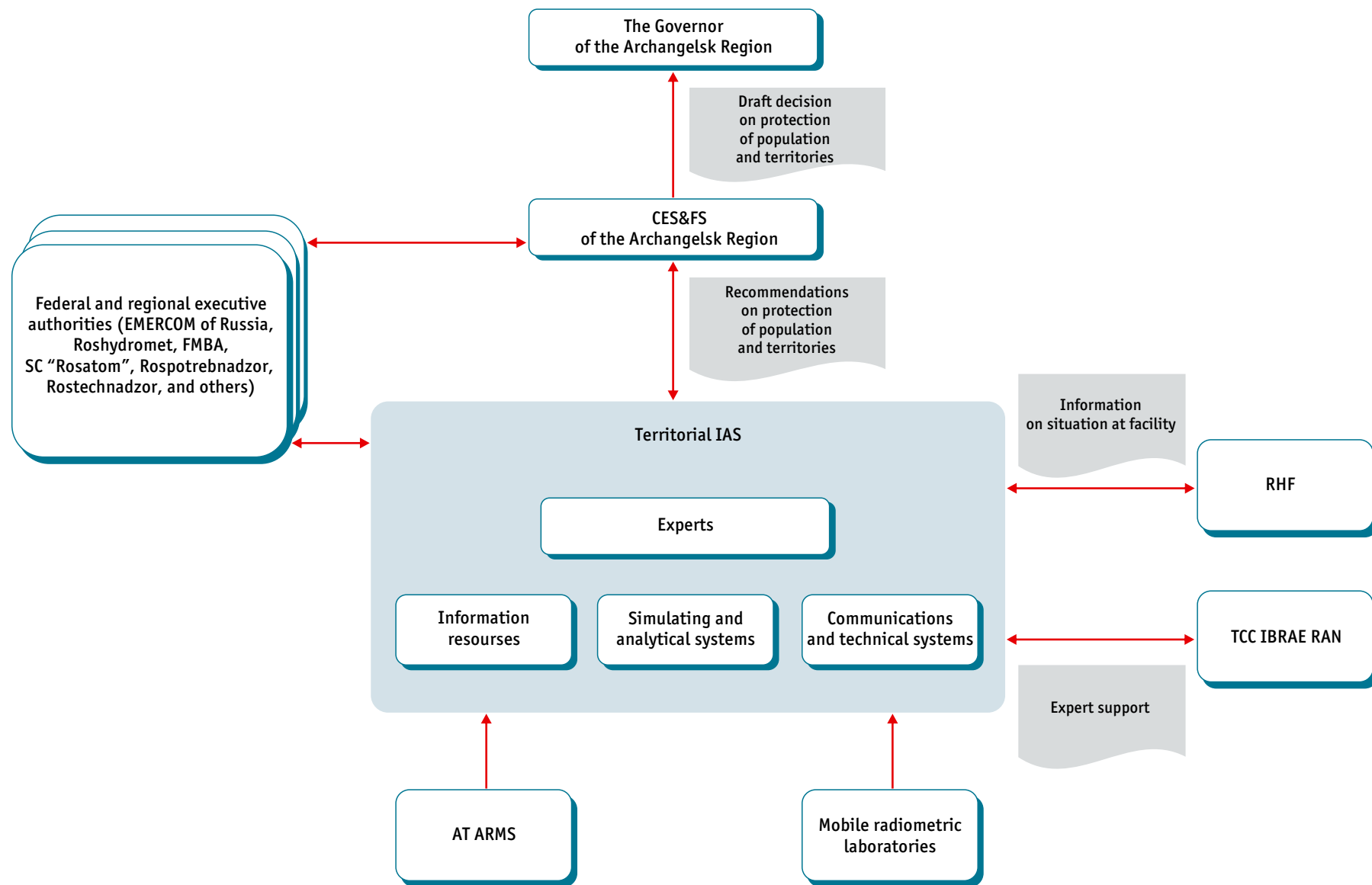
- Main Department of EMERCOM in the Archangelsk Region;
- CSMC of EMERCOM in the Archangelsk Region;
- FSBA “Northern DHEM”;
- Administration of the Governor of the Archangelsk Region;
- State Public Institution of the Archangelsk Region “Centre for ensuring civil protection activities”;
- State Budgetary Institution of the Archangelsk Region “Rescue service”;
- State Public Institution of the Archangelsk Region “Centre for environmental management and protection”;
- State Budgetary Education Institution of Professional Training of the Archangelsk Region “Training Centre for Civil Defence, Emergencies and Fire Safety”;
- Administration of Severodvinsk.



## IAS main tasks:

- informational and technical support to the Government of the Archangelsk Region, CES&FS of the Archangelsk Region, Administration of Severodvinsk, and state executive authorities for conduct of measures on prevention and mitigation of radiological emergencies;
- analysis and forecasting of consequences of radiological emergencies in co-operation with scientific and technical support centres;
- development of recommendations on protection of population, territory and environment;
- acquisition, processing, analysis, storage and presentation of radiation monitoring data from AT ARMS and MRL;
- assurance of operative interaction between the participants of emergency response.





*IAS in the system of response to radiological emergencies*

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### *Monitoring of the main parameters of radiation situation*

AT ARMS was set up to provide automated monitoring of the main parameters of the radiation situation in the territory of the Archangelsk Region. The system is operated by FSBA "Northern DHEM", and on-line monitoring of the readings is provided by on-duty service of CSMC of MD EMERCOM of Russia in the Archangelsk Region.

Specialised MRL were developed for FSBA "Northern DHEM" and Archangelsk regional rescue service to monitor the radiation situation outside the locations of stationary monitoring posts, and for verification of the readings of stationary posts.

AT ARMS and MRL supplement the non-automated scheduled monitoring of the radiation situation in the territory of the Archangelsk Region.

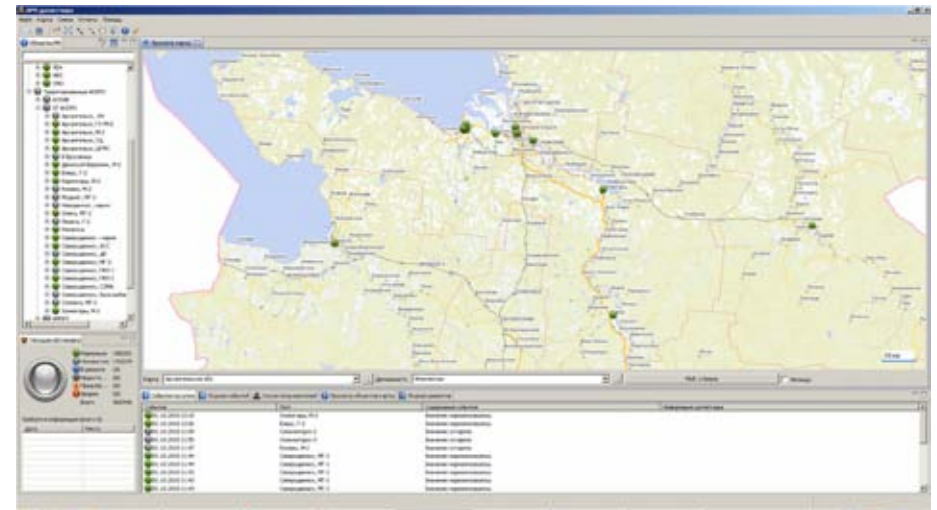
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*Monitoring post in Severodvinsk*



*MRL of the FSBA "Northern DHEM"*



*Dispatcher of radiation monitoring application*

## Decision-making support

One of the main tasks of IAS is an expert on-line assessment of the situation, decision-making support in case of radiological emergencies, or in situations perceived as emergencies by the public.



## To ensure the decision-making support:

- the territorial bodies of EMERCOM of Russia, Roshydromet, authorised organisations of the Government of the Archangelsk Region are equipped with specialised hardware and software for monitoring of the radiation situation, forecasting of radioactivity transport in air and water, as well as specialised information resources for assessment of the situation and decision-making on protection of population and territories;
- scientific and technical support to the organisations of the Archangelsk Region is provided by the Technical Crisis Centre of IBRAE RAN;
- the personnel of organisations were trained;
- Training Centre was set up.

### *Organisation of joint work and furnishing of information*

The Government of the Archangelsk Region, MD EMERCOM on the Archangelsk Region, FSBA "Northern DHEM" and Administration of Severodvinsk are equipped with the required hardware and communication systems for organisation of joint work and on-line information exchange in case of radiological emergencies or situations perceived by the population as emergencies.

#### **Each hardware system includes:**

- communication and server systems;
- automated personnel workstations;
- videoconferencing and telephone systems;
- presentation systems;
- uninterrupted power supply systems.



Dedicated optical fibre communication lines were established for communications between the organisations in Archangelsk and Severodvinsk; radio relay communication channel was set up between two cities, dedicated digital communication lines are leased. Main communication lines are backed up.



The Situation Centre for emergency response to radiological emergencies of the Government of the Archangelsk Region is intended to supply information to the Governor of the Archangelsk Region and the Government of the Region.

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A room for operation of CES&FS of the Archangelsk Region at the MD EMERCOM of Russia in the Archangelsk Region was additionally equipped, and the workstations for experts were furnished. The Situation Centre was set up at the Administration of Severodvinsk for work of the CES&FS of the Administration of Severodvinsk.

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*Meeting room for CES&FS of the Archangelsk Region*



*Situation centre of the CES&FS  
at the Administration of Severodvinsk*



*FSBA "Northern DHEM" experts  
at the centre for collecting and processing information*



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Workstations for experts and specialists were set up at the FSBA "Northern DHEM"; on-line interaction with the participants of the emergency response was established.

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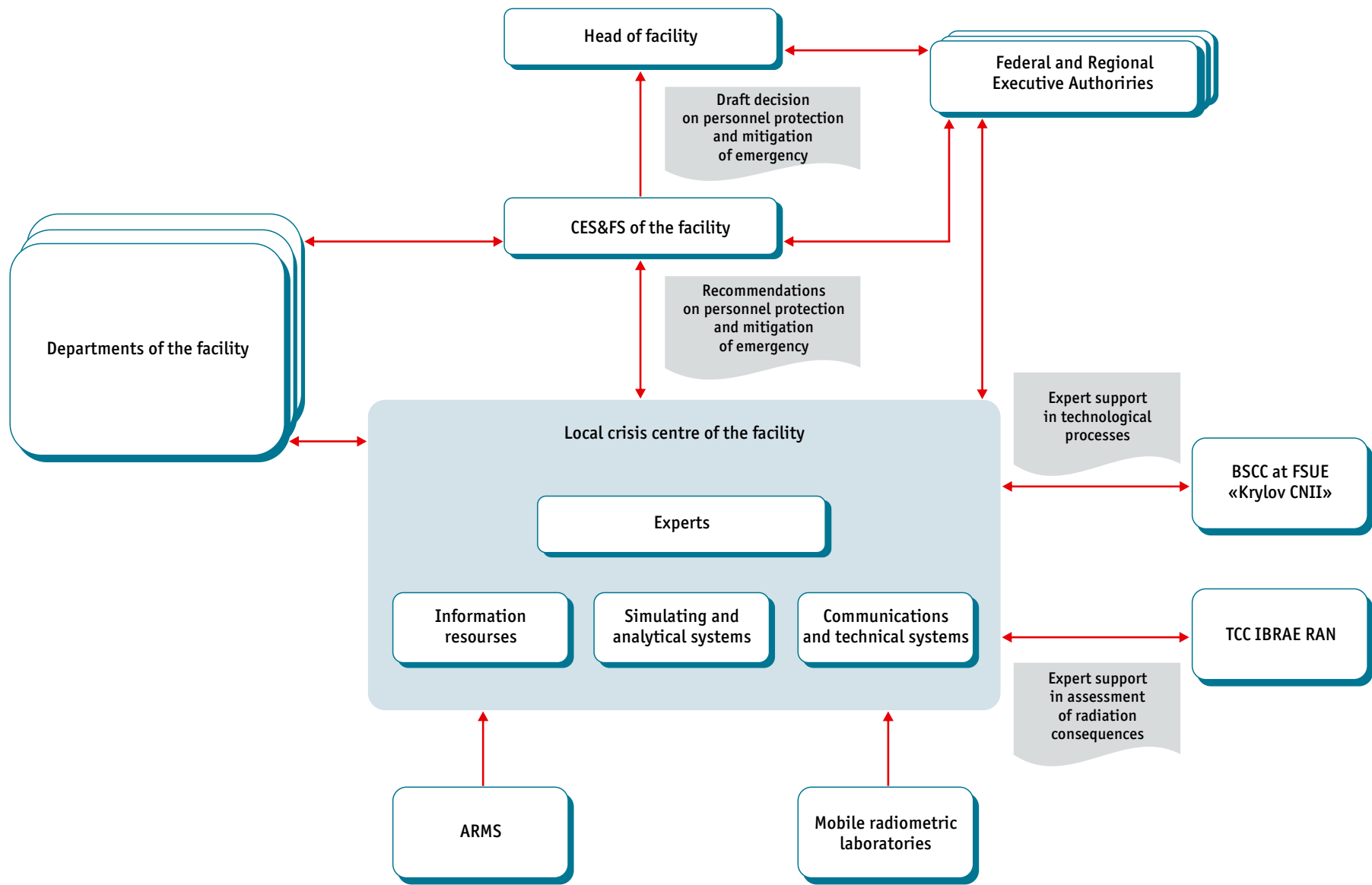
## Enhancement of the Functional RERS Subsystem of Minpromtorg of Russia

The functional subsystem of RERS for prevention and mitigation of emergency situations at organisations (facilities) subordinated to Minpromtorg of Russia was established at Minpromtorg of Russia in accordance with the order No. 794 of the Government of the Russian Federation of December 30, 2003.

### The following works were implemented within the framework of the Project:

- JLCC of JSC “CS “Zvezdochka” and JSC “NIPTB “Onega” was established;
- LCC of JSC “PA “Sevmash” was established;
- facility ARMS of JSC “CS “Zvezdochka” was enhanced;
- facility ARMS of JSC “PA “Sevmash” was established;
- MRL were procured for JSC “CS “Zvezdochka” and JSC “PA “Sevmash”;
- scientific and technical system for support of the facilities in Severodvinsk was established at the Technical Crisis Centre of IBRAE RAN and the BSCC of the Minpromtorg of Russia at FSUE “Krylov CNII”;
- BSCC at FSUE “Krylov CNII” was re-equipped;
- the software and hardware of the subsystem were improved.





*The enhanced elements of the functional RERS subsystem of Minpromtorg of Russia*

# Joint Local Crisis Centre of JSC “CS “Zvezdochka” and JSC “NIPTB “Onega”

Centre of ship-building “Zvezdochka” is a shipyard at the White Sea coast. The facility has 9 subsidiaries in various regions of the Russian Federation. JSC “CS “Zvezdochka” is one of the hail-growth facilities in Severodvinsk.

JSC “CS “Zvezdochka” performs design, production, repair and decommissioning of military surface and subsurface crafts for national and international customers, produces marine equipment for oil and gas industry, produces technical products for machine-building, metallurgy and other industry branches, designs and produces civil crafts and ship equipment.

The facility has a unique unparalleled infrastructure for comprehensive industrial decommissioning of NS and surface nuclear-powered ships. The infrastructure corresponds to both the Russian and international requirements in nuclear, radiation and environmental safety assurance, and allows performing the full scope of works on NS dismantling.

The JLCC was established at the nuclear and radiation safety division, CD and ES division of JSC “CS “Zvezdochka”. The experts of JSC “NIPTB “Onega” take part in the centre’s activity.

## The main tasks of the JLCC:

- information and technical support of the regional CES&FS of JSC “CS “Zvezdochka”;
- assurance of operative interaction with the participants of emergency response;
- decision-making support in emergency prevention activity or in case of an emergency threat;
- acquisition and analysis of data on the radiation situation.





### *Equipment of the Centre:*

- Software: calculation and modelling systems (an express system for forecasting and assessment of the radiation situation in case of radioactivity release into the atmosphere, software for assessment of atmospheric transfer, system for assessment of surface water contamination), engineering applied programs for assessment of internal and external exposure doses, equipment for presentation of radiation monitoring data, information and reference systems on accidents with various scenarios.
- Hardware: videoconferencing equipment, audio and video presentation equipment, modern operator workstations, server and communication equipment, uninterrupted power supply system, including independent diesel generator.
- Communication capabilities: optical fibre communication lines with the Situation Centre at the Administration of Severodvinsk, LCC of JSC "PA "Sevmash", radio relay communication line to MD EMERCOM of the Archangelsk Region, dedicated digital communication channels with the SRA "Department for CDES&FS of the Murmansk Region", FSUE "Krylov CNII". The dedicated data transfer network established within the framework of the Project assures communications between all participants of the emergency response system.
- Mobile radiometric laboratory.



*The workplaces of the JLCC*

## Local Crisis Centre of JSC “PA “Sevmash”

JSC “PA “Sevmash” is the largest shipyard in Russia. The facility site exceeds 300 ha and includes over 100 subdivisions. This largest facility in Severodvinsk employs over 25,000 people.

JSC “PA “Sevmash” performs design, production, repair and dismantling of military surface and subsurface crafts for national and international customers, produces marine equipment for oil and gas industry, produces technical products for machine-building, metallurgy and other industry branches, designs and produces civil craft and ship equipment.

The facility performs a substantial amount of work involving nuclear power.

The LCC of JSC “PA “Sevmash” was established at the nuclear and radiation safety division.

### **The main tasks of the LCC:**

- information and technical support of the work of regional CES&FS of JSC “PA “Sevmash”;
- assurance of efficient interaction with participants of emergency response;
- decision-making support in emergency prevention or in case of an emergency threat;
- acquisition and analysis of data on the radiation situation.





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### Equipment of the Centre:

- Software: calculation and modelling systems (an express system for forecasting and assessment of the radiation situation in case of radioactivity release into the atmosphere, software for assessment of atmospheric transfer, system for assessment of surface water contamination), engineering applied programs for assessment of internal and external exposure doses, equipment for presentation of radiation monitoring data, information and reference systems on accidents with various scenarios.
  - Hardware: videoconferencing equipment, audio and video presentation equipment, modern operator workstations, server and communication equipment, uninterrupted power supply system, including independent diesel generator.
  - Communication capabilities: optical fibre lines with the Situation Centre at the Administration of Severodvinsk and JLCC of JSC "CS "Zvezdochka" and JSC "NIPTB "Onega". The dedicated data transfer network established within the framework of the Project assures communications between all main participants of the emergency response system.
  - Mobile radiometric laboratory.
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# Branch Situation Crisis Centre of Minpromtorg of Russia

## Main tasks of the Centre:

- scientific and methodological support of management of radiation monitoring and radiological emergency response systems at the facilities reported to Minpromtorg of Russia;
- development of methods for calculation and measurement of radiation fields of nuclear-powered ships, nuclear maintenance vessels, floating NPP at all stages of their lifecycle and in various emergency situations.

## The following works were implemented within the framework of the Project:

- equipping of BSCC with communication and presentation equipment, personnel workstations;
- establishment of on-line interaction with JLCC of JSC “CS “Zvezdochka” and JSC “NIPTB “Onega”, and LCC of JSC “PA “Sevmash”;
- equipping of BSCC with tools for display of the radiation monitoring data and an informational reference system on scenarios of possible accidents;
- training of the BSCC personnel.



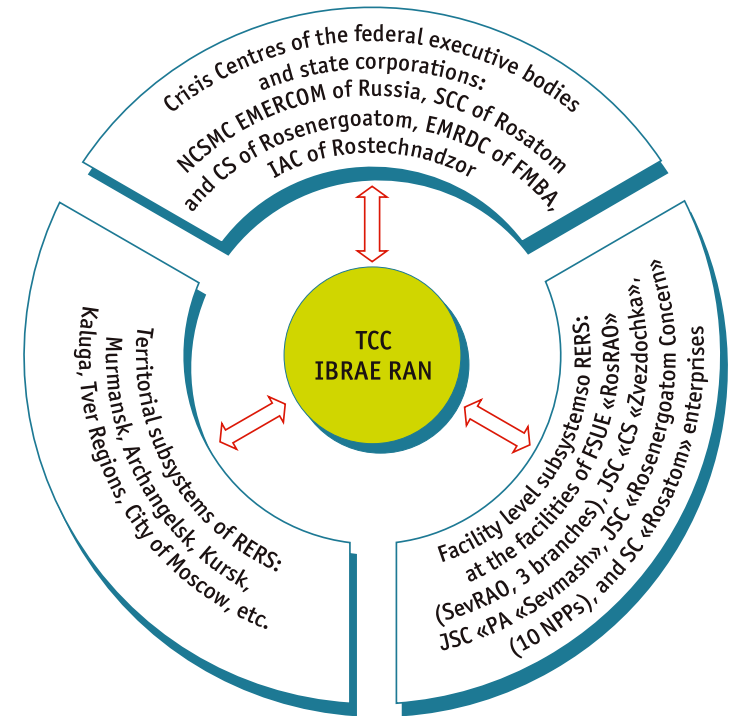
*Commission meeting room*

# Technical Crisis Centre of IBRAE RAN

TCC IBRAE RAN renders scientific, technical, and expert support to the Situation Crisis Centre of State Corporation "Rosatom", National Crisis Situations Management Centre of EMERCOM of Russia, Crisis Centre of "Rosenergoatom" Concern, Information and Analytical Centre of Rostekhnadzor, facilities, and local agencies for prevention and mitigation of ES.

## Main functions within the framework of the Project:

- Expert support of facilities and territorial participants of emergency response, development of recommendations to mitigate the consequences of radiological ES for personnel, population and territories of the Region;
- Scientific, methodological, and technical support of actions aimed at assuring preparedness of emergency response forces and assets, including participation in exercises and training;
- Scientific, informational, methodological and technical support of design, development, and introduction of new software and hardware to support decision-making on protection of personnel, population and territories.



# Informational support and software used in emergency response

Information and software systems are required for decision-making on protection measures for the personnel, population, and territories in case of a radiological ES. The software systems include data bases, informational and geoinformational systems, simulation systems, computer manuals and engineering programs providing assessment and forecast of the consequences of radiation accidents, as well as systems providing access to reference and on-line information.

## Simulation systems and programs

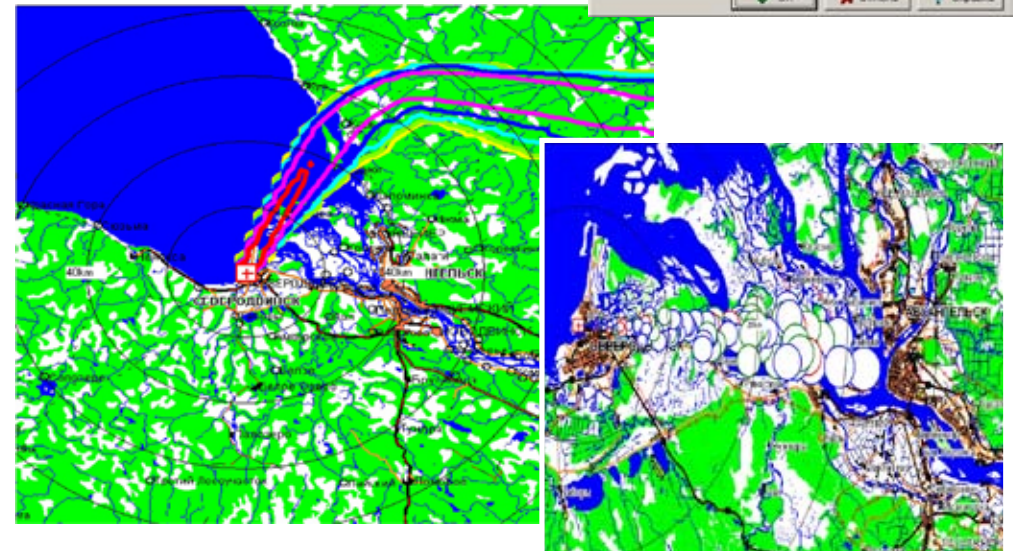
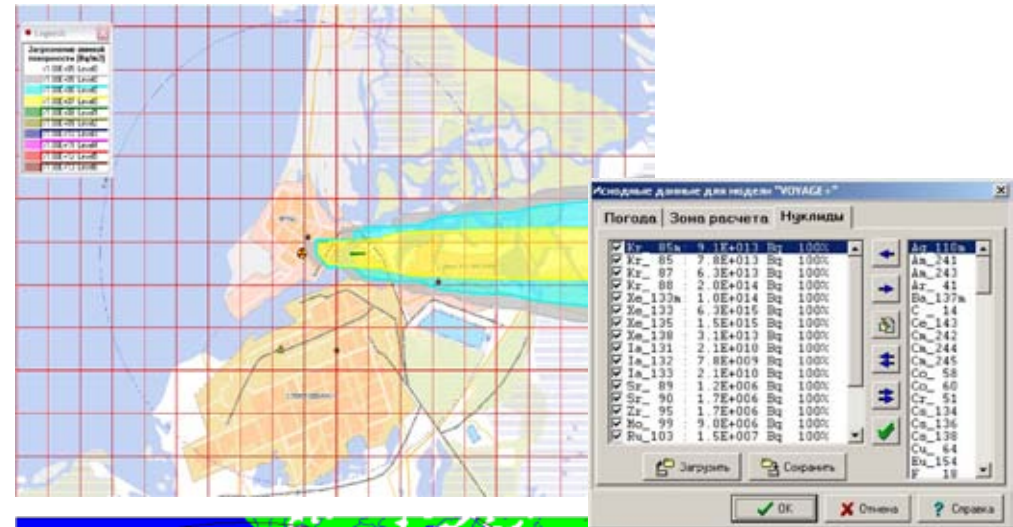
### System "Trace" for express assessment of the radiation situation:

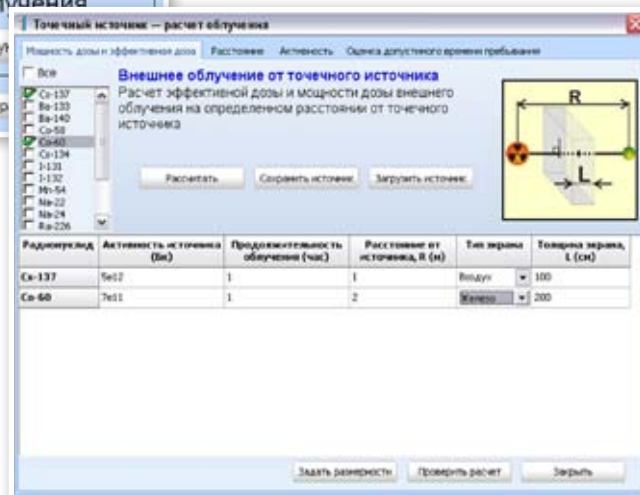
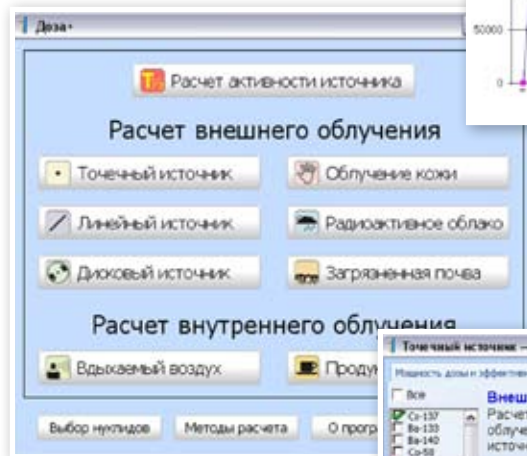
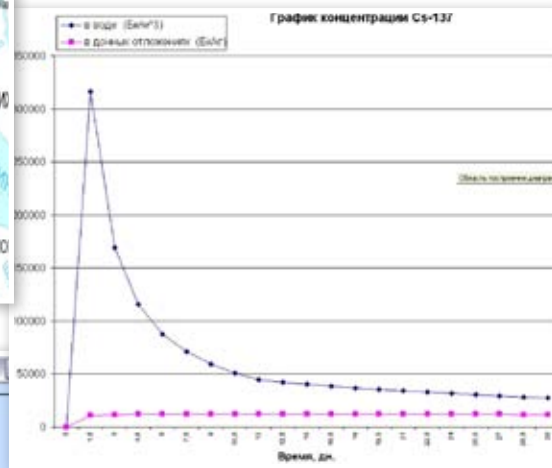
- the computer code is based on the Gaussian model of atmospheric transfer, which has a recommended applicability range of 10 to 20 km,
- the release is considered to be volley (immediate).
- the main advantage of the model is its simplicity and quickness, with the calculation taking several seconds, therefore the software is used for initial (conservative) express assessment of the radiation situation and radiation consequences.

### System "Nostradamus" for assessment and forecast of contamination of territories and environment:

3D Lagrangian stochastic model is implemented in the system. The model has the following advantages over Gaussian techniques:

- ability to calculate contaminant transfer at the distances of hundreds kilometres;
- ability to take into account non-uniformities of wind field and its change with time;
- performing calculations for sources of any configuration and form (point, areal, volumetric) and parameters changing with time;
- account for landscape impact on the spreading process;
- account for local precipitations in a specific coordinate field of radioactive trace transport.





## Computer system “Cassandra” for assessment and forecast of radionuclides spreading in atmosphere and water:

The software system “Cassandra” allows simulating the propagation, accumulation and migration of radioactive materials in water and bottom sediments of rivers and other water bodies, as well as calculating the population exposure doses due to various types of water use. “Cassandra” allows carrying out operative assessments, even if only limited information on radionuclide migration in water is available, which may be significant in crisis situations. At the same time, if more accurate data on the simulated water system are available, the software can adjust its forecast accordingly.

## Systems for assessment of population exposure doses “Doze+”:

“Doze+” software allows express engineering calculations of the dose loads on human from sources of various configurations at various distances from a source (point, linear, disk sources), carrying out calculations of external exposure dose for skin caused by contamination of skin and clothes with beta-radiating nuclides, carry out assessments of radiation impact of gamma-radiation of the radioactive cloud and the contaminated surfaces, internal exposure due to radioactive materials intake by inhalation and ingestion.

## Geoinformational system “GISMAR” of monitoring and fast response:

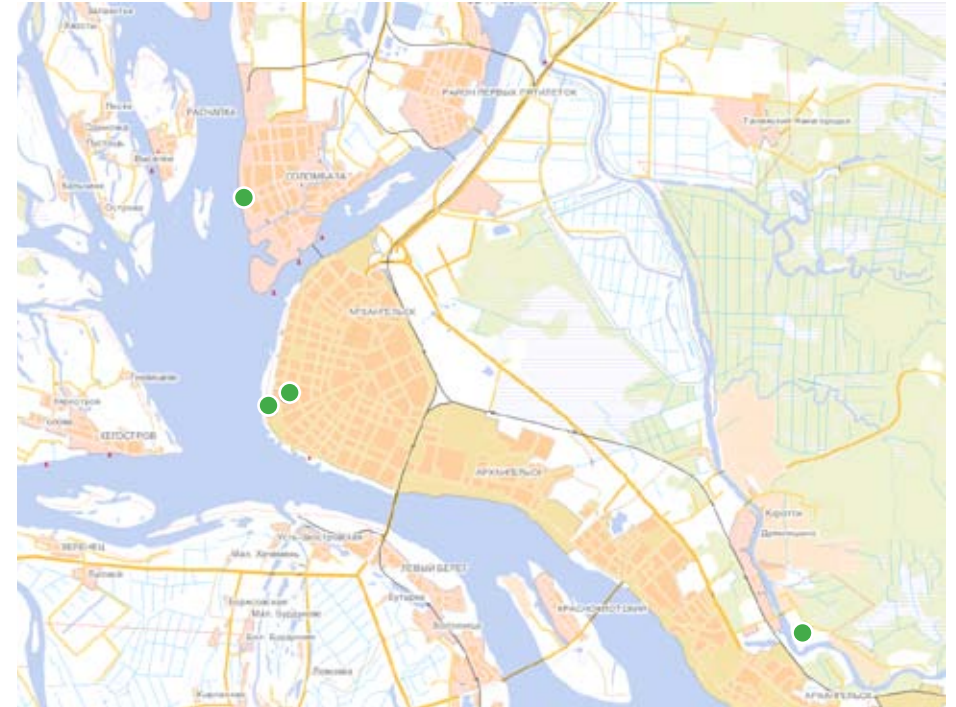
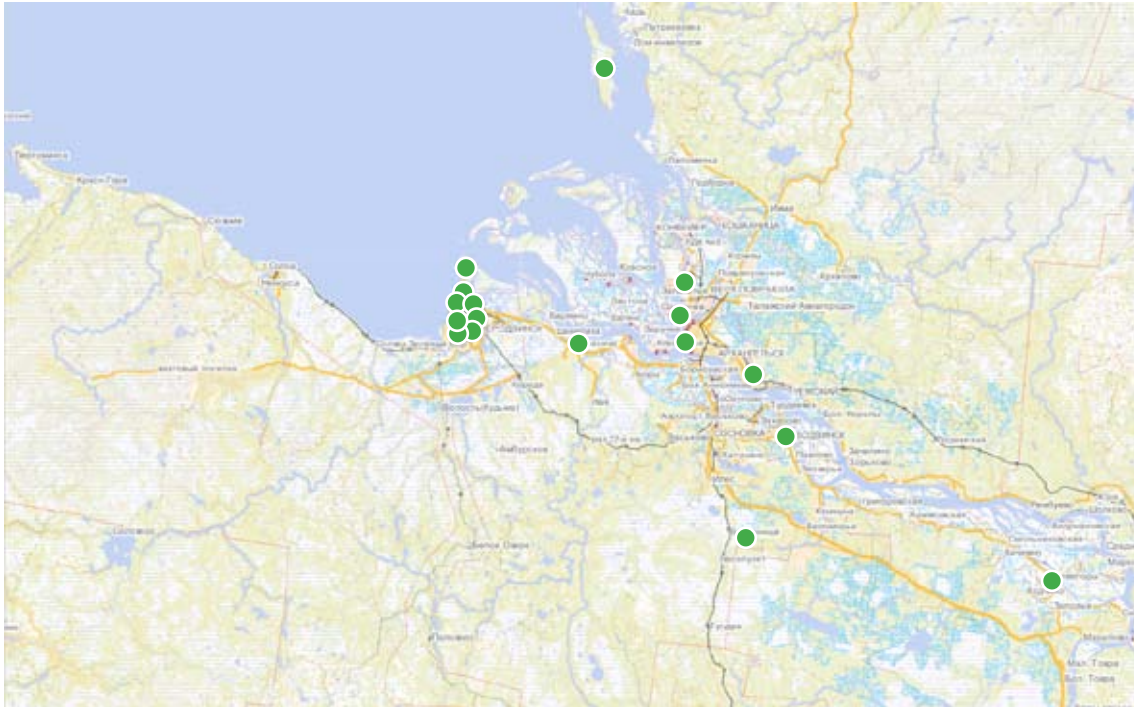
The system is intended for presentation of radiation monitoring data and support of experts. It contains information about facilities, infrastructure, forces and assets of the territorial subsystems of RERS.

Information and reference systems on:

- facilities involved in NS decommissioning, SNF and RW management;
- possible scenarios of radiation accidents, characteristics of possible releases/discharges and their consequences for the population and environment;
- regulatory and technical documentation in the field of emergency response, use of nuclear energy, protection of personnel and population, radiation safety, and environment protection.

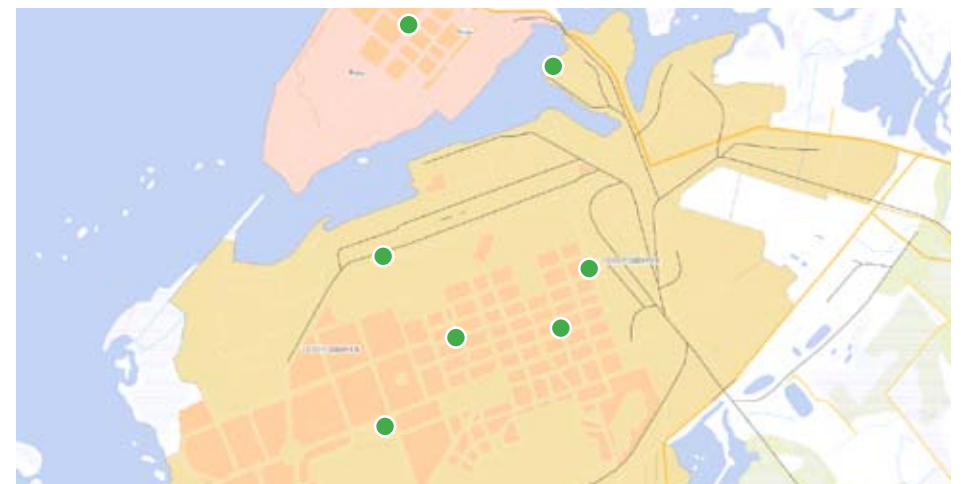
# Archangelsk Territorial Automated Radiation Monitoring System

AT ARMS was established and commissioned within the framework of the Project.

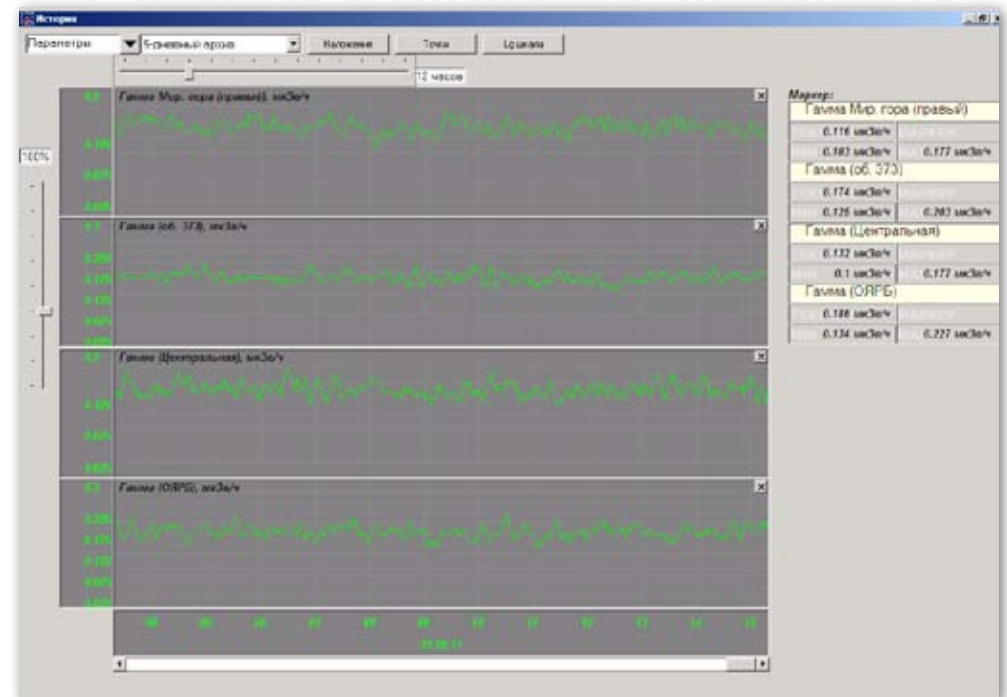
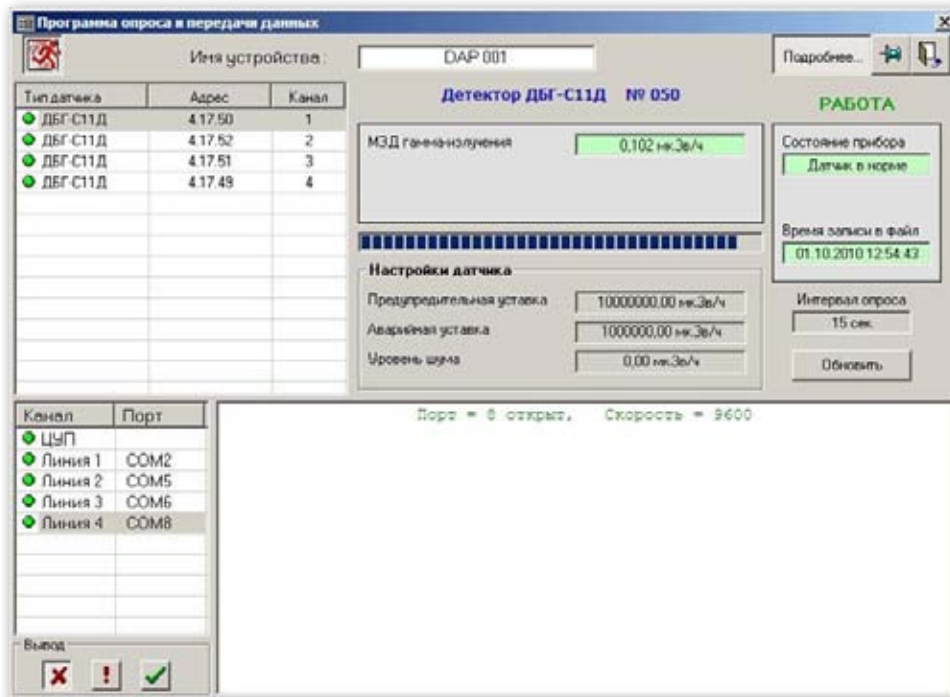


## AT ARMS is designed for:

- instrumental monitoring of the radiation situation: confirmation of normal radiation situation at the location of radiation monitoring posts (●) in everyday operation mode, early warning about the changes in radiation situation, provision of data about the radiation situation in emergency mode;
- informational support of the activities related to radiation safety carried out by territorial and federal executive authorities.



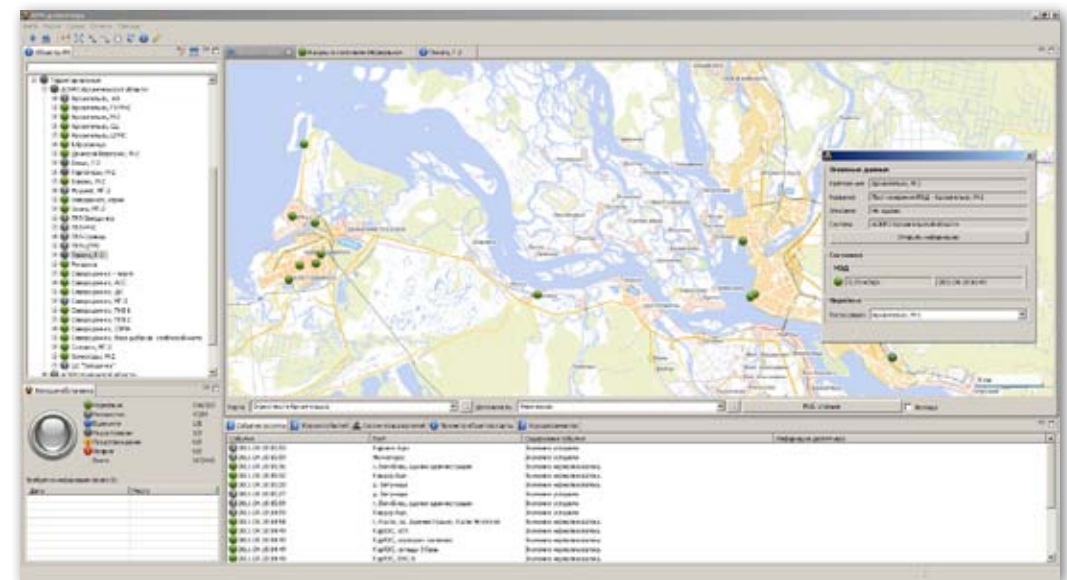




*Specialised software used for data acquisition from AT ARMS posts*

### Works on establishment of AT ARMS:

- installation of 25 automated stations for gamma-radiation dose rate monitoring in the territory of the Archangelsk Region;
- installation of 2 automatic weather stations;
- installation of 4 street information panels;
- installation of computer and communication hardware, servers for acquisition, processing and storage of information;
- development of new software and update of the existing software;
- integration with the territorial ARMS of the Murmansk Region and ISARMS.



*Data presentation in the specialised GIS-system*

# Facility Radiation Monitoring Systems

## JSC "PA "Sevmash", SRW Storage Facility "Mironova Gora"

ARMS of JSC "PA "Sevmash" ensures continuous automated monitoring of the main radiation situation parameters at the site.

Main purpose of the facility ARMS of JSC "PA "Sevmash" is on-line provision of the specialised services and management of the facility with information on the radiation situation in the territory of the facility, control areas and surveillance areas.

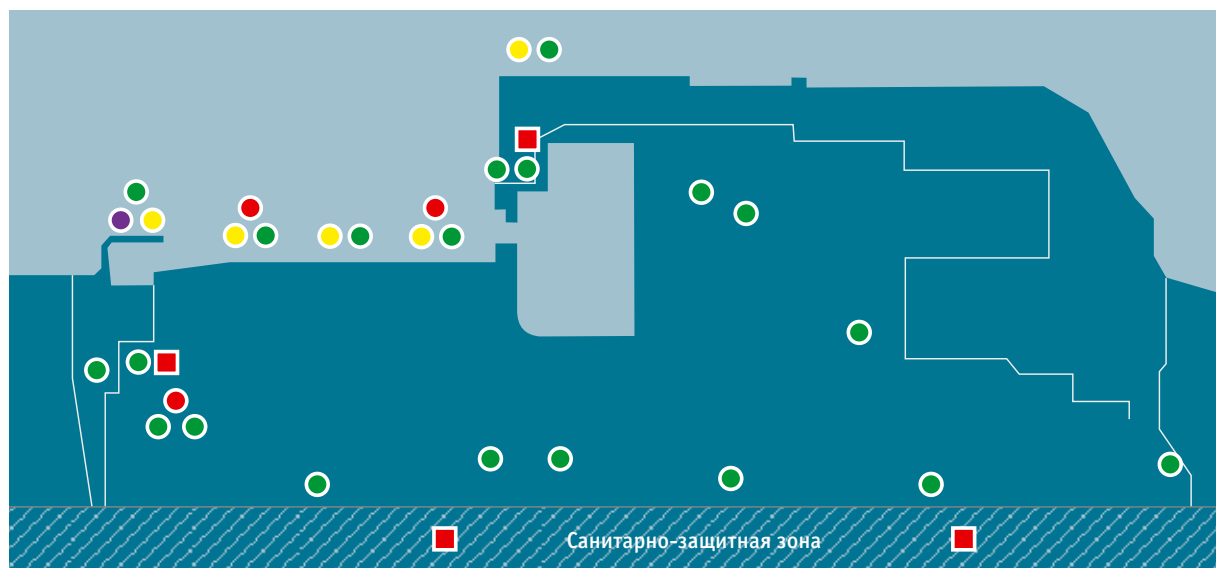
ARMS data are used to assess and forecast the radiation situation and develop recommendations on personnel protection measures. The readings are verified by the Nuclear and Radiation Safety Department of JSC "PA "Sevmash".

The facility ARMS of JSC "PA "Sevmash" includes:

- 20 gamma-radiation dose rate sensors (●);
- 3 stations for measuring volumetric activity of radioactive aerosols (●);
- 5 sensors for monitoring volumetric water activity (●);
- 4 installations for monitoring air contamination (■);
- automatic weather station (●);
- main and backup servers;
- computational system.



JSC "PA "Sevmash"



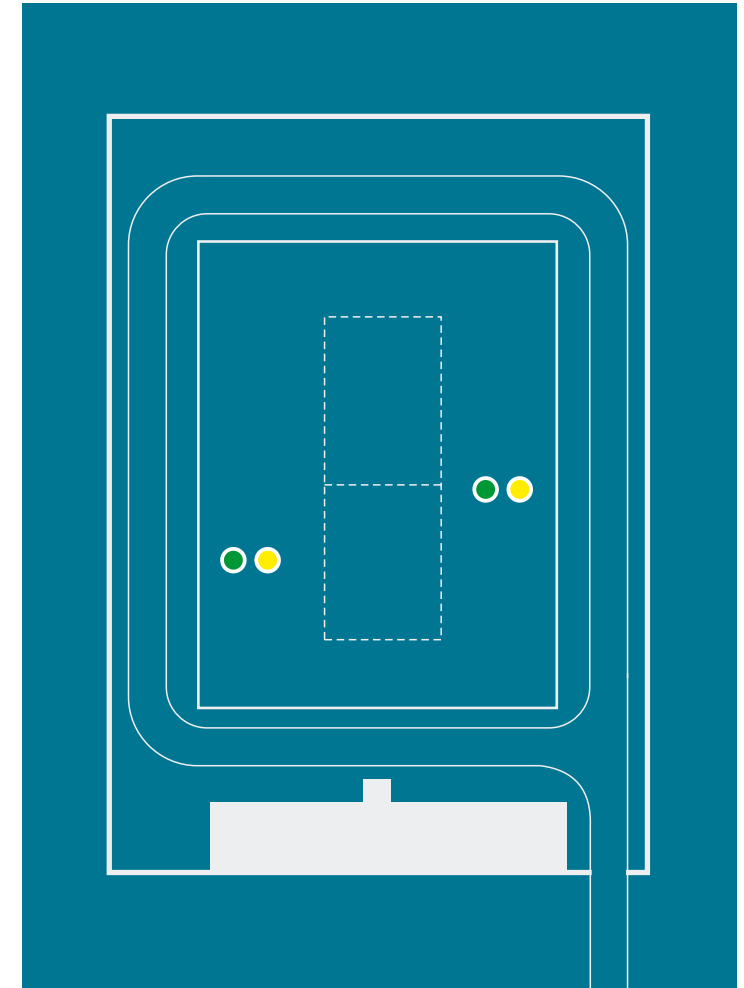
Layout of sensors at JSC "PA "Sevmash"

ARMS of the temporary SRW storage facility "Mironova Gora" is intended to provide information on the radiation situation at the SRW storage pad and transmission of the information to ARMS of JSC "PA "Sevmash".

**ARMS of SRW "Mironova Gora" includes:**

- 2 gamma-radiation dose rate sensors (●);
- 2 sensors for monitoring of volumetric water activity (●);
- independent system server.

ARMS of "Mironova Gora" includes an operator workstation located in the guards room and used for display of information on the radiation situation at the site.



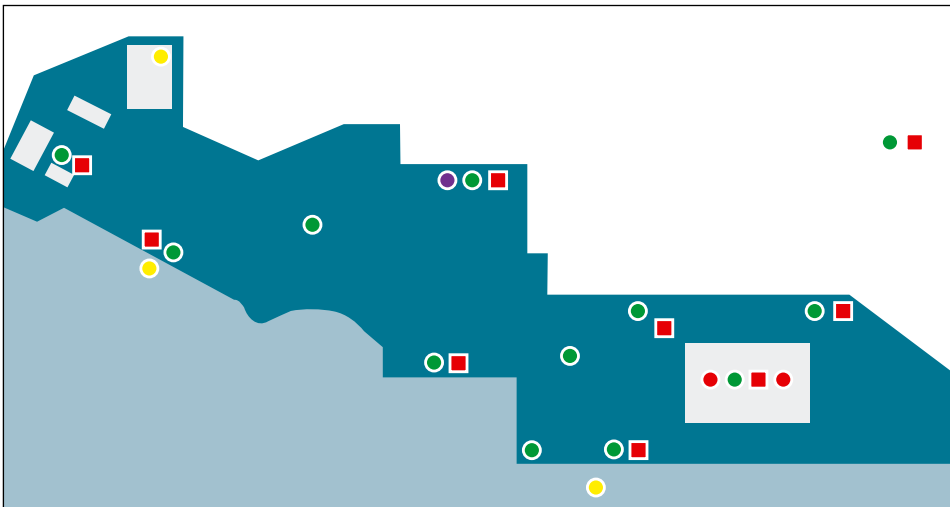
*Layout of sensors*

# Facility Radiation Monitoring Systems

## JSC "CS "Zvezdochka"



*JSC "CS "Zvezdochka"*



*Layout of sensors at JSC "CS "Zvezdochka"*

ARMS of JSC "CS "Zvezdochka" ensures continuous automated monitoring of the main radiation situation parameters at the site.

Main purpose of the facility ARMS of JSC "CS "Zvezdochka" is on-line provision of information on the radiation situation monitoring in the territory of the facility, control and surveillance areas to the specialised services and management of the facility.

ARMS data are used to assess and forecast the radiation situation and develop recommendations on personnel protection measures. The readings are verified by the Nuclear and Radiation Safety Department of JSC "CS "Zvezdochka".

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### Facility ARMS of JSC "CS "Zvezdochka" includes:

- 12 gamma-radiation dose rate sensors (●);
- 2 stations for measuring volumetric activity of radioactive aerosols (●);
- 3 sensors for monitoring volumetric water activity (●);
- 9 installations for monitoring air contamination (■);
- automatic weather station (●);
- main and backup servers;
- computational system.

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ARMS of JSC "CS "Zvezdochka" receives data from the radiation monitoring systems of various site structures.

ARMS of JSC "CS "Zvezdochka"



ARMS of LRW storage facility  
15 measurement channels



ARMS of on-shore defueling facility and interim storage facility  
64 measurement channels




ARMS of RW reprocessing facility  
25 measurement channels



ARMS of SRW incineration facility  
16 measurement channels

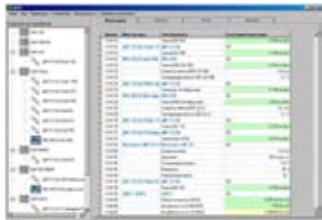


# Software of site radiation monitoring systems



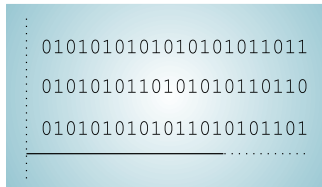
**Upper level.  
Operator monitor:**

- visualisation of data in a graphical environment;
- fast response to the events in the system.



**Intermediate level. CCP:**

- data acquisition;
- data basing;
- system configuring;
- displaying of readings and sensor statuses.



**Lower level.  
Detector control programs:**

- measurements;
- data transfer.



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Specialised applied software developed by ESAC IBRAE RAN is an important element of ARMS. It is divided into three functional levels: upper, intermediate and lower.

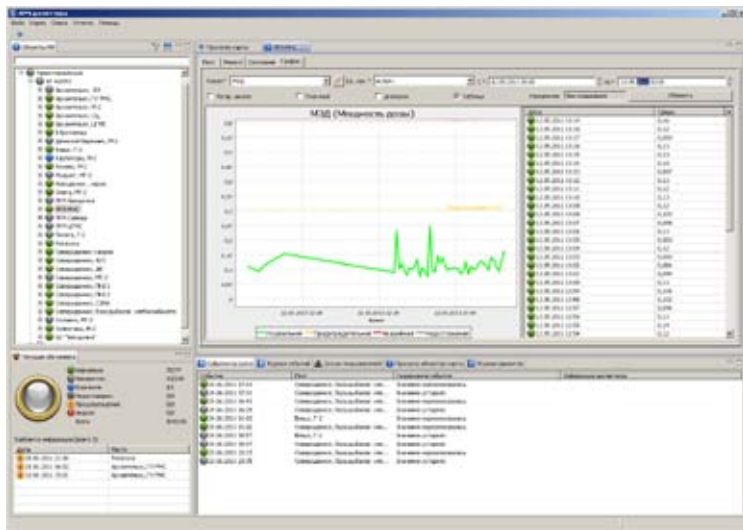
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CCP is the ARMS core. CPP acquires the readings from all units and sensors of the system, keeps the database, sends the required data to the “operator monitor” applications and presents the user with the information on the equipment and current ARMS status. CCP includes service functions to set up the database, configure and change the equipment list. The program allows assessing the operational condition of all units and the whole system.

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The level of interface software includes program modules used with specific types and models of measuring equipment. Generally, the program modules are developed by the manufacturers of the equipment and are used with special controllers.

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### Main functions of the software developed for display of information:

- display of radiation monitoring data at the facility in a real-time mode;
- analysis of data, including display of sensor reading dynamics;
- triggering an alarm in case the sensor readings exceed the set-point.

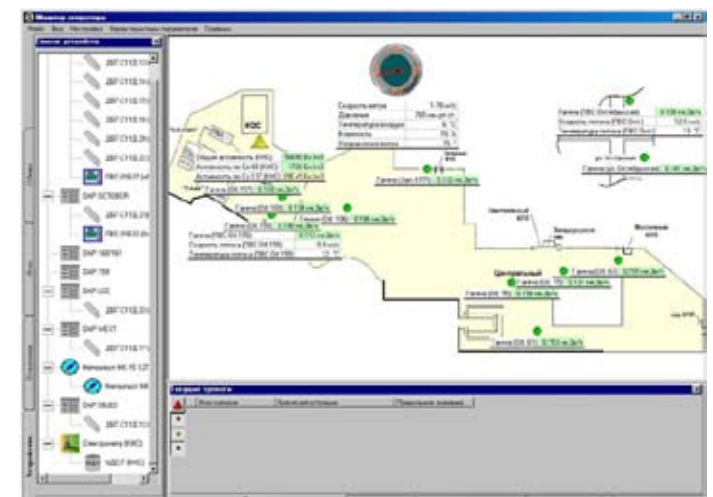
Intermediate level software is used for acquisition and storage of radiation monitoring data. It also includes the tools for measuring equipment configuration and export of data to other systems. The data is stored in a single database.

*History of measured parameters from one of the system sensors (presented as a plot)*

*Set-up of sensor parameters*

Время	Имя датчика	Конфигурация	Состояние/Уровень
10:00:23	ДДП-С112.32 (История)	МДС-Т	0.00 мкЗв/ч
10:00:23	ДДП-С112.38 (История)	МДС-Т	0.00 мкЗв/ч
10:00:23	ДДП-С112.31 (История)	МДС-Т	0.00 мкЗв/ч
10:00:23	ДДП-С112.39 (История)	МДС-Т	0.00 мкЗв/ч
10:00:23	ДДП-С112.40 (История)	МДС-Т	0.00 мкЗв/ч
10:00:23	ДДП-С112.41 (История)	МДС-Т	0.00 мкЗв/ч
10:00:23	ДДП-С112.42 (История)	МДС-Т	0.00 мкЗв/ч
10:00:23	ДДП-С112.43 (История)	МДС-Т	0.00 мкЗв/ч
10:00:23	ДДП-С112.44 (История)	МДС-Т	0.00 мкЗв/ч
10:00:23	ДДП-С112.45 (История)	МДС-Т	0.00 мкЗв/ч
10:00:23	ДДП-С112.46 (История)	МДС-Т	0.00 мкЗв/ч
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10:00:23	ДДП-С112.52 (История)	МДС-Т	0.00 мкЗв/ч
10:00:23	ДДП-С112.53 (История)	МДС-Т	0.00 мкЗв/ч
10:00:23	ДДП-С112.54 (История)	МДС-Т	0.00 мкЗв/ч
10:00:23	ДДП-С112.55 (История)	МДС-Т	0.00 мкЗв/ч
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10:00:23	ДДП-С112.58 (История)	МДС-Т	0.00 мкЗв/ч
10:00:23	ДДП-С112.59 (История)	МДС-Т	0.00 мкЗв/ч
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10:00:23	ДДП-С112.62 (История)	МДС-Т	0.00 мкЗв/ч
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10:00:23	ДДП-С112.65 (История)	МДС-Т	0.00 мкЗв/ч
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10:00:23	ДДП-С113.00 (История)	МДС-Т	0.00 мкЗв/ч

*Summary of data from the system sensors*



*Scroll of prompt data*

# Mobile Radiometric Laboratories



*MRL were developed and transferred to JSC "PA "Sevmash", JSC "CS "Zvezdochka", FSBA "Northern DHEM" and Rescue service of the Archangelsk Region*

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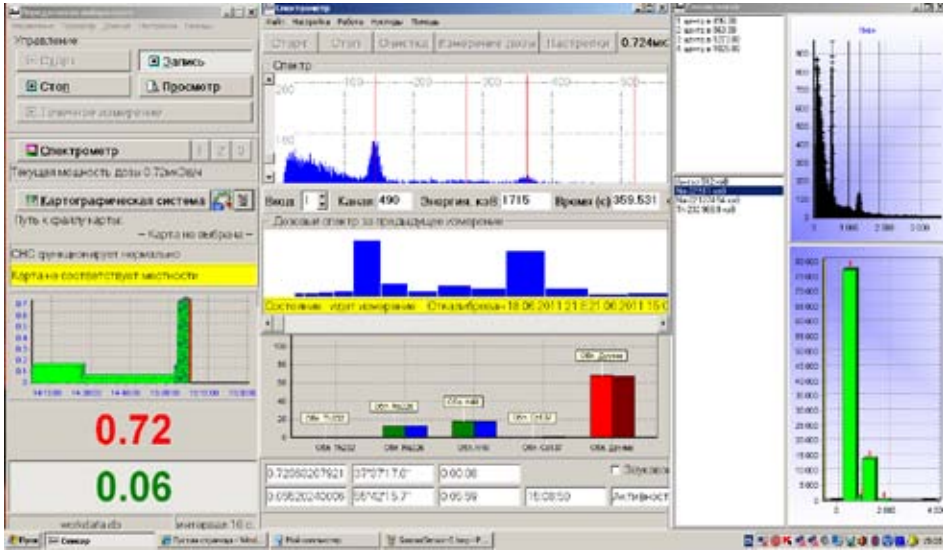
MRL are designed for operative radiation surveys in case of radiological emergencies, as well as for scheduled measurements.

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## Capabilities:

- detection and localisation of radioactive sources and contamination;
  - sampling and express analysis of soil, air and water samples;
  - investigation of contamination characteristics;
  - mapping of the boundaries of contaminated areas;
  - transfer of measured data to crisis centres in a real-time mode.
-





*Visualisation of measured data*



*MRL belonged to JSC "CS "Zvezdochka"*

### **MRL equipment includes:**

- equipment for measurements: stationary and portable gamma-spectrometers, dosimeters, alpha-, beta-, and gamma-radiometers, sampling equipment;
- computer and communication equipment: Inmarsat satellite terminal, cellular telephone communications, VHF radio station, GPS satellite navigation system, industrial computer and an auxiliary laptop, photo and video equipment;
- specialised software;
- auxiliary equipment: vehicle system for power supply of all equipment, including petrol generator and tools for adaptation of the equipment to northern climatic conditions;
- working clothes and deactivation equipment.



*MRL rear compartment*



*Operator working place.  
Measuring and communication equipment*

# Integration of the Emergency Response Systems of the Murmansk and Archangelsk Regions



Taking into account the adjacent location of the Murmansk and Archangelsk Regions, the large number of radiation-hazardous facilities including those located near the common borders, the operative and coordinated interaction of organisations involved in emergency response processes becomes especially important.

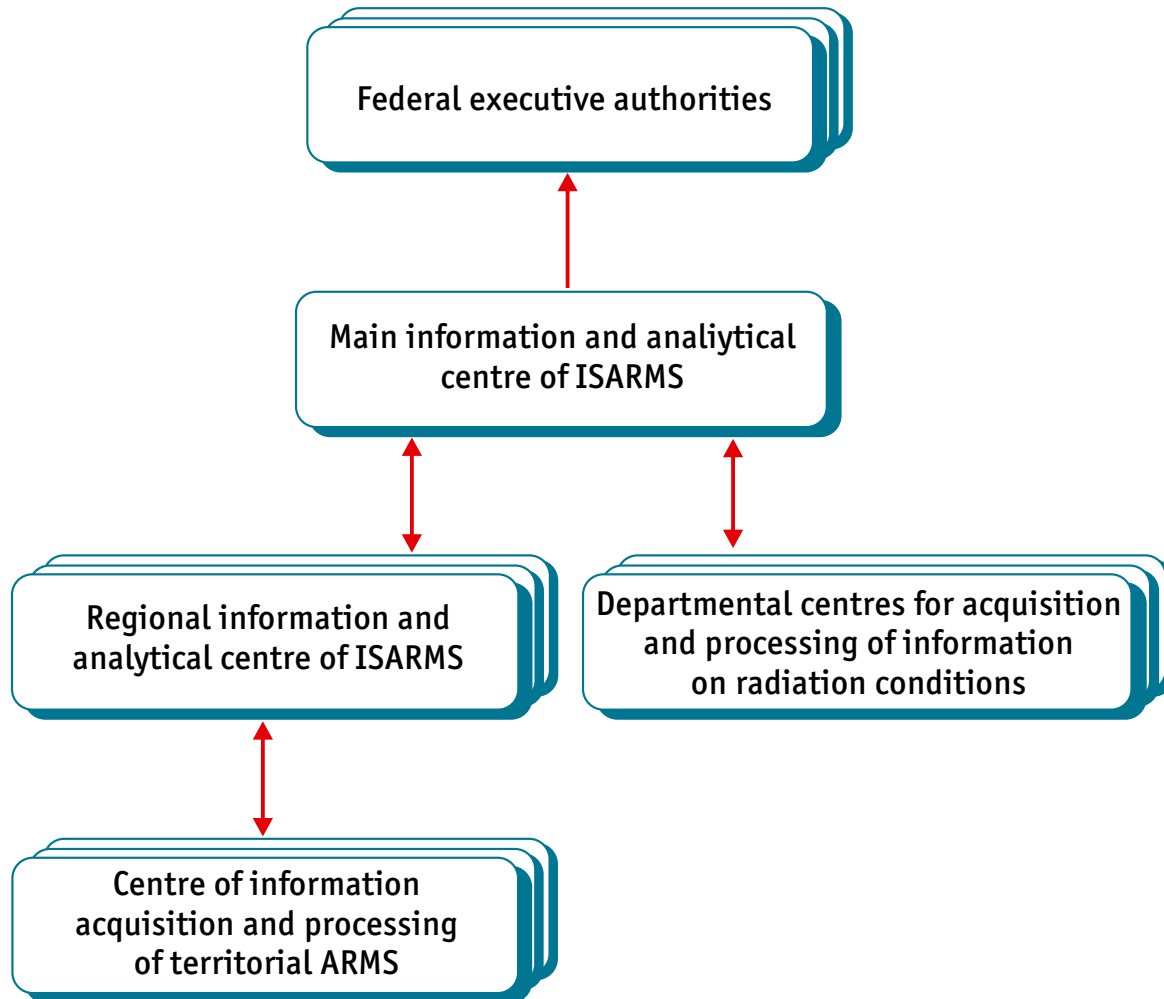
An agreement on enhancement of interaction of the official bodies responsible for emergency response to radiological emergencies in the territories of the Archangelsk and Murmansk Regions was prepared within the framework of the Project.

Such integration is especially important for assurance of the Arctic territory safety.

## Integration of the emergency response systems includes:

- exchange of information about the radiation situation, main characteristics of nuclear and radiation hazardous facilities and organisation of emergency measures;
- mutual informational and expert support in case of radiological emergency or a threat of an emergency;
- coordination of actions in planning of emergency response measures;
- conduct of mutual drills and exercises.

# Integration of AT ARMS and ISARMS



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Roshydromet and the Government of the Archangelsk Region signed an Agreement on information interaction within the framework of ISARMS.

In accordance with the Agreement, data of the AT ARMS are transferred to the Northwest regional information and analytical centre of ISARMS, and data on radiation situation in the territory of the Russian Federation are transmitted to the authorised organisations of the Archangelsk Region.

The information exchange is implemented by FSBA "Northern DHEM".

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# Personnel training

## Directions of activities:

- preparing information materials on the elements of the established system;
- advanced training of the management and personnel of crisis centres in emergency response to radiation accidents and public information in case of radiological emergencies;
- training of specialists and experts in using information and software supporting decision-making on emergency actions, assessment and calculation systems;
- training of technical personnel to operate the equipment;
- development of specialised software to train personnel and conduct exercises;
- preparation and conduct of exercises and drills to mitigate radiological emergency consequences.



## Forms of training:

- specialised lecture courses;
- practical training to use the equipment;
- practical application of emergency response measures using computer simulators;
- drills;
- comprehensive emergency response exercise.

# IAEA Mission

The State Corporation “Rosatom” acting on behalf of the Government of the Russian Federation, and in coordination with the Government of the Archangelsk Region, requested to conduct an EPREV mission to assess the capabilities of the emergency response system in the Archangelsk Region.

The IAEA team of experts worked in the Archangelsk Region on July 4 through July 14, 2011. Experts took part in the comprehensive emergency exercise “Arctic-2011” as observers. The primary objective of experts was an independent assessment of capabilities and preparedness of the Region to effectively respond to radiation and nuclear emergency situations.



The results of the mission were summarized in the report. The IAEA experts gave a high appraisal the emergency preparedness level in the Archangelsk Region. The report contains recommendations on short-term and long-term actions to further improve the system of emergency response. All recommendations of the IAEA mission related to the regional level, were taken into account while implementing the additional works in 2012.

In addition to the set of standard tasks of the EPREV mission, the level of conformity of the NDEP-008 Project results to the international requirements on response to nuclear and radiation emergency was identified. In particular, experts the IAEA experts noted the following:

“The NDEP-008 project has a remarkable impact on the level of preparedness for emergency response. All new elements seem to function: Automatic Radiation Monitoring System (ARMS), data exchange, video conferencing, mobile labs, remote expert assistance, etc. The new system can be a model for other, similar, upgrading projects.”

“The NDEP-008 project largely contributed to the improvement of the infrastructure. Stationary and mobile monitoring systems, communication tools, evaluation and prognostic software are upgraded and made available to the various organizations involved in the response.”

# Comprehensive Emergency Response Exercise “Arctic-2011”

The main objective of the comprehensive emergency exercise “Arctic-2011” (July 13-14, 2011) was to check the preparedness and full-scale demonstration of the capabilities of the radiation monitoring and emergency response system established within the framework of the Project.

The actions of the emergency response system participants were trained during the exercise in the conventional emergency conditions, namely: self-sustained chain reaction in the course of SNF unloading from a nuclear power installation of a decommissioned nuclear-powered submarine in the territory of JSC “CS “Zvezdochka”.



## The exercise participants:

- 9 organisations providing the operation of the information and analytical system of radiological emergency response in the Archangelsk Region;
- JLCC of JSC “CS “Zvezdochka” and JSC “NIPTB “Onega”, LCC of JSC “PA “Sevmash”, facility’s and territorial ARMS, ML;
- The commissions on emergency situations and fire safety of the facility’s, municipal and territorial levels;
- The Situation Crisis Centre of the State Corporation «Rosatom», Burnazjan Federal medical biophysical centre of FMBA of Russia, SPA «Typhoon» of the Federal Hydrometeorology and Environmental Monitoring Service of Russia, Department of CD&ES and FS of the Murmansk Region;
- TKC IBRAE RAN, OCKЦ JSKC of FSUE “Krylov CNII”.

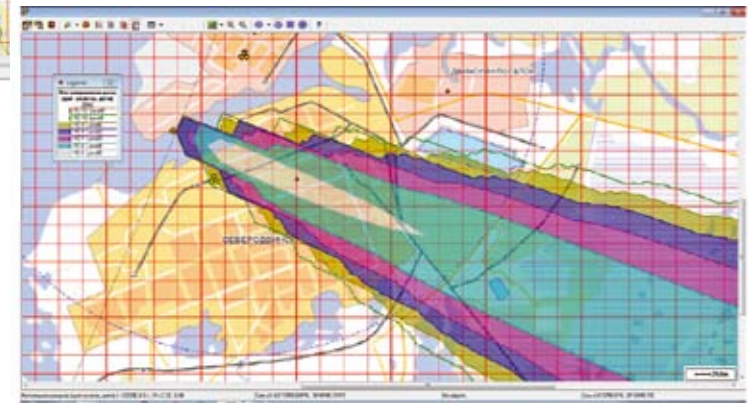
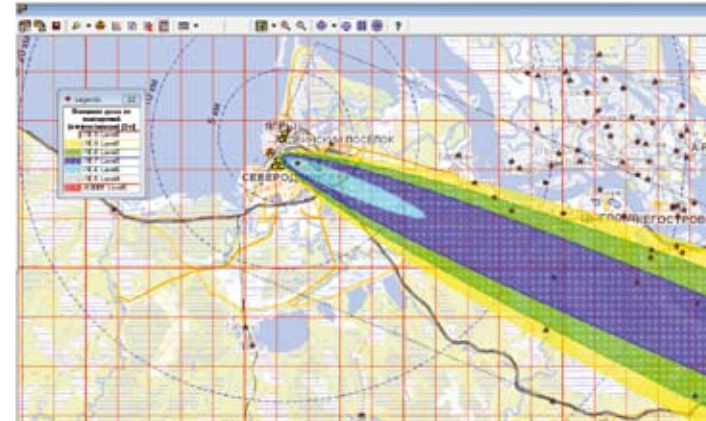
About 150 employees of the organisations - participants of emergency response system and 12 various units (including four ML created within the framework of the Project) were involved in the exercise.

The exercise was observed by: representatives of Minpromtorg, Rospotrebnadzor, EMERCOM of Russia, Joint Shipbuilding Corporation, State Corporation "Rosatom", IBRAE RAN, FMBA of Russia, IAEA mission experts, representatives of the European Bank for Reconstruction and Development, the Arctic council countries, ESAC IBRAE RAN.

The IAC IAEA in Vienna was informed on the exercise via video-conference.

On July 14, 2011, the final meeting dedicated to summarising the works under the Project, IAEA mission results and the large-scale emergency exercise conducted on July 13, 2011 took place in the Oval hall of the Government of the Archangelsk Region.

All purposes of the exercise "Arctic-2011" were achieved as was stated during the final meeting. The interaction of all elements of emergency response system in the Archangelsk Region, interaction with federal enforcement authorities and with the centres of scientific and technical support was practiced. The exercise demonstrated the trouble-free work of all automated systems and communication channels in various modes.

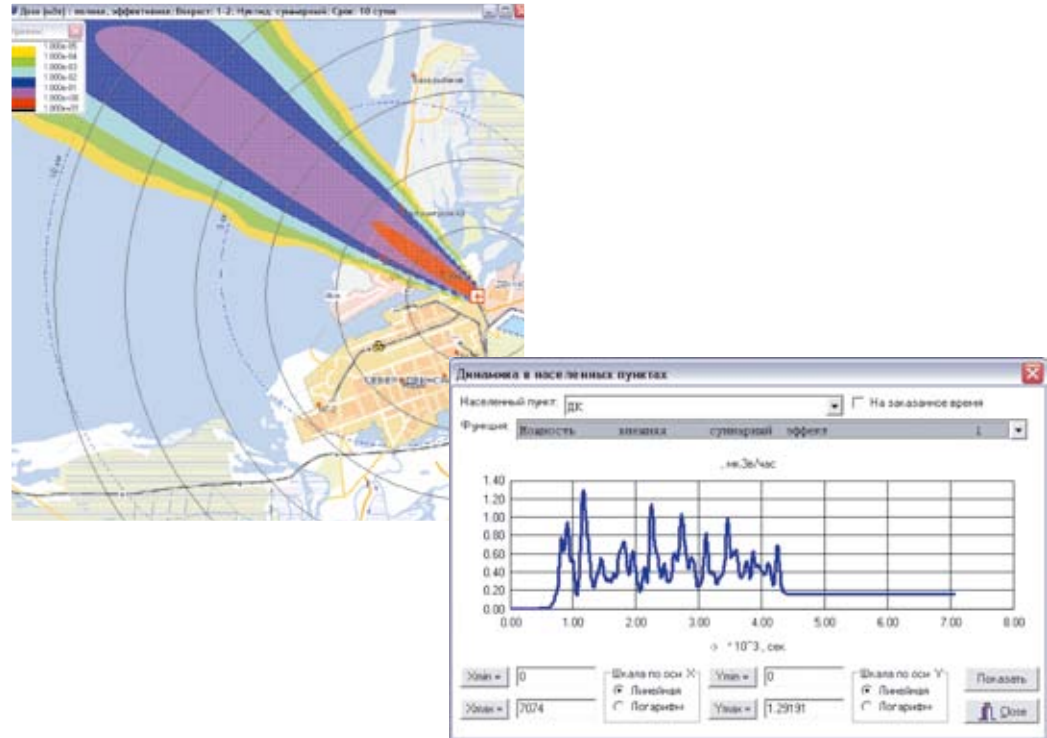


## Table-top exercise “Pomorie-2012”

The basic objective of the table-top exercise “Pomorie-2012” (July 17, 2012) was to validate the procedures on assessment of the situation, information exchange, making decisions on protection and information of public in case of a radiological emergency situation in Severodvinsk. The exercise was prepared by the personnel of organizations – end users of the Project results under expert support by ESAC IBRAE RAN. The recommendations of the IAEA mission conducted in the Archangelsk Region in 2011 were taken into account as well as the comments of the experts and observers made during the exercise “Arctic-2011”.

A conventional release of radioactive substances into the air in Severodvinsk was used as the basis for the exercise scenario. Such scenario allowed engaging all radiation situation monitoring systems and demonstrating the analytical capabilities of the systems established within the Project.

According to the scenario, the exercise participants do not have data on the site of emergency and nuclide composition at the initial stage, thus conducting a radiation survey and defining these parameters by themselves and making decisions on protective measures for population and personnel.



### The exercise participants:

- 8 organisations providing the operation of the information and analytical system of radiological emergency response in the Archangelsk Region;
- JLCC of JSC “CS “Zvezdochka” and JSC “NIPTB “Onega”, LCC of JSC “PA “Sevmash”, facility’s and territorial ARMS, ML;
- The commissions on emergency situations and fire safety of the facility’s, municipal and territorial levels;
- The Situation Crisis Centre of the State Corporation “Rosatom”, the Technical Crisis Centre of IBRAE RAN.



# List of Acronyms

ARMS	Automated Radiation Monitoring System
AT ARMS	Archangelsk Territorial Automated Radiation Monitoring System
BSCC	Branch Situation Crisis Centre
CCP	Central Control Program
CD	civil defence
CDES&FS	civil defence, emergency situation, and fire safety
CES&FS	Commission on Emergency Situation and Fire Safety
CSMC of EMERCOM	EMERCOM Centre for Crisis Situation Management
EBRD	European Bank for Reconstruction and Development
EMERCOM of Russia	Ministry of the Russian Federation for Affairs for Civil Defence, Emergencies and Elimination of Consequences of Natural Disasters
ES	emergency situation
ESAC IBRAE RAN	Energy Safety Analysis Centre of IBRAE RAN
FMBA	Federal Medical and Biological Agency
FSBA "Northern DHEM"	Federal State Budgetary Agency "Northern Department on Hydrometeorology and Environmental Monitoring"
FSUE "Krylov CNII"	Federal State Unitary Enterprise "A.N. Krylov Shipbuilding Research Institute"
IAEA	International Atomic Energy Agency
IAS	Information and Analytical System of Response to Radiological Emergencies
IBRAE RAN	Nuclear Safety Institute of the Russian Academy of Sciences
ISARMS	Integrated State Automated Radiation Monitoring System

JLCC	Joint Local Crisis Centre
JSC "NIPTB "Onega"	Joint-Stock Company "Research and Design Bureau "Onega"
JSC "CS "Zvezdochka"	Joint-Stock Company "Centre of Shipbuilding "Zvezdochka"
JSC "PA "Sevmash"	Joint-Stock Company "Production Association "Sevmash"
LCC	Local Crisis Centre
LRW	liquid radioactive waste
MD EMERCOM	Main Department of the EMERCOM
Minpromtorg of Russia	Ministry of Industry and Trade of the Russian Federation
MRL	mobile radiometric laboratory
NDEP	"Northern Dimension" Environmental Partnership Support Fund
NPP	nuclear power plant
NS	nuclear submarine
RERS	Russian Emergency Response System
RHF	radiation-hazardous facility
RW	radioactive waste
SC	Situation Centre
SC "Rosatom"	State Corporation "Rosatom"
SNF	spent nuclear fuel
SRA	state regional agency
SRW	solid radioactive waste
TCC IBRAE RAN	Technical Crisis Centre of IBRAE RAN

## Sub-Contractors and Participants



Closed Corporation "Doza"



Closed Corporation "Altair"



SPC "Aspect"



SPA "Typhoon"



"Business Media" Ltd.



JSC "Sevzapmontazhavtomatika"



"Welkomm" Ltd.



"Unicom" Ltd.



"Autospecter-NN" Ltd.



JSC "Rostelecom"



JSC "ARD Satcom Service"



JSC "MegaFon"



Information Centre  
"Telecom Service" Ltd.