1. Introduction

1.1. Regulatory framework for activities in Antarctica and history of the Belarusian scientific research in Antarctica

The Antarctic Treaty done in 1959 aims at providing the continent's non-military use, freedom of scientific investigations in Antarctica and cooperation with these purposes. According to this Treaty, governments, organisations and nationals of all the countries are allowed to carry out scientific work in Antarctica on equal basis, provided the compliance with its provisions. The Treaty defines the determining conditions necessary for unhindered implementation of the principle of the freedom of scientific research.

The Republic of Belarus acceded to the Antarctic Treaty in virtue of the Belarusian Law No. 157-3 on accession of the Republic of Belarus to the Antarctic Treaty of July 19, 2006 (Belarusian National Register for Legal Acts, 2006, No. 122, 2/1254). This Treaty entry into force for Belarus since December 27, 2006.

Given the crucial importance of Antarctica as a natural untouched territory, the Protocol on Environmental Protection to the Antarctic Treaty was signed in 1991. In 2008, the President of the Republic of Belarus signed the Decree on accession of the Republic of Belarus to the Protocol on Environmental Protection to the Antarctic Treaty (Presidential Decree No. 200 of April 10, 2008) (entry into force for Belarus since August 15, 2008).

It should be noted that the Belarusian polar explorations in Antarctica began actively in 1957 and have been pursued for many years as part of the Soviet Antarctic Expeditions (SAE). All in all, for the entire period of Antarctic explorations about 70 specialists from Belarus visited Antarctica as members of different expeditions, thus gaining considerable experience in research, logistics and other activities. Belarusian polar explorers contributed a lot in scientific studies of various domains. As an example, in 1983 SAE explorers of the National Hydrometeorology Centre reported the planet's lowest temperature at Vostok Station (-89.2°C) and in 1989 - strongest wind blow (78 m/s) in Antarctica at Leningradskaya station.

The new phase of Antarctic research for the Republic of Belarus started in 2006, when the National Program on Monitoring of the Earth's polar areas and promotion of the Arctic and Antarctic expeditions in 2007-2010 and for the period up to 2015 was adopted and implemented (as approved by Ordinance No. 1104 of the Council of Ministers of August 31, 2006). It was succeeded by the National Program on Monitoring of the Earth's polar areas and promotion of the Arctic and Antarctic expeditions for the period 2011- 2015, launched in 2011 (as approved by Ordinance No. 587 of the Council of Ministers on May 10, 2011).

In 2007, the National Centre for Polar Investigations, a governance authority, was organised for the practical implementation of the objectives set by the National Program. For the period since the National Program adoption, a considerable scope of work in Antarctica has been performed by scientists and specialists of the National Centre for Polar Investigations, research organisations of the National Academy of Sciences and other institutions involved in the

Antarctic program. Antarctic expeditions were organised in 2006-2007, 2007-2008, 2008-2009, 2010-2011, 2011-2012 and 2012-2013 (*Summary ... , 2007; Brief Report ..., 2011*).

As agreed upon with the Russian Antarctic Expedition (RAE), the Belarusian seasonal field camp was organised in the area of Molodyozhnaya Russian Federation station (East Antarctica) at Mount Vechernyaya field base. To provide the vital activities of Belarusian polar explorers, a number of premises at Mount Vechernyaya field base were reactivated, top priority repair work was performed, scientific equipment was installed and meteorological, geophysical, ozonometric, geological, geochemical and biological experiments and observations as well as new scientific equipment elaborated by Belarusian scientists testing have been conducted.

1.2. Objectives of the Belarusian explorations in Antarctica

The major object of the National Programs serves the deployment of research investigations and monitoring of the natural environment at the Earth's Polar Regions, aimed at obtaining the equal participant status of the Republic of Belarus in the global process, and, in future, the Consultative Party status in explorations and use of the planet's high latitude regions. It will promote its long-term political, economic and scientific interests in the Polar Regions, fulfillment of the international obligations under the Antarctic Treaty and the Protocol on Environmental Protection to the Antarctic Treaty.

The main objectives of the National Program for the period 2011-2015, taking into account the outcome of the first stage of the 2007-2010 National Program, are as follows:

- comprehensive scientific investigations and technological development for the study and monitoring of the Antarctic environment, development of a modern system of integrated environmental monitoring in the area of the Belarusian Antarctic expedition using remote sensing technologies;

- organisation of scientific expeditions and construction of the Belarusian Antarctic base infrastructure, equipped with up-to-date technological equipment, practical implementation of the new techniques, technologies and devices, as designed under the National Program, by testing their performance in polar expeditions;

- development of international cooperation in studying the Earth's polar regions, integration of the sensing systems in the international network of environmental monitoring, implementation of measures aimed at Belarus' obtaining of the Antarctic Treaty Consultative Party status.

Resulting from the National Program implementation, it is expected:

- to create pre-conditions for Belarus' obtaining of the Consultative Party status in accordance with the provisions of the Antarctic Treaty (deployment of a scientific station or scientific expeditions organisation);

- to strengthen the role of the Republic of Belarus in the Antarctic Treaty system;

- to promote the effective implementation of the Belarus' international obligations under the Antarctic Treaty and the Protocol on Environmental Protection to the Antarctic Treaty;

- to participate actively in bilateral relations, including cooperation with the Russian Federation, as well as in multilateral international programs within the framework of international cooperation in Antarctica;

- to develop the Belarusian Antarctic station infrastructure;

- to create of new components and upgrade the existing elements of the integrated environmental monitoring system in the area of the Belarusian Antarctic expedition performance, with prevailing use of remote fixed and satellite sensing systems;

- to obtain practical experience in procurement and logistics of polar expeditions and to involve young scientists for Antarctic explorations.

In May 2012 by the order of the Council of Ministers of the Republic of Belarus and pursuant to the objects and objectives of the National Program, a plan of BAS construction was worked out, presupposing its phase-to-phase implementation, starting from 2014.

The western sector of Enderby Land, Mount Vechernyaya Russian field base, located 20 km east of Molodyozhnaya Russian station has been selected as the principal site for BAS deployment (see Figure 1.1).

1.3. Necessity of drafting of CEE of the Belarusian Antarctic station construction

Pursuant to the 1991 Protocol on Environmental Protection to the Antarctic Treaty (Art. 8), "Each Party shall ensure that the assessment procedures set out in Annex I are applied in the planning processes leading to decisions about any activities undertaken in the Antarctic Treaty area pursuant to scientific research programs, tourism and all other governmental and non-governmental activities in the Antarctic Treaty area for which advance notice is required under Article VII (5) of the Antarctic Treaty, including associated logistic support activities". Reference to this requirement, the Initial Environmental Evaluation for the BAS construction and operation was prepared in accordance with the requirements of the Protocol on Environmental Protection to the Antarctic Treaty, based on the architectural design of the station and extrapolating the impact of the existing sources of Mount Vechernyaya field base, taking into consideration the scheduled increase of personnel in 2012. The impact assessment demonstrated that the BAS construction and further operation near Mount Vechernyaya RAE field base will be accompanied by emissions to the atmosphere, domestic water discharges, wastes accumulation, mechanical impacts on soil and ice, as well as heat, noise, electromagnetic exposure and possible introduction of microorganisms. Thus, the impact will be caused to all the major environmental elements within the station area.

Generally, the BAS construction and operation was mainly identified as having "a minor or transitory impact". However, for more accurate and complete estimation of consequences of the BAS construction and operation for the Antarctic environment and taking into account the ATCM Recommendation XV-17, it was decided to prepare a Comprehensive Environmental Evaluation in connection with the Belarusian Antarctic station construction.

The Draft Comprehensive Environmental Evaluation (CEE) of the Belarusian Antarctic station construction and operation has been elaborated pursuant to the Belarusian Antarctic Station Deployment Plan according to the EIA procedures set out in Annex 1 to the Protocol on Environmental Protection to the Antarctic Treaty, national statutory instruments and specification related to EIA, with adaptations to the BAS specific operation.

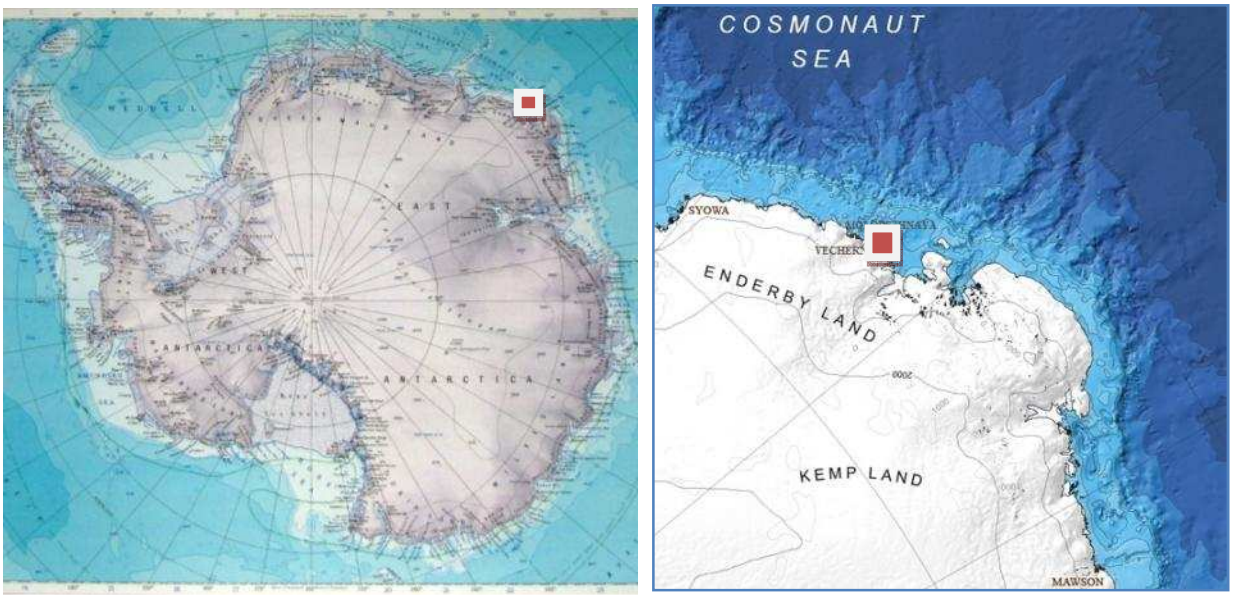


Figure 1.1 – Planed location of the Belarusian Antarctic station

2. Description of planned activity

2.1. Major scientific activities the Republic of Belarus in Antarctica

Pursuant to the Belarusian Act on accession of the Republic of Belarus to the Antarctic Treaty of July 19, 2006, the Republic of Belarus has been engaged in international scientific and logistic activities at the Earth's South Polar Region since 2007.

Starting from 2007, the National Program on Monitoring of the Earth's polar areas and promotion of the Arctic and Antarctic expeditions has been implemented by the Republic of Belarus.

The scientific and practical activities under the National Program is carried out by the National Academy of Sciences of Belarus and Ministry for Natural Resources and Environmental Protection, which organise the research and logistic support of the Belarusian Antarctic expeditions, as well as preparing the necessary legal and technological support in the field of polar investigations.

The major elements of the Belarusian scientific investigations in Antarctica under the National Program are:

1. The comprehensive terrestrial and satellite monitoring of tropospheric aerosol, clouds and underlying surface in Antarctica; development of extra channels for sensing tropospheric ozone and stratospheric polar clouds and creating instrumentation, methodology and software for calibration of satellite optical instruments at the Antarctic ground surroundings;

2. The comprehensive ozonosphere and ultraviolet radiation investigations; hydrometeorological support of the Belarusian Antarctic expedition and climate research;

3. Development of radio devices for monitoring snow & ice cover and atmosphere in the Polar Regions;

4. Geophysical and geochemical surveys of the earth's crust in Antarctica at the Belarusian Antarctic expedition areas;

5. Assessment of prospects for renewable living resources of the Antarctic coastal ecosystems and environmental impact of activities related to the organisation and functioning of the Belarusian Antarctic station.

2.2. Belarusian Antarctic station construction site selection criteria

When selecting the possible sites for construction of the future Belarusian Antarctic station (*Comparative analysis of criteria.., 2007*), the geographical, topographical, geological, meteorological, hydrological factors, as well as accessibility and other important conditions (criteria) for secure living were taken into consideration, i.e.:

- location at the coastal area of the Antarctic continent and possibility of supply vessels to approach as close as possible to the intended place of major structures and facilities deployment, as well as to storage tanks for the main and emergency supply of fuel and

lubricants, and easier supply operations (according to the logistic scheme: ship - shore / barrier - station);

- presence of significant flat outcrops of rocks or alluvial deposits at the site;

- accessibility for ship-based helicopters;

- feasibility to arrange a snow & ice landing strip for aircraft engaged on scheduled inland flights;

- friendly topography and windproof properties of natural obstacles;

- site's optimal orientation, as refers to the prevailing wind direction;

- feasibility of engineering a safe, year-round transport corridor with access to the ice canopy and Molodyozhnaya – Mount Vechernyaya field base route;

- proximity of non-frozen water reservoirs (lakes) with fresh (potable) water;

- availability of representative sites to be opted at the mountain terraces or nearby areas for scientific instruments and process equipment intended for open-air installation and deployment;

- availability of safe walking of the station staff around the territory of the possible development, as well as at the adjacent areas;

- presence of year-round or seasonal station of another State Party to the Antarctic Treaty in the reasonable vicinity (20 km), in order to use its facilities (fuel, diesel generators, foodstuff, buildings and structures) in case of emergency or other force majeure circumstances;

- favorable ecological environment at the selected site.

As mentioned above, since 2006 the Belarusian Antarctic expeditions used the infrastructure of Mount Vechernyaya field base of Russian Antarctic expedition, located 20 km east of Molodyozhnaya Russian station. In this regard, the Mount Vechernyaya field base site was considered the top priority for the BAS placement. The field base location and BAS intended deployment area in coordination with Molodyozhnaya station location is given at Figure 2.1.

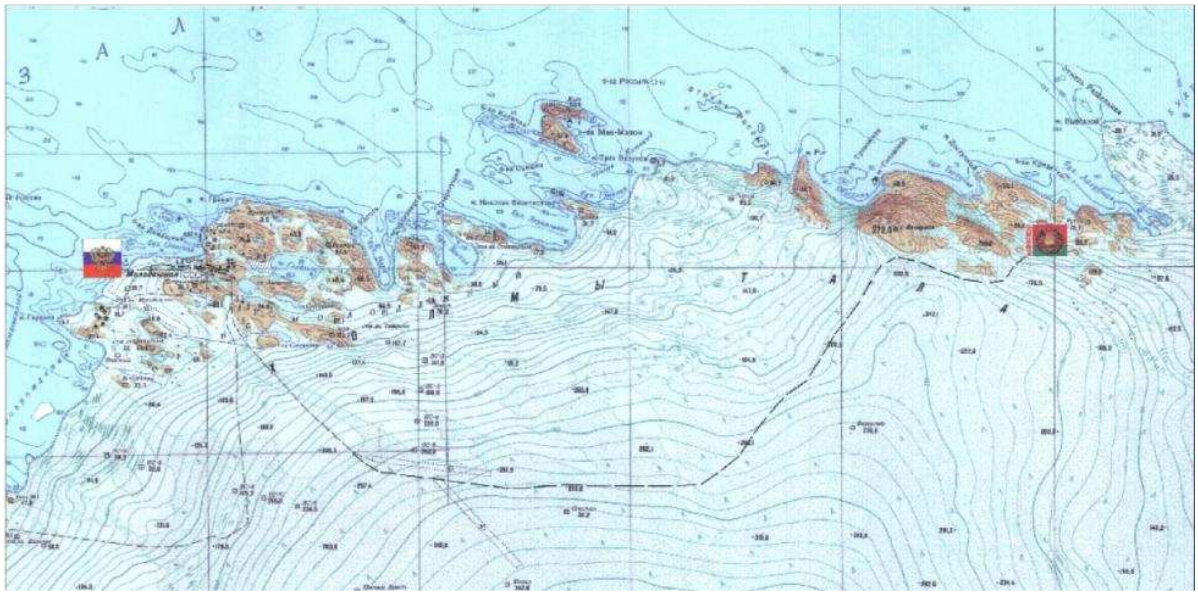


Figure 2.1 – BAS proposed placement relative to Molodyozhnaya station, Enderby Land

Three alternative sites were considered for the Belarusian Antarctic station possible placement (see Figure 2.2).

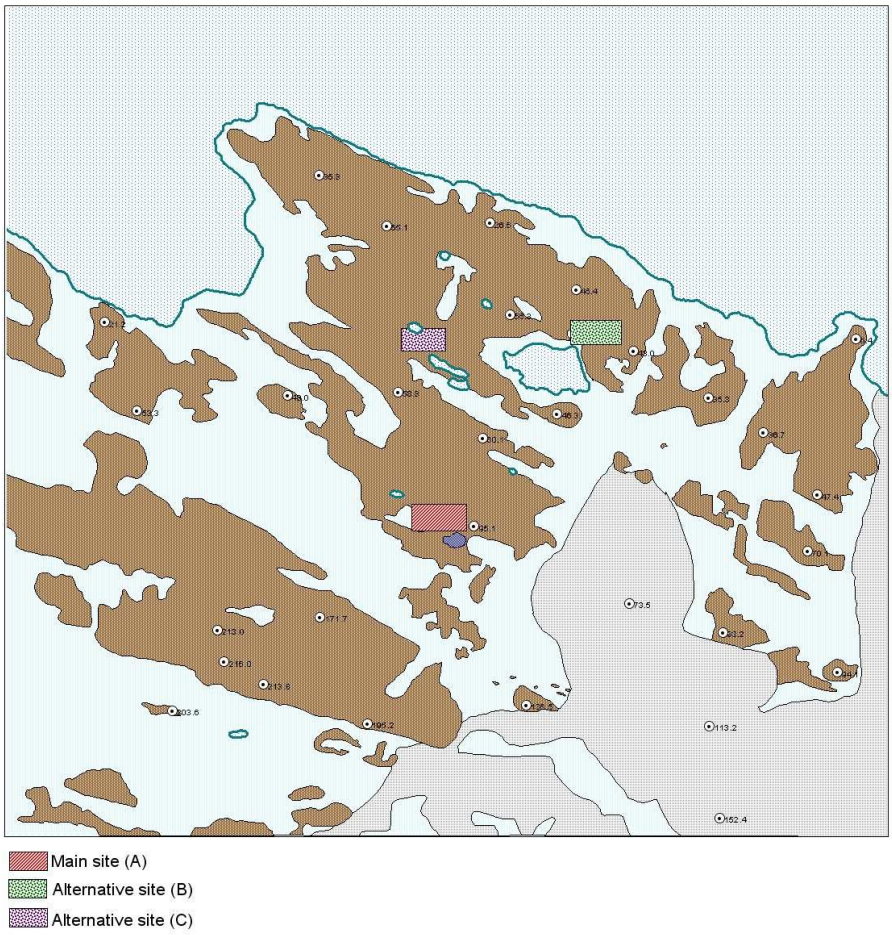


Figure 2.2 – Alternative sites for BAS construction at Mount Vechernyaya

Site A. Located on the eastern slope of Mount Vechernyaya. The selected site is a relatively flat, mountain terrace, sized about 350 m long and 50-80 m wide, having a reliable transport access for automotive and light snowmobile vehicles. The terrace is conveniently located towards the prevailing wind in a blown mountain ravine. It is well protected from katabatic winds and severe snowdrifts by the Mount Vechernyaya eastern spur from the one side and by a rocky ridge to cover up this hollow from the seaside.

Site A is located at approx. 120 m distance from Mount Vechernyaya RAE field base residential premises and 12 - 15 m higher. It stands at about 250 m distance from the RAE Mount Vechernyaya field base main complex of buildings and structures and Nizhneye lakeside.

The Site A convenient location on the eastern slope of Mount Vechernyaya makes it feasible to engineer a year-round, reliable transport access, including that available for tracked vehicles.

At the site area (approx. 0.5 km^2 around) no faulty equipment and/or waste deposits from past production activities are reported. This deems to be rather favorable for the Belarusian explorers.

The only minor problem, currently evident and associated with Site A location, may arise with independent supply of fresh water at winter seasons. The distance between the site and the Nizhneye Lake and 50-60 m vertical drop can substantially complicate the water supply process. The problem of domestic and potable water supply can be resolved by electric snow-melting heater to be placed in the immediate vicinity of the buildings and facilities. At the same time, the abundant glacial, seasonally melt waters of small lakes at the terrace, being accumulated during the November-March period, can serve the evidence of no such potable water problem to exist for at least half-year period. If needed in other seasons (April to October), the potable water can be periodically delivered by a specially designed tank trailer from the nearest non-frozen pond – the Nizhneye Lake.

The comparative analysis of the initially selected sites showed that Site A combines the best characteristics for BAS location and should be considered as the top priority option. The characteristics of the alternative sites are provided in Section 2.4 below.

2.3. Possibilities to use the RAE Mount Vechernyaya field base infrastructure

The all-steel modular residential complex and other facilities of Mount Vechernyaya RAE field base are situated at 100-200 m distance northeast of the selected site. The Vechernyaya field base infrastructure was built in 1979. It was designed to accommodate year-round technical staff for IL-76 aircraft landing strip. Originally, Vechernyaya field base residential and production premises consisted of 13 individual and semi-detached buildings. For 10 years, until the end of IL-76 flights from the Soviet Union, Vechernyaya field base operated year-round independently. Since 2006 the field base has been accommodated by 2-6 BAE staff scientists in summers. Nowadays, Mount Vechernyaya field base residential and production premises compose of 7 individual and semi-detached buildings; the rest facilities were dismantled by the Russian Antarctic Expedition with participation of Belarusian specialists during the period 2006-2009.

At the present time the remaining field base infrastructure is worn out, partially destroyed, and unable to support the proper operation of the station and accomplishment of the objectives set by the National Program on Monitoring of the Earth's polar areas.

2.4. Station design concept and major parameters

2.4.1. Station design concept

The requirements for the national infrastructure creation in Antarctica are all-weather performance, versatility and space-saving design of most residential and service-specific modules.

Modern international experience in creating similar facilities of polar infrastructure, the practical experience of Belarusian explorers accumulated during their work in earlier Antarctic

expeditions, and the need for the entire BAS infrastructure to comply with environmental safety requirements in order to limit adverse impacts on the Antarctic environment and ecosystems, were taken into consideration in the development of the BAS concept.

The BAS design is conceptually based on small modular structures, being assembled in Belarus, with their subsequent delivery by land, sea and air transport to Antarctica and installation on site by helicopter. Reference to the Belarusian Antarctic station creation plan, during the period 2014-2018 the following residential & production modules and service-specific blocks, pavilions and boxes will be deployed stage-by-stage, i.e.:

- laboratory & residential module, single-storey;
- service & residential module, single-storey;
- laboratory & residential module, two-storey;
- two production & residential modules, two-storey;
- sanitary & hygiene block;
- heated and unheated warehouse pavilions;
- garage & conservation box.

During the period 2014-2018, nine service & residential, kitchen & utility and production modules, specifically designed for operation in the harsh Antarctic environment, are expected to be delivered to Antarctica and installed on site.

At later periods (2019-2020 and further on), the following facilities will be deployed:

- non-magnetic pavilion;
- fuel & lubricant tanks (2 tanks of 50 m^3 each, 1 tank of 25 m^3, 2 tanks of 3-5 m^3 each);
- 2 diesel power stations of 100 kW capacity each;
- incinerator (waste disposal burner);
- press for empty fuel barrels disposal;
- jet dump device with sewage collector for water waste disposal to the coastal marine area;
- water supply system (to buildings);
- 2 refuel pumps (diesel/petrol) for motor vehicles.

Electric power will be mainly supplied by diesel generators and solar panels; in future, wind power generators are also planned to be used.

2.4.2. Structural features and major parameters of modules

Design features

Structurally, the Belarusian Antarctic station (BAS) will consist of separate modules of different functions. Each module will be built on a single fixed-site basement, elevated above the surface with manually operated outriggers, mounted under each corner of the module. The design

project for the Belarusian Antarctic station modules was developed in 2012-2013 by Midivisana Ltd. BAS modules will be mounted to the basement on-site and fixed with special clamps.

The module is based on 20-ft container core with welded steel frame, made of shaped tube with 120 mm beam flange height.

The steel basement will be encased by panels. The panel encasement will be made of precast polyurethane sandwich panels with integrated special inserts for internal hardware to be installed. The module panels are fixed rigidly on metal rivets with sealing agent applied. The panel thickness, depending on its location in the module, varies from 75 to 120 mm. The internal insulating layer is made of rigid polyurethane foam with density of at least 70 kg/m^2.

Each panel will be composed of:

- siding: galvanised steel with white-coloured polymer coating;
- inner lining: galvanised steel with polyester coating;
- exterior finish elements of the wagon (hardware) - stainless steel;
- floor: wear-resistant linoleum;
- furniture and interior of the modules: water-resistant plastic-laminated plywood.

Windows: three-chamber double-glass PVC panes with swing-open mechanism, curtains.

Doors: inward open, fixed window at the front door. Metal profile water drains above each window. The access to the modules is provided from platforms, made of metal plates with punching. The ladder to the platform is non-folding, bolted. When in transport position, it is secured to the outer side of the module. When transporting, the entry ladder is removed.

The modules are equipped with lobbies. The internal walls and partitions are made of MDF with laminated coating. For most efficient keeping of indoor operating temperature, an automatic climate system is designed, with a backup device - electric heater.

Power supply system: The wiring will be made open through cable ducts. The power system will be equipped with switchboard / junction box, which integrates automatic circuit breakers and residual current circuit breakers. Metal parts of power installations, electrical housing and drives will be made in compliance with the regulatory documents and specifications. 380V separate socket and 220V outlet block will be mounted in each sleeping room and 3 blocks in the main room (under the table, at the stand for electrical devices and between the sink and refrigerator). External power source (380V) with earthing and a cable of 40 m long. The lights, both internal and external, have dustproof and waterproof design. Individual lights are installed near each bed and above the basin mirror.

Alternative power supply: solar panels with total capacity 1-1.5 kW at each module.

Emergency power supply: indoor-located high-capacity batteries.

Ventilation: forced plenum and extract ventilation, through open windows and doors. Backup device -side air vent with sealed cap.

Water supply: water heater, made of stainless steel with fittings and piping for user-friendly consumption.

Sanitary equipment:

For heating: electric boiler with automatic shutoff in case of water deficiency.

For water supply to consumers: water pumping system without a water tower installed.

Drainage system: downstream the drain siphon, a degreasing station is installed, providing waste water purification from fat and impurities with further water forwarding to the sewerage system.

Excreta disposal system: electric toilet (Incinolet) with recovery system will be installed in the residential modules. The processed residues (ash) will be disposed as household wastes.

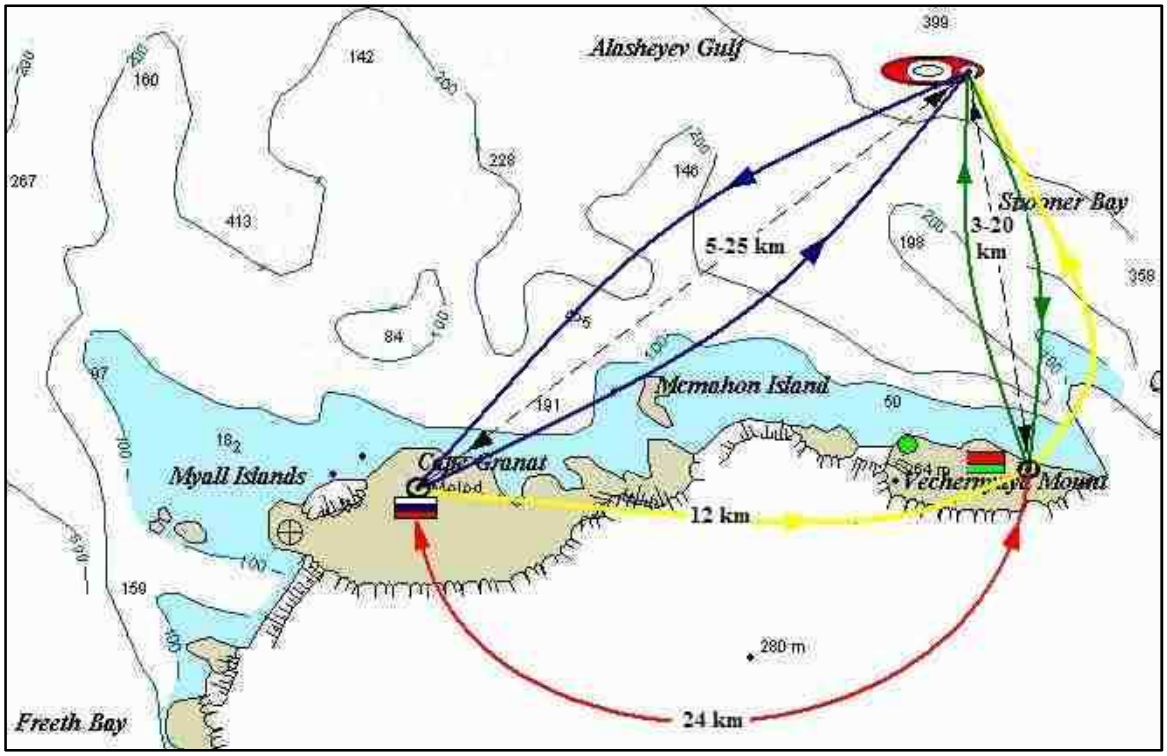
Drainage: drainage system with a set of heated pipes and fittings, with optional connection to the central collector or wastewater storage tank of heated double-layer wall design.

Communication devices: cable gland for connecting automatic exchange open lines and socket connections.

The general view of the planned Belarusian Antarctic station (modules deployment option) is shown at Figure 2.3 below.

Figure 2.3 – General view of several BAS modules (architectural design)

The modules will be pre-assembled and transported to the operation site in Antarctica by sea (on RAE ships) and air (Ka-32 helicopter) (Figure 2.4).



Symbols	Description
	Russian Antarctic Molodyozhnaya station
	Mount Vechernyaya field base of the Belarusian Antarctic expedition
	Research supply ship with helicopter landing spot
	Helicopter flight route for Molodyozhnaya RAE logistics & procurement
	Helicopter flight route for BAS modules delivery
	Possible helicopter transit route through Molodyozhnaya RAE to Mount Vechernyaya field camp for BAS instrumentation and equipment deliveries
	Adelie penguin colony at Gnezdovoy Bay 3.5 km along the coast to the west from BAS Mount Vechernyaya field camp
	Land route for transport vehicles shuttling between RAE Molodyozhnaya field base and BAS Mount Vechernyaya field base

Figure 2.4 – Plan of the modules delivery from ships to the construction site

Parameters of modules

The modules are designed to operate at the following conditions:

- ambient outdoor air – from -60 to +40°C;
- atmospheric pressure – from 60 to 107 kPa (450 to 800 mm Hg);
- relative humidity ranging 30 to 98%;
- resistant to snow, rain, frost and wind (blasts up to 70 m/sec).

Modules feature different sizes and accessories. The major parameters of modules are given in Table 2.1 below.

Table 2.1 – Types and major parameters of BAS modules

Module type	Dimensions, mm			Overall weight, kg
	Length	Width	Height	
Laboratory & residential, single-storey	6058	7314	2438	8900
Service & residential, single-storey	6 058	7314	2 438	10250
Laboratory & residential, two-storey	6 058	2 438	4 876	6300
Production & residential, two-storey	6 058	6 058	4 876	9 300

The laboratory & residential single-storey module (Figure 2.5) composes of:

- 2-section prefabricated platform-basement;
- one lab & household butterfly-type wagon section (single-sided);
- one container-type service & residential wagon section.

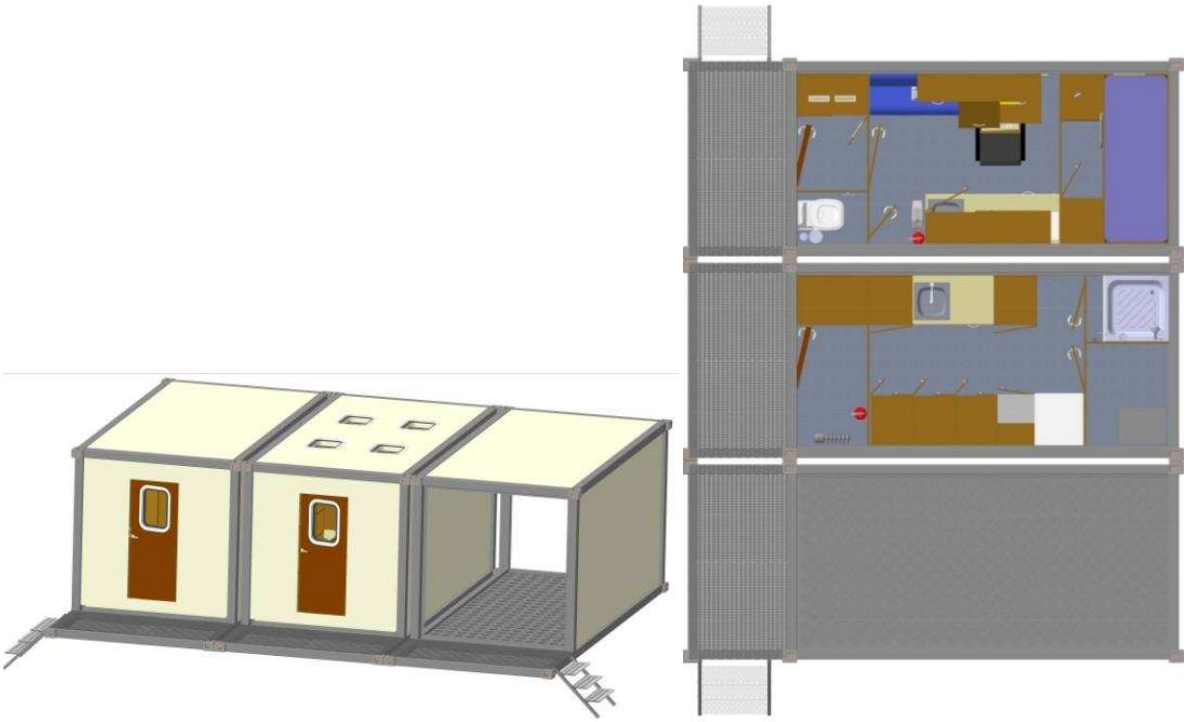


Figure 2.5 – General view (A) and layout (B) of the laboratory & residential single-storey module

The service & residential single-storey module (Figure 2.6) composes of:

- 3-section prefabricated platform-basement;
- two container-type service & residential wagon sections;
- one container-type household wagon section.

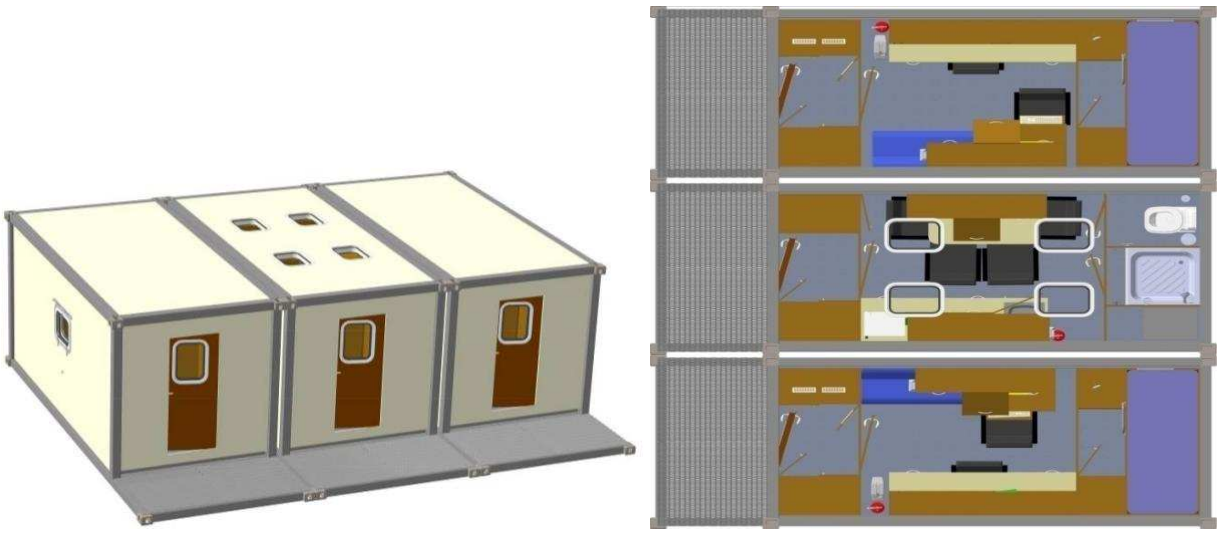


Figure 2.6 – General view (A) and layout (B) of the service & residential single-storey module

The laboratory & residential two-storey block module (Figure 2.7) composes of:

- one container-type service & residential wagon section;
- one block (wagon section) for communications, navigation and routine weather monitoring.

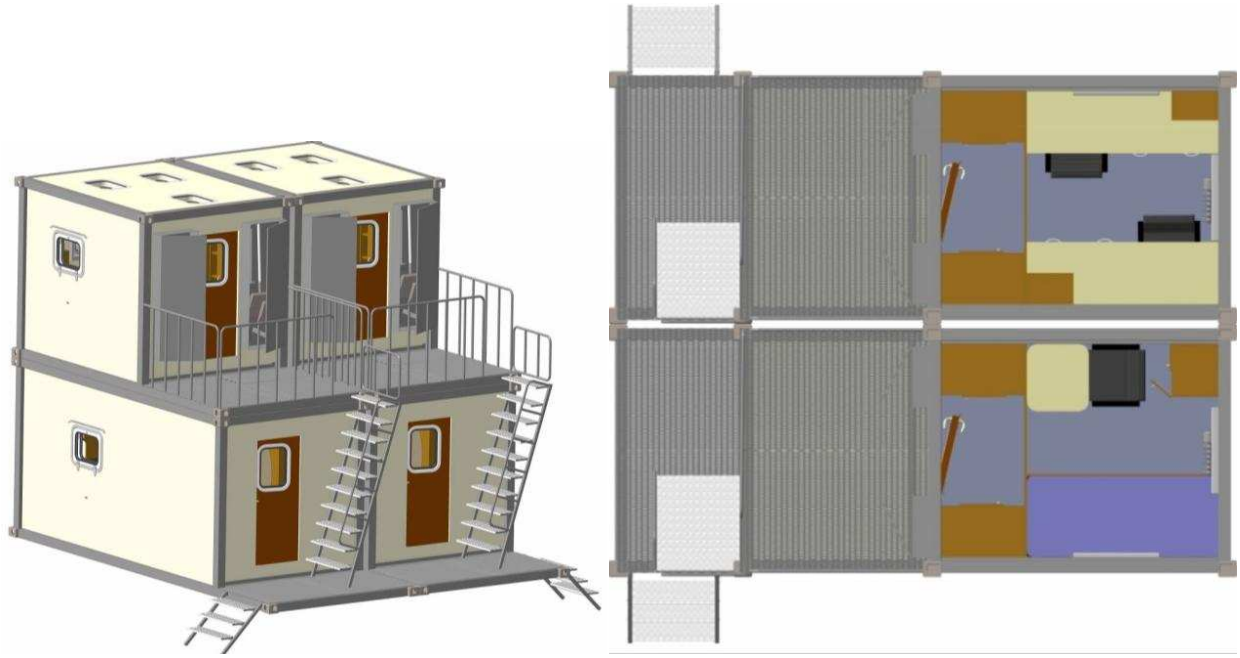
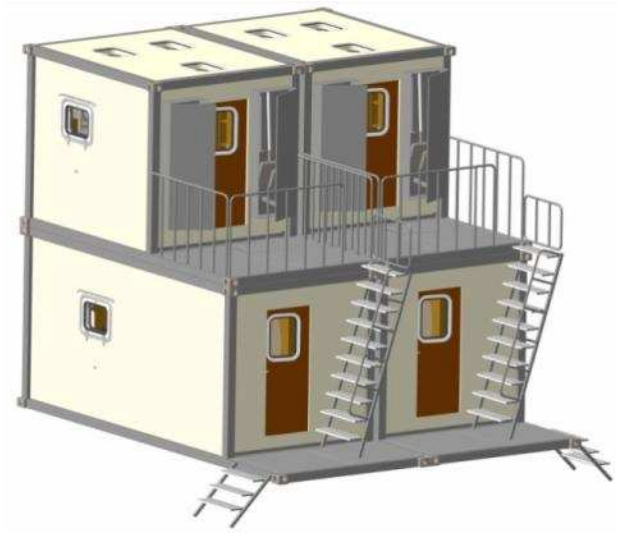


Figure 2.7 – General view (A) and layout (B) of the laboratory & residential two-storey module

The production & residential two-storey module (Figure 2.8) composes of:

- simplex prefabricated platform-basement;
- container-type residential wagon section (lower block);
- container-type production wagon section (upper block)

A)



Б) В)

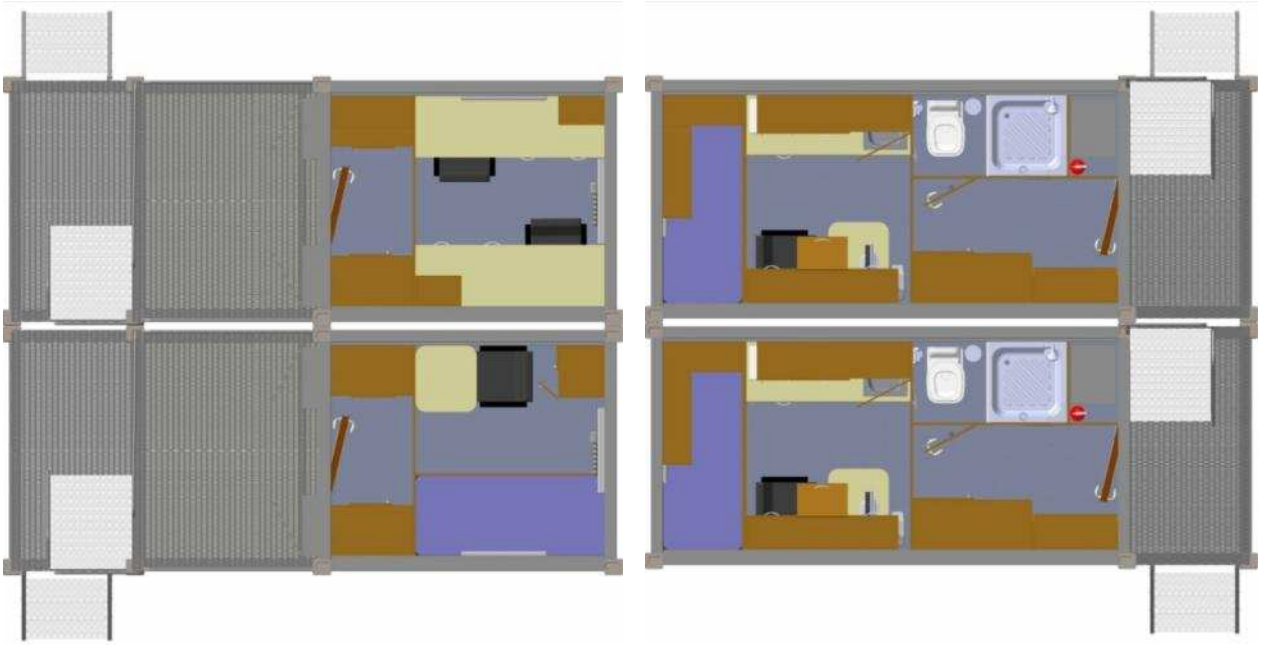


Figure 2.8 – General view (A) and layout (B) of the production & residential two-storey module

The modules will be mounted on platform-basements and fixed with outrigger jacks and extra telescopic adjustable legs. To install the container-type wagon section onto the basements, easy-removable ladders and enclosures will be used.

Some special-purpose wagon sections will be equipped with self-contained power supply systems.

In general, the complex of multi-purpose modular structures for the Belarusian Antarctic station is designed to provide all life-sustaining conditions during the seasonal (up to 6 months) and wintering (up to 18 months) Belarusian Antarctic expeditions in the extreme climatic environment of Antarctica.

The design lifetime of the modules – min. 15 years.

The detailed BAS modules specifications are given in the Annex 1.

The on-site disposition of the BAS facilities is given at Figure 2.9 below.

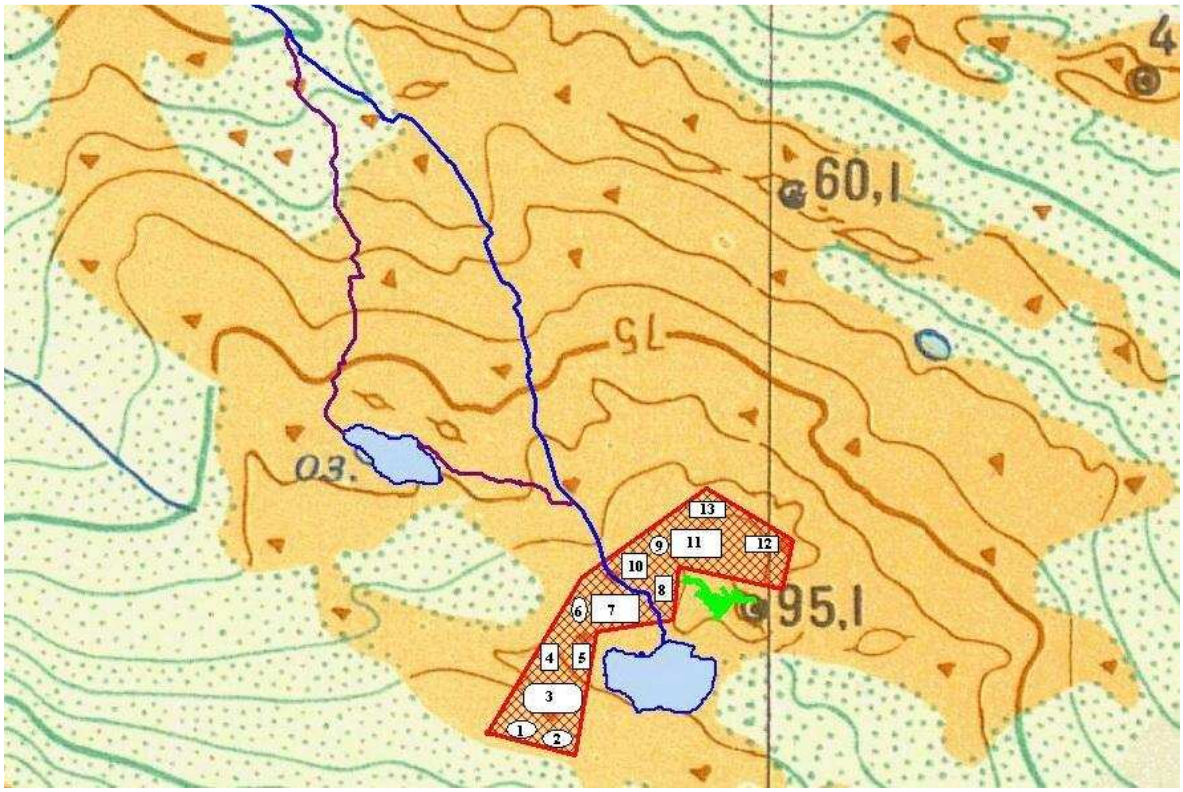


Figure 2.9 – BAS facilities allocation at construction site: 1 and 2 - 50 m^3 fuel & lubricant tanks; 3 - Semi-detached containers with diesel power station of 20, 60 and 100 kVA capacity; 4 - incinerator (waste burner); 5 – sanitary unit; 6 - 25 m^3 fuel & lubricant tank; 7 – garage & storage facility box; 8 - production & residential two-storey module; 9 - jet dump device with sewage collector for water waste disposal; 10 - two semi-detached warehouse pavilion (heated and unheated); 11 – laboratory & residential container module; 12 and 14 - semi-detached laboratory & residential and industrial & residential block modules; 13 – service & residential container module.

2.4.3. Power supply system

The station's power supply system will be based on diesel generators and also solar power installations. The first phase of BAS construction is expected to operate the existing diesel generators of DG-20 AD16-T400-2RP, DG-60 AD60-T48C-2RP and GEKO 6401 type, currently located at Mount Vechernyaya field base; specific fuel consumption ranging 1.43 to 15.5 l/h, diesel fuel (Table 2.1), as well as generators with petrol engines (3 pcs.) as standby facilities, and diesel-operated blow heaters (Table 2.2).

Table 2.2 – Parameters of diesel generators to be used at the BAS

Generator type	Fuel consumption, depending on output, ref. to the manufacturer's specifications		Type of fuel	Actual fuel consumption in Antarctic conditions
	% output/kW	l/h		
DG-20 AD16-T400-2RP	100/16	5.4	diesel	5.94
	75/12	4.6	diesel	5.06
	50/8	2.7	diesel	2.97
	idle run	1.5	diesel	1.65
DG-60 AD60-T48C-2RP	100/48	14.1	diesel	15.50
	75/36	10.8	diesel	11.88
	50/24	7.4	diesel	8.14
	idle run	3.0	diesel	3.30
GEKO 6401	100	1.8	diesel	1.98
	50	1.3	diesel	1.43

Table 2.3 – Parameters of blow heaters and petrol engines to be used at BAS

Unit type	Fuel consumption, depending on output, ref. to the manufacturer's specifications		Type of fuel	Actual fuel consumption in Antarctic conditions
	% output/kW	l/h		
Blow heater, 20 kW	100/20	3.3	diesel	3.30
Blow heater, 44 kW	100/44	4.0	diesel	4.00
MAKITA power generator, 4.2 kW	100/3.5 50/1.75	2.5 1.3	petroleum	2.75 1.45
GEKO 7401ED-AA power generator	100/6.4 50/3.7	3.3 1.8	petroleum	3.63 1.98
GEKO 1001E-S/UHBA power generator	100/0.7 50/0.35	0.64 0.32	petroleum	6.5 0.35

As part of the laboratory & residential two-storey module, 2.5-3.5 kW (service & residential) and 1.0-1.5 kW (communication unit) emergency power generator are planned to be integrated.

All laboratory & service modules will accommodate rotary metal frames with adjustable inclination for solar panel installation.

The power from the generators to the station modules will supplied on overhead lines.

2.4.4. Water supply and drainage

The amount of fresh water, as required for BAS seasonal operation (5-6 persons), is expected to count (min.) 5.0-6.0 m^3 per month, the rated water consumption for 10-12 people in winter is (min.) 9.0-10.0 m^3 monthly. For four months' period (November-February), potable water will be taken from the nearby seasonal lakes. The water will be pumped to metal water tanks

placed directly in the BAS kitchen & utility modules. In the other periods, the water will be transported from the Nizhneye Lake in special tanks mounted on a sled.

During the BAS first-phase construction and operation (2014-2018 years), each kitchen & utility module (wagon section) will be equipped with a system for collecting wastewater / storage tank (400 l capacity with internal heating). The storage tank will be transported separately and mounted underneath the wagon section following the platform-basement deployment. Upon wastewater accumulation it will be pumped from time to time into a special container on a sled for further domestic wastewater discharge to the seacoast locations, which are reported to be fit for initial dilution and rapid dispersal.

At the second phase (2019-2020 and later), a jet dump device is expected to be built for waste water disposal through central sewage collector to the coastal marine area. For domestic wastewater discharge to the central collector, a powerful hydraulic pump will be used. The wastewater is planned to be discharged through the central collector directly into the sea in areas, which are reported to be fit for waste waters initial dilution and rapid dispersal.

All BAS kitchen & utility modules (wagon sections) will be equipped with electric toilets (Incinolet) and showers. The service & residential modules may alternatively be equipped with portable bio-toilets.

2.4.5. Waste management

The station operation will be inevitably accompanied by solid waste generation. Improper waste management might cause environmental problems due to waste accumulation.

According to estimates (see chapter 4.1.2.6) in case of 5-6 people engaged in the BAS field season operation, the following wastes will be generated per season: 700-1000 kg of household wastes, including 180-290 kg of food wastes and 240-300 kg of combustible wastes as allowed for incineration under the Protocol on Environmental Protection. At year-round operation number of wastes will be approximately 6 times higher.

During vehicles and equipment operation and maintenance, a significant amount of industrial wastes, including barrels from fuel, lubricants, antifreeze, defective engine parts and equipment, etc. will be generated. In particular, the amount of annual accumulation of empty fuel & lubricant barrels during the first phase station operation will be 15-20 pieces.

The service and maintenance of diesel generators and vehicles will produce oil sludge (waste oils) and antifreeze. The total amount of oil sludge to be generated is estimated at 100 liters per month, the waste antifreeze – no more than 50 liters per month.

A separate waste collection, including combustible, non-combustible, food, oil sludge, fuel & lubricant containers, etc. will be organised. Any combustible wastes can be accumulated and further incinerated at RAE Molodyozhnaya station incinerator in accordance with the Protocol on Environmental Protection (until the incinerator is installed at BAS); non-combustible wastes, including hazardous substances, are planned to be stored on-site in containers and barrels,

until removed to the continent. Food wastes will be dumped into the sea in accordance with the requirements of the Protocol on Environmental Protection.

Oil sludge and waste antifreeze will also be accumulated and further transported to the continent.

The incinerator parameters and projected emissions are given in Section 4.1 below.

2.4.6. Logistics

According the existing agreements, the delivery of the station modules and cargo, as may be required for the BAS construction and operation and further research activities will be carried out by Academician Fedorov and Academician Treshnikov RAE ships generally engaged to supply RAE research stations, including Molodyozhnaya field base. The modules and cargo will be transferred from the ships to the station construction site by Ka-32 helicopters. The parameters of the vessels and helicopters are given in Section 4.1.

2.5. BAS construction alternative sites at Mount Vechernyaya locations and zero alternative

2.5.1. Alternative sites at Mount Vechernyaya

Site B. This site is located on the Nizhneye lakeside, opposite to Mount Vechernyaya field base at approx. 350 m distance from the base' residential premises and ~20 m above the Nizhneye lake surface.

The site features a slightly rugged plot of rocky outcrops, sized 150x50 m. It borders on the Nizhneye lake basin from the south-western side and on a small rocky ridge from the north-east, sloping steeply to the coastal ice barrier.

Site C. Located at the same line with the core group of buildings and structures of Mount Vechernyaya field base, at 250 m distance from the outermost field base building (diesel generator).

It features a slightly rugged plot of rocky outcrops, sized approx. 100x100 m. In the vicinity, there are two small, freezing in winter, fresh water reservoirs.

These sites, as well as the principal site (Site A), are situated at 2 km vicinity from each other at similar locations. Site D was also subject to alternative consideration, which is located at Granat Cape ~ 1.2 km north-east from the residential centre of Molodyozhnaya field base. It is a slightly billowy plot at Molodyozhny oasis territory, sized ~ 250x250 m.

The alternative options, as examined, presuppose the station to be built outside oasis boundaries (no nesting birds and/or places with high biodiversity, etc.), and therefore will not be significant differences in the environmental impacts when choosing any site option. Reference to the comparative analysis of the selected sites, Site A possesses the best characteristics for BAS deployment.