The Russian Research and Production Company GRASYS is the leading designer, manufacturer and EPCM contractor in the field of air and gas separation in CIS and Eastern Europe.

Core Business Lines of Grasys:

- Treatment of natural and associated petroleum gas (APG)
- Development and manufacturing of air separation and gas separation equipment
- Engineering and design
- Turn-key integrated projects (EPC and EPCM contracts) for air and gas separation, APG recovery, NG and APG treatment

The priority tasks of Grasys are: manufacturing excellence, continuous technological development and scientific research that enable the company to produce high-technology advanced equipment and perform complex projects with maximum economic efficiency for customers.

The high quality of Grasys’ products is ensured by the modern manufacturing base with extensive technological capabilities. Grasys has implemented more than 850 projects for 550 companies in petroleum, petrochemical, chemical, energy, coal, metal, construction, food and other industries.

The company staff includes the leading specialists in the industry — graduates of the best national technical and economic institutions, candidates and doctors of science. Using their unique experience and knowledge, the specialists of Grasys develop new solutions and achieve top results ensuring the company’s sustainable growth during more than 14 years.

Continuous scientific research carried out by the company in the field of membrane and adsorption air and gas separation technologies allows finding and implementing new solutions for development of science and industrial enterprises. The company specialists have developed a special membrane with technical characteristics exceeding its counterparts all over the world.

Membrane plants of Grasys are operated at the leading petroleum enterprises offering efficient solutions for the tasks of conditioning natural and associated petroleum gas.

Grasys has all the necessary permits and certificates for carrying out its activities. The company’s quality management system complies with international ISO 9001:2008 standards.

Grasys manufactures its equipment in accordance with the ASME, CE regulations as well as the corporate codes of Total, Gazprom, and Shell; develops and issues documentation in line with the world standards internationally adopted for EPCM contracts.
More than 350 world-renowned clients!

**OIL, GAS, CHEMISTRY, PETROCHEMISTRY, ENERGY:**
- Gazprom, Rosneft, Lukoil, Exxon Mobil, Shell, Enel, Eni, ConocoPhillips, Petrofac, Oil Industry of Serbia, Himmash, Sibur, Eurochem, TurkmenGaz, KazMunaiGaz, Orsknefteorgsintez, Kazakhmys, Zarubezhneft, Surgutneftegaz, Rusvyetpetro, Slavneft, Tatneft, Gazprom neft, Transneft, Novatek, Ritec, Iruktsi Oil Company, Samara Nafta, Neftisa, Belorusneft, Russneft, etc.

**METALLURGY, MACHINE ENGINEERING, COAL INDUSTRY:**

**FOOD INDUSTRY:**
- Pepsi, Mars, Unilever, Chibo, Paulig, Wimm Bill Dann, Lebedyansky Cannery, Sun Products, Moscow Fat Plant, EFCO Group, Royal Canin, Podsolnuh TD, Martin Union etc.

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**GAZPROM**
- Grasys’ nitrogen stations are used on the Nord Stream, Altai, Jubga-Lazarevskoe-Sochi, Gryazovetsky-Vyborg and many other pipelines, as well as at the Nizhneturinskaya CS, Medvezhye field, Yamburgskaya CS, Volykhovskaya CS, Sheksinskaya CS, Prokopyevskaya CS, Nyuksenitsa CS, Lyrinalaya CS, Chazhentso CS – overall, more than 250 nitrogen stations. The air compressor stations and mobile stations for production and bottling of oxygen are used at the oil and gas condensate fields of the company.

Gazprom and Grasys are implementing joint projects for helium recovery from natural gas.

**ROSNEFT**
- The extensive list of supplies of nitrogen producing equipment to the company’s sites, including the largest projects of turn-key nitrogen plants construction at the terminal pumping stations, gas treatment plants, free water knockout units and field support bases of the Vanikor field.

Supply of Grasys’ equipment to the Fakhirovskoe, Tarasovskoe, Fainskoe, Ugutskoe, Kynskoe and other fields of the company.

The unique membrane plant for APG treatment up to the Gazprom network standards for RN-Krasnodarneftegaz, and APG treatment plant for RN-Stavropolneftegaz.

The largest adsorption nitrogen plant is supplied to the Kuibyshev Refinery for nitrogen based hydraulic treatment of the vacuum gasoil complex.

**LUKOIL**
- The high-capacity plant for nitrogen production with adsorption air separation process at the largest oil refining company of Lukoil-Nizhegorodnefteorgsintez. The largest membrane nitrogen plant at the chemical production company Saratovorgsintez.

The nitrogen membrane plant on the offshore platform of the Korchaginskoe North Caspian Field. The nitrogen plants at the Varandey offshore ice-resistance stationary loading terminal. Mobile nitrogen and air compressor stations at the Yuzhnoe Helcheyu field.

The membrane APG stripping and drying plant for Lukoil-Kaliningradmorneft, NSP Romanovo.

**SIBUR**
- The nitrogen production plants are operated at SIBUR’S gas processing facilities: Noyabrysko condensate gas heater, Nyagan-gazpererabotka, Yuzhno-Balyksky condensate gas heater.

Grasys’ equipment supplies nitrogen to the largest polypropylene production company Tobolsk Polymer.

**SURGUTNEFTEGAZ**
- Supply of the nitrogen production equipment to the Rogozhinsko field; supply of mobile nitrogen stations to the subsidiary companies of Surgutneftegaz.

**NOVATEK**
- Grasys’ nitrogen stations for support of the stable gas condensate transshipment and fractionation process in the Ust-Luga Commercial Sea Port as part of the Novatek – Purovsky Plant. Mobile nitrogen stations at the Yurkharovskoe field, Novatek-Yurkharovskneftegaz, Novatek-Tarkosaleneftegaz, and Yarego.

**RITEC**
- The integrated associated petroleum gas recovery projects at RITEC’S field in Tatarstan, supply of air compressor and nitrogen stations.

**ORSKNFTEORGSIINTEZ**
- The 3000 m³/hr adsorption nitrogen plant.

**RUSVYPETRO**
- The membrane plant for associated petroleum gas treatment up to the fuel gas requirements. Nitrogen and packaged compressor stations for the company’s fields.
Areas of Activity of Grasys
Research & Development, Design & Experimental and Technological Works
Science and research are the most important and integral areas of Grasys’ operations ensuring its leadership in the industry. The development of unique solutions based on its in-house technologies, improvement and adaption of the existing technologies help successfully support a high engineering level of the equipment produced, efficiently resolve the tasks of industrial enterprises and enhance production productivity.

Grasys continuously searches and implements new technical and engineering solutions in the field of gas separation. It also holds patents for inventions and utility models in the field of air separation and gas separation based on various technologies.

The research and development activities at the research and testing benches of the company’s Engineering Center are conducted in close cooperation with the leading research centers Kurchatov Research Center and RAS IPS. Industrial tests of new technological solutions are carried out at the fields of Gazprom, Rosneft etc. together with the design institutions of oil and gas companies.

One of the most important results of Grasys’ Research Program has become the development of a brand new globally unrivaled gaseous hydrocarbons separation technology based on hollow fiber membrane. The new technology gave rise to production of the advanced industrial plants and development of new patented process solutions in the field of associated petroleum gas treatment with membrane method.

Grasys is currently involved in the intensive research covering various spheres of gas separation and conditioning, such as: treatment of hydrocarbon gases to remove hydrogen sulfide with plasma-chemical methods, removal of hydrogen sulfide from natural gas with ultra violet, improvement of PSA technology, improvement of low-temperature separation technology, development of new design for propane coolers, new filtration systems, in particular, coalescing filters, membrane gas mixture separation systems and combined technology schemes.

Grasys continues improving its membrane technology for conditioning hydrocarbon gases. In 2012, the Research Department of Grasys developed new membranes for special applications, in particular, for H₂S-enriched gases, enhanced separation membranes, new cartridge casing designs.

The company continues testing its new process solutions, membrane module designs and explores new opportunities for use of Grasys’ membrane technology to efficiently resolve the tasks of petroleum industry.
Grasys lays special emphasis on the quality of its products. The company’s equipment is manufactured at its in-house modern manufacturing facility in Moscow region, which includes: manufacturing workshops, warehouses, utility areas, office space and research laboratory. The daily manufacturing activities of Grasys are supported by its high-skilled employees involved in management, equipment assembly, quality control and product acceptance based on the up-to-date manufacturing project management methods.

The production system of Grasys meets the highest contemporary standards set by the independent audit firms (Swiss Engineering Group (SEG), Moody’s) providing technical audit and expediting services (control of manufacturing timelines and scope, assessment of related risks) for our clients.

All Grasys’ equipment undergoes a multi-stage quality control procedure during its manufacturing, and has Certificates and Declarations confirming compliance of its Products with the Technical Regulations of the Customs Union.

Grasys’ manufacturing facility is equipped with modern benches for testing and improving membrane cartridges and air separation systems using various gas separation technologies. The test benches developed by Grasys have no analogues in Europe.
MEMBRANE PLANTS FOR ASSOCIATED PETROLEUM GAS AND NATURAL GAS TREATMENT
NATURAL AND ASSOCIATED PETROLEUM GAS TREATMENT TECHNOLOGIES

The technologies offered by Grasys help resolve the following natural and associated petroleum gas treatment tasks:

- Compliance with environmental requirements, terms and conditions of license agreements: ultimate reduction of gas flaring volumes
- Conditioning, cleaning, drying and recovery of gas at production facilities
- Self-sustainability of energy facilities, existing infrastructure and transport systems. Gas treatment up to the fuel gas requirements for gas engine power plants and gas turbine power plants
- Gas treatment up to gas pipeline specifications
- Saving on capital expenditures and operating costs through process solutions optimization
- Reduction of hazardous emissions from gas engine power plants and gas turbine power plants

Grasys performs integrated projects for APG recovery and natural gas treatment based on its in-house novel membrane technology and other existing technologies:

GAS DRYING
- Grasys membrane technology
- Glycol gas drying

GAS STRIPPING
- Grasys membrane technology
- Low-temperature separation
- Low-temperature condensation
- Combined technologies

REMOVAL OF SULFUR COMPOUNDS AND CO₂
- Grasys membrane technology
- Adsorption technology
- Absorption technology
- Alkali treatment

GAS COMPRESSION

GAS CONDITIONING BEFORE LIQUEFACTION

TASKS RESOLVED WITH GRASYS MEMBRANE TECHNOLOGY:

NATURAL AND ASSOCIATED PETROLEUM GAS TREATMENT FOR TRANSPORTATION

Membrane plants water and hydrocarbon dew point control to meet gas pipelines specification.
Depending on the process flowchart, the drying efficiency may be 15-60°C.

ASSOCIATED PETROLEUM GAS TREATMENT UP TO FUEL GAS REQUIREMENTS

Membrane plants for hydrocarbon dew point control, removal of sulfur compounds, aerosols, condensed moisture and solids.
Increase of methane number by 15-60 units.
Reduction of C4+hydrocarbons content by 2.5-8 times.
Reduction of hydrocarbons and water dew point by 15-60°C.

H₂S-BEARING GAS TREATMENT UP TO FUEL GAS REQUIREMENTS

Treatment of H₂S-bearing gas up to the fuel gas requirements.
Reduction of hydrogen sulfide concentration by 10–250 times. Reduction of hydrocarbons and water dew point by 15-60°C.
Increase of methane content by 10-25% mole. Increase of lower heating value.

The high efficiency of Grasys membrane technology for removal of water, higher hydrocarbons, CO₂ and hydrogen sulfide from petroleum gas was confirmed by a set of tests at industrial sites of the leading oil and gas companies. Over recent years, the industrial membrane hydrocarbon plants offered by Grasys have been supplied to and commissioned by the major national enterprises. The associated petroleum gas treated with Grasys' plants fully meets the declared characteristics.
MEMBRANE PLANTS FOR ASSOCIATED PETROLEUM GAS AND NATURAL GAS TREATMENT
850 projects implemented | More than 14 years in the industry | Performance of really complex tasks | High product quality | Innovative technologies | Compliance with ISO 9001:2008
PRODUCTION

850 projects implemented | More than 14 years in the industry | Performance on really complex tasks | High product quality | Innovative technologies | Compliance with ISO 9001:2008
Grasys membrane nitrogen plants are stationary fully automated systems designed for indoor nitrogen production. Due to the use of the most recent achievements, Grasys nitrogen plants are exceptionally reliable with the membrane unit service life reaching 180,000 continuous running hours.

**Nitrogen outlet parameters**

<table>
<thead>
<tr>
<th>Purity, %</th>
<th>Capacity, m³/hr</th>
<th>Pressure, bar</th>
<th>Dew point, °C</th>
<th>Warm-up time, max, min</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 99.95</td>
<td>up to 5,000</td>
<td>up to 350</td>
<td>up to –60</td>
<td>10</td>
</tr>
</tbody>
</table>
Grasys adsorption technology based nitrogen generators are cost-effective, highly reliable equipment designed for high-purity nitrogen production from air. Featuring many advantages of membrane systems, such as high automation degree and simple operation, adsorption generators compare favorably due to lower capital expenditures.

**Nitrogen outlet parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purity, %</td>
<td>up to 99.9995</td>
</tr>
<tr>
<td>Capacity, m³/hr</td>
<td>up to 10,000</td>
</tr>
<tr>
<td>Pressure, atm</td>
<td>up to 350</td>
</tr>
<tr>
<td>Dew point, °C</td>
<td>up to –70</td>
</tr>
<tr>
<td>Warm-up time, min</td>
<td>20**</td>
</tr>
</tbody>
</table>

*The capacity is referenced to the standard conditions (t=20°C, P=760 mmhg).**Depending on the nitrogen concentration.
High quality compact nitrogen generators for various industries. The nitrogen generators are produced in two design versions NITROPOWER and NITROPOWER PLUS, each with a variety of configurations and a set of additional options.

NITROPOWER SERIAL NITROGEN GENERATORS

Nitrogen outlet parameters

<table>
<thead>
<tr>
<th>Purity, %</th>
<th>Capacity, m³/hr*</th>
<th>Pressure, bar</th>
<th>Dew point, °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 99.999</td>
<td>up to 30</td>
<td>up to 8</td>
<td>up to –60</td>
</tr>
</tbody>
</table>

* The capacity is referenced to the standard conditions (t=20°C, P=760 mmHg).

Warm-up time, max, min: 10 min.
The nitrogen stations produced by Grasys are a real technological breakthrough in the production of high-capacity, simple and exceptionally reliable mobile systems for nitrogen production from air. At customer request, the station may be provided in a stationary, trailer-mounted or truck-mounted version. The combination of advance technologies and long-term experience allows guaranteeing the station quality at the level of the world highest standards.
The new-generation nitrogen compressor stations offered by Grasys are designed for nitrogen production with any of the customer’s preferred pressure ratings: low or high. The stations may also be configured so as to allow producing low and high pressure nitrogen depending on the process requirements. The portable nitrogen compressor stations are recommended by Rostekhnadzor of Russia for use during drilling, workover and operation of oil and gas wells, entering pay formations, repair and testing of pipelines and tanks in oil and gas industry.

### NITROGEN PLANTS AND STATIONS

**PORTABLE NITROGEN COMPRESSOR STATIONS**

<table>
<thead>
<tr>
<th>Purity, %</th>
<th>Capacity, m³/hr*</th>
<th>Pressure, atm</th>
<th>Dew point, °C</th>
<th>Warm-up time, min</th>
<th>Operating ambient air temperature, °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 99.9</td>
<td>up to 2,000</td>
<td>up to 350</td>
<td>up to −60</td>
<td>30</td>
<td>−60 — +50</td>
</tr>
</tbody>
</table>

* The capacity is referenced to the standard conditions (t=20°C, P=760 mmHg).
OXYGEN PLANTS AND STATIONS

The adsorption oxygen plants are designed for production of up to 6,000 m³/hr of oxygen with a maximum purity of 95% (one process train). Where necessary, the product oxygen may be additionally treated up to the concentration of 99%. An unconditional advantage of the adsorption oxygen plants is low cost of oxygen where the product oxygen is not subject to strict purity requirements.

<table>
<thead>
<tr>
<th>Oxygen outlet parameters</th>
<th>Warm-up time, max, min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purity, %</td>
<td>Capacity, m³/hr**</td>
</tr>
<tr>
<td>up to 99</td>
<td>up to 6,000</td>
</tr>
<tr>
<td>Pressure, at.</td>
<td>Dew point, °C</td>
</tr>
<tr>
<td>up to 5</td>
<td>up to –70</td>
</tr>
</tbody>
</table>

*The capacity is referenced to the standard conditions (t=20°C, P=760 mmHg).
**Depending on the oxygen concentration.
The use of Grasys membrane oxygenation systems in the production process ensures multiple saving provided that the oxygen concentration up to 45% is sufficient for the enterprise operations. Apart from the economy realized through the low oxygen cost, additional economic effect is achieved due to very low operating expenses.

### Oxygen outlet parameters

<table>
<thead>
<tr>
<th>Purity, %</th>
<th>Capacity, m³/hr*</th>
<th>Dew point, °C</th>
<th>Warm-up time, max, min</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 45</td>
<td>5,000</td>
<td>up to –70</td>
<td>10</td>
</tr>
</tbody>
</table>

* The capacity is referenced to the standard conditions (t=20°C, P=760 mmhg).
Grasys adsorption oxygen plants are intended for production of up to 1,000 oxygen cylinders per day with oxygen purity reaching 99%. The plants are designed for indoor operation and allow deploying the complete cycle of oxygen production from atmospheric air and cylinders filling under 150 ati at the minimum footprint.

**OXYGEN PLANTS AND STATIONS**

**ADSORPTION OXYGEN PLANTS FOR CYLINDERS FILLING**

Grasys adsorption oxygen plants are intended for production of up to 1,000 oxygen cylinders per day with oxygen purity reaching 99%. The plants are designed for indoor operation and allow deploying the complete cycle of oxygen production from atmospheric air and cylinders filling under 150 ati at the minimum footprint.
The mobile oxygen stations offered by Grasys allow efficiently deploying the oxygen production with the option of oxygen cylinders filling at 150 ati. The stations are installed without a special foundation and only require 380 V power supply; no other utilities are required to produce oxygen. The stations are placed in standard block-boxes with dimensions of 2500 x 2500 x 6000 mm and as such may be easily chassis-mounted and transported to relevant locations.
Grasys modular compressor stations (MCS) are containerized ready-to-use systems designed for compressed air or gas supply to enterprises. Grasys MCSs are completed with high-quality and reliable compressors of the world leading producers. The stations are completely automated and do not require constant manned attendance during operation. The compressors are provided with 100% redundancy.

### Air outlet parameters

<table>
<thead>
<tr>
<th>Volumetric air output, m³/hr*</th>
<th>Pressure, psi</th>
<th>Dew point, °C</th>
<th>Operating ambient air temperature, °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 10,000</td>
<td>up to 300</td>
<td>up to -70</td>
<td>-60 — +50</td>
</tr>
</tbody>
</table>

* The capacity is referenced to the standard conditions (t=20°C, P=760 mmHg).
Membrane gas separation plants produce a gas flow enriched with hydrogen up to 99.5% mole, with the recycling option. Due to an increased hydrogen concentration, the flow rate of hydrogen-bearing gas declines dramatically ensuring a significant life cycle extension for process compressors.

**HYDROGEN PLANTS**

**MEMBRANE HYDROGEN PLANTS**

Membrane gas separation plants produce a gas flow enriched with hydrogen up to 99.5% mole, with the recycling option. Due to an increased hydrogen concentration, the flow rate of hydrogen-bearing gas declines dramatically ensuring a significant life cycle extension for process compressors.

<table>
<thead>
<tr>
<th>Hydrogen outlet parameters</th>
<th>Operating ambient air temperature, °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purity, %</td>
<td>Capacity, m³/hr*</td>
</tr>
<tr>
<td>up to 99.9</td>
<td>up to 50,000</td>
</tr>
<tr>
<td></td>
<td>Pressure, atm</td>
</tr>
<tr>
<td></td>
<td>up to 110</td>
</tr>
</tbody>
</table>

*The capacity is referenced to the standard conditions (T=20°C, P=760 mmhg).
Grasys provide the engineering services, including: selection of efficient technologies; delivery and assembly of necessary equipment and accessories; development of design documents and obtaining of permits, equipment installation.

The engineering services cover the following areas:

- **AIR SEPARATION**
  - Production of nitrogen, oxygen

- **CONCENTRATION OF HYDROGEN-BEARING GASES**

- **TREATMENT AND RECOVERY OF NATURAL AND ASSOCIATED PETROLEUM GAS NG and APG water and hydrocarbon dew point control**
  - Grasys membrane technology
  - Glycol gas drying
  - Gas stripping
    - Grasys membrane technology
    - Low-temperature separation
    - Low-temperature condensation
    - Combined technologies
  - Removal of sulfur compounds and CO₂
    - Grasys membrane technology
    - Adsorption technology
    - Absorption technology (amine treating)
    - Alkali treatment
- Gas compression
- Gas conditioning before liquefaction
Grasys nitrogen plant is installed on the Korchaginskoe field offshore platform.
Grasys prepares a package of project documentation for construction of facilities in the field of air separation, gas separation, APG treatment and recovery.

The key technological solutions developed by Grasys are optimized in consideration of the customer individual requirements and the effective regulatory standards.

**WORKS PERFORMED:**
- Development of key technological solutions
- 3D design
- Preparation of design and detailed documentation
- Industrial safety expert appraisal, state expert appraisal
- Development of process procedures, manuals and instructions
850 projects implemented | More than 14 years in the industry | Performance of really complex tasks | High product quality | Innovative technologies | Compliance with ISO 9001:2008
850 projects implemented | More than 14 years in the industry | Performance of really complex tasks | High product quality | Innovative technologies | Compliance with ISO 9001:2008
EQUIPMENT OVERHAUL AND REPAIR
The Grasys available production potential allows performing repairs of any complexity within the customer agreed timelines. OEM parts, consumable materials and their analogues are delivered from the central warehouse in Moscow. Grasys offers spare parts and consumable materials for compressors of Atlas Copco, Bauer and many other foreign producers.

COMMISSIONING
High-quality and competent equipment installation, start-up and run-in is a ticket to its continuous failure-free operation. The commissioning package enables the customer to obtain a facility fully prepared for operation.

PILOT OPERATION
Grasys carries out pilot operation of its new solutions at customer enterprises as part of joint projects.

REGULAR EQUIPMENT MAINTENANCE
Periodic equipment inspection and diagnostics as well as technical consultations with the customer help prevent troubles and standbys. The Grasys specialists perform workmanlike maintenance and repair at the time convenient for the customer over the entire equipment operation period.

EQUIPMENT OVERHAUL AND REPAIR
The Grasys available production potential allows performing repairs of any complexity within the customer agreed timelines. OEM parts, consumable materials and their analogues are delivered from the central warehouse in Moscow. Grasys offers spare parts and consumable materials for compressors of Atlas Copco, Bauer and many other foreign producers.

UPGRADING
Grasys upgrades the previously supplied own and third party equipment. The aim of such upgrading is normally an increase in the capacity of the existing system and improvement of the equipment control simplifying the plant operator’s duties and signal transmission to the upper-level automatic control system.

PERSONNEL TRAINING
The customer may have its personnel properly trained to ensure further adequate operation of the equipment supplied by Grasys. The training process may be arranged both at customer site and in the Grasys training center.
TURN-KEY PROJECTS

(EPCM contracts)
EPCM (engineering, procurement, construction management — control of design, supply and construction) — a general contractor agreement covering equipment design and supply, construction and delivery to the customer of a completed facility ready for operation.

The project management activities of Grasys are carried out on the basis of the advance and efficient methods. The in-house business process streamlining department continuously improves and modifies the current business processes to reflect the evolution of new challenges and technologies. The efficient project control and monitoring allows achieving the target results within the established timeframe.

**THE EPCM CONTRACT INCLUDES:**

1. Project management
2. Technical audit and consulting
3. Engineering survey
4. Design
5. Procurement, manufacture and supply of equipment
6. Logistics
7. Construction and installation works, installation of the main process equipment
8. Facility delivery and commissioning
9. Services, personnel training