ANNEX 1
PROJECT ENVIRONMENTAL AND SOCIAL STANDARDS

Arctic LNG 2 Project

ASSESSMENT AND MANAGEMENT OF ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS OF THE ARCTIC LNG 2 PROJECT IN ACCORDANCE WITH REQUIREMENTS OF THE INTERNATIONAL FINANCIAL INSTITUTIONS

PROJECT ENVIRONMENTAL AND SOCIAL STANDARDS DOCUMENT

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1. INTRODUCTION

The Project Environmental and Social Standards document (hereinafter - the Project Standards) is intended to summarise the national and international requirements, standards, and guidelines applicable to the Arctic LNG 2 Project (hereinafter - the Project) and formalise the standards and guidelines adopted by the Project.

The Project Standards is a control document for management of environmental and social aspects of the Project within the overarching Project Environmental and Social Management System (ESMS) and basis for preparation of the environmental, social and health impact assessment (ESHIA) package.

The Project Standards serve as a source of reference and a guidance document for continuous development of the Project, particularly in terms of regulatory compliance and meeting the Lenders' requirements. The Standards are subject to revision and updating as the external demands and Project requirements evolve.

2. DEVELOPMENT OF PROJECT STANDARDS

2.1 Strategy

The approach to prevention and mitigation of impact and threats to the aquatic and terrestrial environment components is based on the following basic principles:

- Compliance with the Russian environmental law.
- Compliance with the project-specific requirements (PSRs) - the design specifications established specifically for the Project.
- Application of the Good International Industry Practice (GIIP) in the area of integrated pollution prevention and control.
- Implementation of the Best Available Techniques (BAT) in the context of the applicable Russian regulations, and the BAT of the European Union (EU)[1].

According to the IFC Performance Standard 3, in case the Russian regulations differ from the international recommendations / guidelines that establish acceptable emission levels / environmental quality, the more stringent requirement shall be applied, and deviation may be accepted only against a full and detailed justification.

The principle of compliance with the Russian law and application of BAT for minimisation of pollution emissions and discharges to the environment is also applicable to protection of community health. In terms of other social impacts, e.g. resettlement, influx of population (internal migration), stakeholder engagement, etc., quantitative standards are hardly applicable, but the most appropriate methods of management based on the best Russian and international practices will be applied to minimise adverse effects and enhance benefits of such impacts.

2.2 Project Background

The Arctic LNG 2 Project is being implemented within the license area comprising Salmanovskoye (Utrenneye) oil, gas, and condensate field located in the Tazovsky District of the Yamal-Nenets Autonomous Okrug on the western coast of the Gydan Peninsula.

Arctic LNG 2 Project includes:

- Development of the Salmanovskoye (Utrenneye) OGCF;
- GBS Plant for production, storage, and offloading of liquefied natural gas (LNG) and stabilized gas condensate (SGC);
- Utrenny LNG and SGC Terminal;
- Other linear and areal facilities as part of Arctic LNG 2 Project infrastructure.

2.3 Source Documents

The Project Standards document has been developed on the basis on the following source materials:

- International treaties and conventions;
- IFC guidance documents / standards to which requirements of the potential Project Lenders will refer;
- The RF laws and regulations;
- Results of environmental and engineering surveys, design documentation, and associated permits for all Project facilities.

2.4 National Requirements

Summary of the key Russian legislation and adopted international treaties and conventions is provided in Appendices 1 and 2. The detailed list of the applicable laws and regulations of the RF is provided in Appendix 3. The quantitative standards applicable to the Project are listed in Chapter 3 of this document.

Natural gas production facilities, including natural gas processing, meet the criteria to be classified as category I facilities, which cause significant adverse environmental impact, and fall within the scope of application of the best available technologies (BAT).

[1] The Russian Federation adopted the BAT principle in environmental regulation process starting from 2019. National BAT Reference Documents have been developed taking into account EU BAT Reference Documents for the period of 2015-2017.

The following Russian sector-specific information and technical reference documents (ITS) on BAT are directly applicable to the Project:

- ITS 50-2017 Processing of natural and accompanying gas;
- ITS 29-2017 Natural gas production.

The list of BATs applicable to natural gas production, treatment, and liquefaction and gas condensate stabilization are provided in Table 3-11. Reference quantitative process parameters of applicable technologies are presented in Tables 3-10 – 3-12.

Besides the sector-specific reference documents, cross-sectoral BAT reference documents are also applicable to the Project. In particular, these relate to emissions and discharges treatment, waste management processes, design and operation of waste treatment and disposal facilities, storage of goods, implementation of environmental management and energy management systems:

- ITS 38-2017 Fuel combustion on large plants for production of energy;
- ITS 8-2015 Wastewater treatment in the production of products (goods), performance of works and provision of services at large enterprises;
- ITS 15-2016 Recycling and disposal of waste (except for thermal disposal of waste (waste incineration));
- ITS 9-2015 Thermal waste treatment (waste incineration);
- ITS 17-2016 Disposal of production and consumption waste;
- ITS 22-2016 Purification of atmospheric discharge (pollutants) in manufacturing of products (goods), as well as performing works and providing services at large enterprises;
- ITS 22.1-2016 General principles of industrial environmental monitoring and its metrological support;
- ITS 46-2019 Reduction of pollution emissions and discharges from storage of products (goods);
- ITS 48-2017 Increasing energy efficiency of economic and/or other activities;

The formulations of the most requirements of the cross-sectoral reference documents are general in nature and substantially duplicate the existing requirements of the RF environmental law. However, certain BAT requirements are quite specific and shall be considered during selection of process technologies and subsequent development of the relevant design solutions for the Project.

2.5 Applicable Agreements and Conventions

The RF has ratified a number of international conventions concerned with environmental and social protection, the requirements of which shall be met in the course of development and implementation of the Project.

Environmental Impact Assessment

- Convention on Environmental Impact Assessment in a Transboundary Context, 1991 (amended in 2004) (Espoo Convention[2]).

Biodiversity

- Convention on Biological Diversity, 1992;
- Convention on the Protection of Migratory Species, 1979 (Bonn Convention)[3], 1979;
- Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) (came into force in 1999)[4]
- Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention)[5], 1979;

[2]The Espoo Convention has not been ratified by the Russian Federation; this document is listed here as the Russian Federation contemplates its ratification. The Espoo Convention requirements are not applicable to the Project as its impacts are expected not to extend beyond the borders of the Russian Federation.

[3] Russia is not a party to the Convention. IFC Performance Standard 6 relies on and supports the implementation of applicable regulations of international law and conventions.

[4] Russia is not a party to the Agreement.

[5] Russia has been a party to the Council of Europe since 1995, but is not a party to the Bern Convention. The representative of the Ministry of Natural Resources and the Environment of the Russian Federation participates in the events in the capacity of observer. IFC Performance Standard 6 relies on and supports the implementation of applicable regulations of international law and conventions.

- Convention on Wetlands of International Importance Especially as Waterfowl Habitat, 1971 (the Ramsar Convention);
- Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973 (CITES).

Air quality and climate change

- United Nations Framework Convention on Climate Change, 1992
- Kyoto Protocol, 1997
- Paris Agreement, 2015[6]
- Vienna Convention for the Protection of the Ozone Layer, 1988
- Montreal Protocol on Substances that Deplete the Ozone Layer, 1989
- Sofia Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes, 1988

Waste

- Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 1989 (Basel Convention)
- Minamata Convention on Mercury, 2013

Stakeholder Engagement

- United Nations Economic Commission for Europe (UNECE), "Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention[7]), 1998

Cultural Heritage

- Convention Concerning the Protection of the World Cultural and Natural Heritage, 1972
- International Convention for the Safeguarding of the Intangible Cultural Heritage, 2003.[8]

Conventions concerning the rights of indigenous peoples

- ILO Convention No. 169 Concerning Indigenous and Tribal Peoples in Independent Countries, 1989[9]
- International Covenant on Civil and Political Rights, 1966

Shipping (in the context of vessels used during the construction phase, as well as associated facilities/activities in the operations phase of the Project)

- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention), 1972
- International Convention for the Prevention of Pollution from Ships, 1973, as amended by the Protocol of 1978 (MARPOL 73/78).
- International Convention on Civil Liability for Oil Pollution Damage, 1969, and the Protocol of 1992 to amend the Convention
- International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971, and the Protocol of 1992
- Convention relating to the Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969
- International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004
- International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001
- United Nations Convention on the Law of the Sea, 1994 (UNCLOS)
- International Code for Ships Operating in Polar Waters (Polar Code), 2014
- Convention on the International Regulations for Preventing Collisions at Sea, 1972
- International Convention on Oil Pollution Preparedness Response and Co-operation, 1990 (OPRC 90)
- International Convention for the Safety of Life at Sea (SOLAS), 1974

[6] The Agreement has been adopted by the RF Resolution of 21.09.2019 No. 1228 "On the adoption of the Paris Agreement"

[7] The Aarhus Convention has not yet been ratified by the Russian Federation; however, this document is listed here as the Russian Federation contemplates to ratify it and mostly complies with its requirements.

[8] Russia is not a party to the Convention yet.

[9] The Convention has not been ratified by the Russian Federation.

- International Convention on Civil Liability for Bunker Oil Pollution Damage (Bunker Convention), 2001
- International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances[10] by Sea, 1996, as amended by the 2010 Protocol (HNS Convention)

Industrial Safety

- Convention on the Transboundary Effects of Industrial Accidents, 1992.

Community and workforce

- International Labor Organisation (ILO)[11] conventions including the core conventions protecting the rights of workers and indigenous population:
  - ILO Convention 87 concerning Freedom of Association and Protection of the Right to Organise;
  - ILO Convention 98 concerning the Application of the Principles of the Right to Organise and to Bargain Collectively;
  - ILO Convention 29 concerning Forced or Compulsory Labour;
  - ILO Convention 105 concerning the Abolition of Forced Labour;
  - ILO Convention 138 concerning Minimum Age for Admission to Employment;
  - ILO Convention 169 concerning Indigenous and Tribal Peoples in Independent Countries;
  - ILO Convention 182 concerning the Prohibition and Immediate Action for the Elimination of the Worst Forms of Child Labour (Worst Forms of Child Labour Convention);
  - ILO Convention 100 concerning Equal Remuneration for Men and Women Workers for Work of Equal Value (Equal Remuneration Convention);
  - ILO Convention 111 concerning Discrimination in Respect of Employment and Occupation (Discrimination (Employment and Occupation) Convention);
- The United Nations Convention on the Rights of the Child, 1989;
- International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families, 1990[12].

Human Rights

- The International Bill of Human Rights, 1948.

Regional agreements

- Agreement on the Conservation of Polar Bears, 1973;
- Arctic Environmental Protection Strategy (AEPS) and Declaration on the Protection of the Arctic Environment ("Rovaniemi Declaration"), 1991;
- Nuuk Declaration on Environment and Development in the Arctic, 1993.

In the year 1996, a leading intergovernmental forum – the **Arctic Council**[13] was established to provide means for cooperation, coordination, and interaction among the Arctic States, with the involvement of the Arctic Indigenous communities and other Arctic inhabitants on common Arctic issues; in particular, issues of sustainable development and environmental protection in the Arctic. The Council consists of the eight Arctic States: Canada, the Kingdom of Denmark, Finland, Iceland, Norway, Russian Federation, Sweden, and the United States of America.

The following six Working Groups are the essential part of the Council: Arctic Monitoring and Assessment Programme (AMAP), Conservation of Arctic Flora and Fauna (CAFF), Emergency Prevention, Preparedness and Response (EPPR), Protection of the Arctic Marine Environment (PAME) Sustainable Development Working Group (SDWG), Arctic Contaminants Action Program (ACAP). The output of the work of these Working Groups regularly includes advanced comprehensive assessment surveys on environmental and social issues, issues on development of the region and its environmental safety, and so on.

The Council also provides a space for international negotiations on development of legally binding agreements. There has already been three agreements concluded by the eight Arctic States as a result of this work:

[10] At the time of the report being issued, the Convention has not yet entered into force.

[11] Up to this moment, Russia has ratified 69 ILO conventions, including all essential ones.

[12] Russia is not a party to the Convention. IFC PS2 refers to the requirements of this Convention.

[13] https://arctic-council.org/ru/

- Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic, Nuuk (Greenland), 2011;
- Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic, Kiruna (Sweden), 2013;
- Agreement on Enhancing International Arctic Scientific Cooperation, Fairbanks (Alaska), 2017.

Among the latest documents issued by the Arctic Council, the following documents may be singled out as relevant in the context of the Project implementation:

- The Arctic Migratory Birds Initiative (AMBI) Work Plan 2019-2023 - a project of the Conservation of Arctic Flora and Fauna (CAFF) Working Group (CAFF, May 2019);
- Good Practices for Environmental Impact Assessment and Meaningful Engagement in the Arctic - including recommendations (SDWG, May 2019)[14].

Bilateral agreements

- Declaration of Friendship and Cooperation between Canada and the Russian Federation, 1992;
- Agreement Between the Governments of the Kingdom of Norway and the Government of the Russian Federation on Cooperation in the Field of Environmental Protection, 1992;
- Agreement Between the Governments of the United States of America and the Government of the Russian Federation on Cooperation in the Prevention of Pollution of the Environment of the Arctic, 1994.

2.6 International Financial Institutions Policies and Standards

2.6.1 Equator Principles

The Equator Principles[15] is a set of ten volunteer environmental and social standards to be adhered to if the Project is to be financed by Equator Principles Financial Institutions (EPFIs). The Equator Principles were first launched in 2003 and subsequently updated by the Equator Principles Association in 2006 (EP II), 2013 (EP III), and 2020 (EP4). The latest updated version (EP4) comes into effect on the 1st of July 2020.

The Equator Principles include:

- Principle 1: Review and Categorisation
- Principle 2: Environmental and Social Assessment
- Principle 3: Applicable Environmental and Social Standards
- Principle 4: Environmental and Social Management System and Equator Principles Action Plan
- Principle 5: Stakeholder Engagement
- Principle 6: Grievance Mechanism
- Principle 7: Independent Review
- Principle 8: Covenants
- Principle 9: Independent Monitoring and Reporting
- Principle 10: Reporting and Transparency

The key changes introduced by EP4 and potentially applicable to the Project are presented below. In large part, the requirements of the new version of the Equator Principles (EP4) are in sync with the provisions of the IFC Performance Standards and international best practices; therefore, they are taken into account in one way or another in the process of development, disclosure, and discussion of the ESIA materials.

Principle 2: Environmental and Social Assessment EP4 introduce requirements for assessments of human rights impacts and climate change risk assessment as integral part of the ESIA or other type of assessment included in the project design documentation.

The client shall follow the UN Guiding Principles on Business and Human Rights in the process of human rights due diligence.[16]

[14] https://oaarchive.arctic-council.org/handle/11374/2377

[15] https://equator-principles.com

[16] https://www.ohchr.org/Documents/Publications/GuidingPrinciplesBusinessHR_RU.pdf

Climate change risk assessment shall be conducted adopting the risk categories (transition risks, physical risks) identified by the Task Force on Climate-related Financial Disclosures (the TCFD).[17] The assessment of these risks is:

- required for all Category A projects and, as applicable, Category B projects and is to include consideration of all relevant physical risks specified by the TCFD.
- applicable for all projects in all locations, when combined Scope 1[18] and Scope 2 Emissions are expected to be more than 100,000 tonnes of CO_2 equivalent annually, and is to include consideration of relevant transition risks specified by the TCFD and alternative analysis to evaluate less greenhouse gas (GHG) emission intensive alternatives.

The application of the **Principal 3 (Applicable Environmental and Social Standards)** is specified in EP4 as follows:

- for Designated Countries (Russia is a non-designated country), assessment of the project related risks is required to determine whether the IFC Performance Standards could be used as guidance to successfully address those risks, in addition to host country law;
- for all Category A and B projects regardless of their location, environmental and social due diligence is to be performed by the financial institutions (EPFIs) in order to review and confirm how the Project and the planned transaction meet each of the 10 Equator Principles.

Principle 5: Stakeholder Engagement. EP4 strengthen the obligations for stakeholder engagement with indigenous communities, which now specify requirements for the FPIC (Free, Prior and Informed Consent) obtaining procedure with reference to the paragraphs 13-17 of the IFC Performance Standard 7. It is required by the EPFIs, that the process of engagement with indigenous communities and its results are assessed for compliance with the requirements of the host country and IFC PS7 requirements by the qualified independent consultant.

EP4 broadly interpret requirements for stakeholder engagement and for providing access to the appropriate feedback and grievance mechanism for workers. The proposed definition of *workers* covers all personnel engaged in the Project implementation including contractors' and subcontractors' personnel, but excluding personnel of the primary suppliers (supply chain workers).

However, while it is established that FPIC shall be obtained where required under IFC Performance Standard 7, EP4 allow for the implementation of certain projects with no FPIC being obtained in due form; such diversion from the "letter" of the IFC standard 7 is allowed only in cases, where the full compliance with its "spirit" is ensured and confirmed by the financial institutions and independent consultants (i.e. if there is a documented evidence of all contentious issues between the company and indigenous communities being successfully resolved and performed consultation activities being in compliance with the requirements of the IFC Standards). In case it remains unclear, whether the results of the consultations with the indigenous communities can be considered fully compliant with the FPIC criteria, additional corrective actions can be proposed by the financial institution.

Principle 10: Reporting and Transparency establishes the minimum client reporting requirements for all Category A projects and, as appropriate, Category B projects:

- the summary of the ESIA shall be made publicly accessible and available online; it shall contain findings on human rights associated risks and impacts, as well as on climate change, as applicable;
- Annual public reports on GHG Emission levels (combined Scope 1 and Scope 2 emissions and, where applicable, comparison of the sector-specific performance indicators for GHG emissions) shall be issued during the operational phase for projects with emission levels over 100,000 tons of CO_2-equivalent annually.
- EPFIs shall encourage the companies implementing Category A and B projects to disclose information on biodiversity conditions within the area of the project implementation (given that disclosure of such information would not harm the economic interests of the companies, i.e. such project-specific data is commercially non-sensitive) and share it with the Global Biodiversity Information Facility and relevant national data repositories.

[17] https://www.fsb-tcfd.org/wp-content/uploads/2017/12/FINAL-TCFD-Annex-Amended-121517.pdf

[18] Scope 1 Emissions are direct GHG emissions from the facilities owned or controlled within the physical Project boundary.

2.6.2 *IFC Performance Standards*

In January 2012, the International Finance Corporation (IFC) has developed and published an updated Sustainability Framework, revised IFC Policy and Performance Standards (PSs) on Environmental and Social Sustainability[19].

PS 1: Assessment and Management of Environmental and Social Risks and Impacts

PS 2: Labor and Working Conditions

PS 3: Resource Efficiency and Pollution Prevention

PS 4: Community Health, Safety, and Security

PS 5: Land Acquisition and Involuntary Resettlement

PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

PS 7: Indigenous Peoples

PS 8: Cultural heritage

Eight Performance Standards are supplemented by the IFC EHS Guidelines. In July of 2019, the Guidance Note providing guidance for application of one of the Standards – NG6 (Biodiversity Conservation and Sustainable Management of Living Natural Resources) – has been updated and reissued.

2.6.3 *Applicable IFC EHS Guidelines*

The following IFC guidelines are relevant to the Project[20]:

- General EHS guidelines, 2007;
- Guidelines for Natural Gas Processing, 2007;
- EHS Guidelines for Onshore Oil and Gas Development, 2007;
- EHS Guidelines for Offshore Oil and Gas Development, 2015;
- EHS Guidelines for Liquefied Natural Gas (LNG) Facilities, 2017;
- EHS Guidelines for Thermal Power Plants, 2008;
- EHS Guidelines for Ports, Harbors, and Terminals, 2017;
- EHS Guidelines for Crude Oil and Petroleum Product Terminals, 2007;
- EHS Guidelines for Waste Management Facilities, 2007;
- EHS Guidelines for Water and Sanitation, 2007;
- EHS Guidelines for Shipping, 2007;
- EHS Guidelines for Airports, 2007.

Other applicable IFC guidelines and procedures are:

- IFC Environmental and Social Review Procedures, 2016;
- Environmental and Social Management System (ESMS) Implementation Handbook (General), 2015;
- Environmental and Social Management System (ESMS) Implementation Handbook (Construction), 2014;
- Stakeholder Engagement (A Good Practice Handbook for Companies Doing Business in Emerging Markets), 2007;
- Good Practice Note: Managing Contractors' Environmental and Social Performance (2017);
- Good Practice Handbook: Use of Security Forces: Assessing and Managing Risks and Impacts (2017);
- Workers' Accommodation: Processes and Standards (A guidance note by the IFC and the EBRD, 2009);
- Good Practice Handbook: on Cumulative Impact Assessment and Management. Guidance for the Private Sector in Emerging Markets (2013).

[19] http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/performance-standards

[20] http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines

2.6.4 *OECD Common Approaches*

Export Credit Agencies (ECAs) of the Organisation for Economic Cooperation and Development (OECD) member countries apply the Recommendation of the Council on Common Approaches for Officially Supported Export Credits and Environmental and Social Due Diligence (the Common Approaches) revised in 2016[21].

The Common Approaches provide guidance to ECAs on screening, classification, and review of projects under their consideration. Review includes the benchmarking of projects against the relevant creditor-country's standards and one or more international standards listed below:

- all ten World Bank EHS Standards;
- all eight International Financial Corporation (IFC) Performance Standards;
- relevant provisions of the standards applied by regional development banks (such as European Bank for Reconstruction and Development (EBRD));
- relevant internationally accepted standards, such as European Union (EU) Standards.
- In addition, member-countries can also benchmark projects against appropriate provisions of the internationally recognised sector-specific and issue specific standards, which are out of scope of the World Bank Group Standards.

2.6.5 *World Bank Environmental and Social Framework*

On August 04, 2016, the World Bank approved a new version of the Environmental and Social Framework, which came into effect in October, 2018[22].

The ES Framework comprises a Vision for Sustainable Development, the World Bank Environmental and Social Policy for Investment Project Financing, and ten Environmental and Social Standards (ESS). They set out the mandatory World Bank requirements for Borrowers regarding projects it supports through Investment Project Financing:

- Standard 1: Assessment and Management of Environmental and Social Risks and Impacts
- Standard 2: Labor and Working Conditions
- Standard 3: Resource Efficiency and Pollution Prevention and Management
- Standard 4: Community Health, Safety, and Security
- Standard 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement
- Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- Standard 7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities
- Standard 8: Cultural heritage
- Standard 9: Financial Intermediaries
- Standard 10: Stakeholder Engagement and Information Disclosure.

2.6.6 *Japan Bank for International Cooperation (JBIC) Guidelines for Confirmation of Environmental and Social Considerations (2015)*

In 2015, the Japan Bank for International Cooperation (JBIC) reviewed its Guidelines for Confirmation of Environmental and Social Considerations, which were adopted on April 01, 2012[23].

The Guidelines' objective is to ensure consideration of the environmental and social aspects in all projects subject to lending or other financial operations by JBIC.

For confirmation of environmental and social considerations, JBIC undertakes:

- screening – classification of the project (A, B, C, and FI);
- reviews on environmental and social considerations when making a decision on funding, to confirm that the requirements are duly satisfied;
- monitoring and follow-up after the decision on funding has been made.

[21] http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=TAD/ECG%282016%293&doclanguage=en

[22] https://www.worldbank.org/en/projects-operations/environmental-and-social-framework

[23] https://www.jbic.go.jp/en/business-areas/environment.html

2.6.7 NEXI Guidelines on Environmental and Social Considerations in Trade Insurance

Upon receiving the application for insurance services, NEXI verifies whether the project sponsors take into consideration environmental and social consequences of the project implementation. NEXI confirms whether the environmental and social considerations for the project are adequate and sufficient based on the Guidelines on Environmental and Social Considerations in Trade Insurance[24].

2.7 European Union Environmental and Social Standards

EU documents that might be relevant to the Project:

- Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment;
- Directive 2003/35/EC providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment;
- Directive 2004/35/CE on environmental liability with regard to the prevention and remedying of environmental damage;
- Directive 2008/50/EC on ambient air quality;
- Regulation (EC) 2037/2000 on substances that deplete the ozone layer;
- Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control);
- Directive 2002/49/EC relating to the assessment and management of environmental noise;
- Directive 2000/60/EC establishing a framework for Community action in the field of water policy;
- Directive 2008/105/EC on environmental quality standards in the field of water policy (priority substances);
- Directive on the protection of groundwater against pollution and deterioration (2006/118/EC);
- Council Directive 78/659/EEC on the quality of fresh waters needing protection or improvement in order to support fish life;
- Waste Framework Directive (2008/98/EC);
- Directive 2012/18/EU on the control of major-accident hazards involving dangerous substances;
- Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora;
- Directive 2009/147/EC on the conservation of wild birds;
- Directive 98/83/EC on the quality of water intended for human consumption.

Directive 2010/75/EU establishes fixed emission limit values and lays out recommended schemes for equipment design and use to ensure a high level of protection of the environment as a whole through the use of the best available techniques (BAT).

The following EU BAT Reference Documents (BREF)[25] may be applicable to the Project:

- Refining of Mineral Oil and Gas, 2015;
- Common Wastewater and Waste Gas Treatment/Management Systems in the Chemical Sector, 2016;
- Large Combustion Plants, 2006;
- Emissions from Storage, 2006;
- Energy Efficiency, 2009.

2.8 Applicability of Standards

Individual applicability of the above standards to specific facilities/activities is summarized in the matrix below. Applicability of each convention/standard is conditioned by its immediate relevance, or by being a primary or secondary Project Standard.

	GBS & LNG SGC Plant	Power Plants	Materials offloading facilities	Port	Well Pads	Pipelines	Infrastructure	Airport	Workforce	Comments (see at the table bottom)
National legislation	●	●	●	●	●	●	●	●	●	
Espoo	-	-	-	-	-	-	-	-	-	Comment 1

[24] https://www.nexi.go.jp/en/environment/pdf/ins_kankyou_gl-e.pdf

[25] http://eippcb.jrc.ec.europa.eu/reference/

	GBS & LNG SGC Plant	Power Plants	Materials offloading facilities	Port	Well Pads	Pipelines	Infrastructure	Airport	Workforce	Comments (see at the table bottom)
Bonn Convention	○	○	○	○AF	○ AF	○ AF	○	○ AF	-	Comment 2
Bern Convention	○	○	○	○AF	○ AF	○ AF	○	○ AF	-	Comment 2
Convention on Biodiversity	●	●	●	● AF	● AF	● AF	●	● AF	-	
Ramsar Convention	-	-	-	-	-	-	-	-	-	Comment 3
CITES, 1973	-	-	-	-	-	-	-	-	●	
UN Framework Convention on Climate Change; Kyoto Protocol, Paris Agreement	○	○	○	○AF	○ AF	○ AF	○	○ AF	-	
Vienna Convention for the Protection of the Ozone Layer, Montreal Protocol	○	○	○	○ AF	○ AF	○	○ AF	○ AF	-	
Convention on long-range transboundary air pollution	●	●	●	● AF	● AF	● AF	●	● AF	-	
Basel Convention, 1989	-	-	-	-	-	-	○	-	-	
London Convention, 1972	-	-	-	● AF	-	-	-	-		
Aarhus Convention	○	○	○	○ AF	○ AF	○ AF	○	○ AF	-	
Convention Concerning the Protection of the World Cultural and Natural Heritage	●	●	●	● AF	● AF	● AF	●	● AF	●	
ILO Conventions, UN Convention on the Rights of the Child, UN Convention on the Protection of the Rights of all Migrant Workers	-	-	-	-	-	-	-	-	●	Comment 4
MARPOL 73/78	-	-	● vc	● AF	-	-	-	-	-	Comment 5
CLC[26]	-	-	○ vc	● AF	-	-	-	-	-	
AFS[27]	-	-	○ vc	● AF	-	-	-	-	-	
BMW[28]	-	-	○ vc	● AF	-	-	-	-	-	
Bunker Convention[29]	-	-	○ vc	● AF	-	-	-	-	-	
UNCLOS[30]	-	-	● vc	● AF	-	-	-	-	-	
SOLAS[31]	-	-	● vc	● AF	-	-	-	-	-	
OPRC[32]	-	-	○ vc	○ AF	-	-	-	-	-	
Convention relating to the Intervention on the High Seas in Cases of Oil Pollution Casualties	-	-	● vc	● AF	-	-	-	-	-	
COLREG[33]	-	-	○ vc	○ AF	-	-	-	-	-	
Convention on the Transboundary	●	●	●	● AF	●	●	●	●	-	

International Convention on Civil Liability for Oil Pollution Damage

[27]International Convention on the Control of Harmful Anti-fouling Systems on Ships

[28]Convention for the Control and Management of Ships' Ballast Water and Sediments

[29]International Convention on Civil Liability for Bunker Oil Pollution Damage

[30]United Nations Convention on the Law of the Sea

[31]International Convention for the Safety of Life at Sea

[32]International Convention on Oil Pollution Preparedness, Response and Co-operation

[33]Convention on the International Regulations for Preventing Collisions at Sea

	GBS LNG & SGC Plant	Power Plants	Materials offloading facilities	Port	Well Pads	Pipelines	Infrastructure	Airport	Workforce	Comments (see at the table bottom)
Effects of Industrial Accidents										
Polar Code	●	-	● vc	● AF	-	-	-	-	-	
OECD Common Approaches	●	●	●	● AF	● AF	●	●	● AF	-	
Equator Principles	○	○	○	○ AF	○ AF	○	○	○ AF	○	
IFC Performance Standards	●	●	●	● AF	● AF	●	●	● AF	●	
Environmental and Social Framework	○	○	○	○ AF	○ AF	○	○	○ AF	○	
JBIC and NEXI	○	○	○	○ AF	○ AF	○	○	○ AF	○	
IFC EHS Guidelines										
• General EHS Guidelines	●	●	●	●	●	●	●	●	-	
• Thermal Power Plants	-	●	-	-	-	-	-	-	-	
• Onshore Oil and Gas Development	-	-	-	-	●	●	-	-	-	
• Offshore Oil and Gas Development	○	-	○	-	-	-	-	-	-	
• LNG Facilities	●	-	-	-	-	○	-	-	-	
• Crude Oil and Petroleum Product Terminals	●	-	-	-	-	-	-	0	-	
• Ports, Harbours, and Terminals	-	-	○	● AF	-	-	-	-	-	
• Shipping	-	-	○	○	-	-	-	-	-	
• Airports	-	-	-	-	-	-		○	-	
• Waste Management Facilities	-	-	-	-	-	-	○	-	-	
• Water and Sanitation	-	-	-	-	-	-	●	-	-	
EU Standards and Documents	○	○	○	○ AF	○ AF	○ AF	○	○ AF	○	

Legend

●	Directly relevant to the Project or a primary Project Standard;
○	Secondary Project Standard supplementing a primary Standard, or applicable to the Project to some extent;
-	Expected to be hardly applicable or irrelevant to the Project;
AF	Associated Facilities (limited control and impact on facility is expected);
VC	With respect to vessels during construction;
VO	With respect to vessels during operation

Comments

1. The Espoo Convention has not been ratified by the Russian Federation. It is also noted that the Convention will only be relevant in the unlikely situation where the Project Area of Influence as identified in the ESHIA extends beyond international boundaries.
2. The Conventions are applicable if the Project Area of Influence includes wildlife habitats / migration routes of species protected by the Conventions.
3. The Project Area of Influence does not include any areas where Ramsar Convention is or may be applicable.
4. The ILO Conventions 87, 98, 100, 111, 169, the UN Convention on the Rights of the Child, and the UN Convention on the Protection of the Rights of all Migrant Workers and Members of their Families are considered the most

applicable ones. Other Conventions concerning forced and child labour should also be considered, however, they are hardly applicable.

5. The Conventions on shipping are applicable to the vessels used for transportation of materials and equipment to the materials offloading facilities during construction, and to the LNG and condensate carriers during operation and management of the port operations. The operational shipping and port management activities are not considered as Associated Facilities/Activities.

3. QUANTITATIVE PROJECT STANDARDS

The quantitative Project Standards and related recommendations for the Project are included in various documents, primarily the IFI Requirements (e.g. IFC EHS Guidelines, etc.) and source documents. Such standards and recommendations are summarized in the tables, with a break-down into the fields of application / objects of monitoring, to facilitate comparison of the applicable national standards and the Lenders' requirements.

The Standards are grouped as a set of thematic tables as follows:

Table 3-1: Environmental standards for air pollution emissions;

Table 3-2: Environmental standards for ambient air quality;

Table 3-3: Environmental standards for water quality and pollution discharges to water bodies;

Table 3-4: Drinking water quality standards;

Table 3-5: Water protection zones and near-shore protective belts and shoreline strips

Table 3-6: Environmental standards for waste management;

Table 3-7: Environmental standards for noise;

Table 3-8: Soil Quality Standards;

Table 3-9: Regional environmental quality standards (Tazovsky Municipal District);

Table 3-10: Social environment and working conditions;

Table 3-11: List of BATs applicable to natural gas production and treatment, liquefied natural gas production, and gas condensate stabilization;

Table 3-12: BAT Technological indicators for air pollutant emissions applicable to natural gas production;

Table 3-13: BAT Technological indicators most commonly applicable to operation of surface facilities in the course of natural gas production;

Table 3-14: BAT Technological indicators for air pollutant emissions applicable to gas condensate stabilization.

The quantitative Project Standards tables present a side-by-side comparison of various standards identified in the source documents for each of the above topics. The tables further identify the Quantitative Project Standards (i.e. mandatory for all Project activities) in each sphere, and rationale for their selection (in absence of special notice and justification, the most stringent standards are adopted). The environmental standards for waste management (Tables 3-6) contain not only quantitative standards.

Table 3.1: Environmental standards for air pollution emissions

Topic	National Requirements / Standards	IFI Guidelines / Standards		Adopted Project Standard	Rationale
	RF	IFC General EHS Guidelines (or IFC Performance Standards)	Other applicable guidelines / standards (including IFC Industry Sector Guidelines)		
Emissions from boiler house (liquid fuel and natural gas)	**ГОСТ Р 50831-95**[34], mg/m^3 SO_x <**200 MW** 1200 (normalized fuel sulphur <0.045 %)/ 1400 (≥ 0.045%) **200-249 MW** 950 (normalized fuel sulphur <0.045 %)/ 1050 (≥ 0.045%) **>250 MW** 700 NO_x 125 (gas) 250 (fuel oil) CO 300 (gas and fuel oil) **ITS 38-2017**[35] gas NO_x 250 CO 300 Liquid fuel SO_x 1400 (from 50 to 100 MW) / 1200 (more than 100 MW) NO_x 450 CO 300	For small combustion units (3-50 MW) (mg/Nm^3) Liquid fuel: Particulate matter - 50 (up to 150 - if justified by environmental expert review) SO_2 2000 NO_x 460 Residual O_2 3% Natural gas: NO_x 320 Residual O_2 3%	**IFC EHS Guidelines for Thermal Power Plants (mg/Nm^3)** Liquid fuel (plant capacity from >50 to <600 MW): PM 50 (NDA) SO_2 200-850 Natural gas: NO_x 240 NO_x 240 Residual O2 3%	The standards are set in mg/Nm^3 PM 50 (liquid fuel) SO_2 200-850 (liquid fuel) NO_x 250 (fuel oil) Residual O_2 3% (liquid fuel, gas) NO_x 125 (gas) CO 300 (gas and fuel oil)	Most stringent
Ozone depleting substances (ODS) emissions	No applicable quantitative standards are established.	No applicable quantitative standards are established. Introduction of equipment or processes using chlorofluorocarbons (CFCs), halogens, 1,1,1-trichloroethane, carbon tetrachloride, methylbromide, or	No applicable quantitative standards are established.	The principle of non-use of ODS is applied in compliance with the applicable international conventions and IFC standards	Good Practice

[34] GOST R 50831-95 "Boiler plant. Heat-mechanical equipment. General technical requirements". The standard is applicable to heat machinery equipment within boiler-based power generation facilities within the range of 80 to 1200 MW.

[35] ITS 38-2017 Fuel combustion on large plants for production of energy

Topic	National Requirements / Standards	IFI Guidelines / Standards		Adopted Project Standard	Rationale
	RF	IFC General EHS Guidelines (or IFC Performance Standards)	Other applicable guidelines / standards (including IFC Industry Sector Guidelines)		
		hydrobromofluorocarbons (HBFCs) is prohibited.			
Emissions from onshore thermal waste treatment facilities	**ITS 9-2015[36] and RF Ministry of Natural Resources Order of 24.04.2019 No.270[37], mg/m³** NO_x 200 SO_2 50 CO 50 saturated hydrocarbons C12-C19 10 carbon (soot) 10 suspended solids 10 benzapyrene 0.001 ng/m³ HCl 10 HF 1 dioxins 0.1 ng/m³ mercury and its compounds 0.05 Cd + Tl 0.05 total other heavy metals 0.5	No applicable quantitative standards are established.	**IFC EHS Guidelines for Waste Management Facilities, mg/m³:** suspended solids: 10 (24 h) SO_2 50 (24 h) NO_x 200-400 (24 h) HCl 10 dioxins and furans 0.1 mg TEQ[38] /m³ (6 – average during 8 hours) cadmium 0.05-0.1 (0.5 - average during 8 hours) CO 50-150 total metals: 0.5-1 (0.5 - average during 8 hours) mercury 0.05-0.1 (0.5 - average during 8 hours) HF	NO_x 200 mg/m³ SO_2 50 mg/m³ CO 50 mg/m³ C12-C19 10 mg/m³ carbon (soot) 10 mg/m³ suspended solids 10 mg/m³ benzapyrene 0.001 ng/m³ HCl 10 mg/m³ HF 1 mg/m³ Dioxins 0.1 ng/m³ mercury and its compounds 0.05 mg/m³ Cd + Tl 0.05 mg/m³ total other heavy metals 0.5 mg/m³	Most stringent
Greenhouse gas (GHG) emissions	Currently, there is a legal framework being developed for the System of reporting on GHG emission volumes in Russia.	According to the IFC PS3 of 2012, the quantification of emissions for the projects producing more than 25,000 tonnes of CO_2 annually shall be conducted in accordance with internationally recognized methodologies and good practice.	**IFC EHS Guidelines for Liquefied Natural Gas (LNG) Facilities** Annual calculation and reporting of GHG emissions is required.	No applicable quantitative standard. GHG emissions from all facilities and auxiliary operations are calculated annually, in case of annual emissions > 25,000 tonnes of CO_2-eq per year.	Most appropriate
Emissions from vessel propulsion engines	MARPOL Convention requirements shall be applied	No applicable quantitative standards are established.	**IFC EHS Guidelines for Shipping** Regulations 13, 14, and 15 in Appendix VI of MARPOL 73/78:	MARPOL Convention requirements shall be applied	Most appropriate

[36]ITS 9-2015 Thermal waste treatment (waste incineration);

[37]RF Ministry of Natural Resources Order of 24.04.2019 No.270 "On approval of environmental regulation document "Process parameters of the best available technologies for thermal disposal of waste (waste incineration)"

[38]TEQ – toxicity equivalent

Topic	National Requirements / Standards	IFI Guidelines / Standards		Adopted Project Standard	Rationale
	RF	IFC General EHS Guidelines (or IFC Performance Standards)	Other applicable guidelines / standards (including IFC Industry Sector Guidelines)		
			NO_x emission limits [39]: vessel built on or after 1 of January 2000 till 1 of January 2011: 17.0 g/kWh, at n[40] less than 130 rpm; 45.0 x $n^{(-0.2)}$ g/kWh, at n of 130 rpm or higher, but less than 2000 rpm; 9.8 g/kWh at n of 2000 rpm or more. vessel built on or after 1 of January 2011: 14.4 g/kWh, at n less than 130 rpm; 44.0 x $n^{(-0.23)}$ g/kWh, at n of 130 rpm or higher, but less than 2000 rpm; 7.7 g/kWh at n of 2000 rpm or more. vessel built on or after 1 of January 2016: 3.4 g/kWh, at n less than 130 rpm; 9 x $n^{(-0.2)}$ g/kWh, at n of 130 rpm or higher, but less than 2000 rpm; 2.0 g/kWh at n of 2000 rpm or more. Sulfur: Limits for sulphur content in fuel (See the lowest fuel specification values below) VOC: VOC emissions from tankers shall be regulated in ports or terminals by governments of the signatory countries of the 1997 Protocol	NO_x emission limits [41]: vessel built on or after 1 of January 2000 till 1 of January 2011: 17.0 g/kWh, at n[42] less than 130 rpm; 45.0 x $n^{(-0.2)}$ g/kWh, at n of 130 rpm or higher, but less than 2000 rpm; 9.8 g/kWh at n of 2000 rpm or more. vessel built on or after 1 of January 2011: 14.4 g/kWh, at n less than 130 rpm; 44.0 x $n^{(-0.23)}$ g/kWh, at n of 130 rpm or higher, but less than 2000 rpm; 7.7 g/kWh at n of 2000 rpm or more. vessel built on or after 1 of January 2016: 3.4 g/kWh, at n less than 130 rpm; 9 x $n^{(-0.2)}$ g/kWh, at n of 130 rpm or higher, but less than 2000 rpm; 2.0 g/kWh at n of 2000 rpm or more. Sulfur: Limits for sulphur content in fuel (See the lowest fuel specification values below) VOC: VOC emissions from tankers shall be regulated in	

[39]Applicable to each diesel engine with capacity over 130 kW. Not applicable to diesel engines in emergency situations, engines on rescue boats, and on any other devices or equipment intended only for emergency use.

[40] n = rated engine rotation speed (crankshaft rotations per minute)

[41]Applicable to each diesel engine with capacity over 130 kW. Not applicable to diesel engines in emergency situations, engines on rescue boats, and on any other devices or equipment intended only for emergency use.

[42] n = rated engine rotation speed (crankshaft rotations per minute)

Topic	National Requirements / Standards	IFI Guidelines / Standards		Adopted Project Standard	Rationale
	RF	IFC General EHS Guidelines (or IFC Performance Standards)	Other applicable guidelines / standards (including IFC Industry Sector Guidelines)		
				ports or terminals by governments of the signatory countries of the 1997 Protocol	
Shipboard incinerators emissions	MARPOL Convention requirements shall be applied	No applicable quantitative standards are established.	**IFC EHS Guidelines for Shipping** Combustion temperature standard >850°C and other emission control measures. The use of exhaust gas purification devices in compliance with provisions of Annex VI to the MARPOL Convention and Article 5 and Section V of Annex C to the Stockholm Convention on Persistent Organic Pollutants. **MARPOL** Annex IV, Regulation 16 - Shipboard incineration: Shipboard incineration of the following substances is prohibited: - cargo residues listed in Annexes I, II and III; - polychlorinated biphenyls (PCBs); - garbage, as defined in Annex V, containing more than traces of heavy metals; - refined petroleum products containing halogen compounds; - sewage sludge and sludge oil other than those generated during the normal operation of a ship; and - residues from exhaust gas treatment systems. Shipboard incineration of polyvinyl chlorides (PVCs) shall be prohibited, except in shipboard incinerators for which IMO Type Approval Certificates have been issued. Shipboard incineration of sewage sludge and sludge oil generated during the normal operation of vessel could	MARPOL Convention requirements shall be applied Shipboard incineration of substances in accordance with Annex IV Regulation 16 - Shipboard incineration - is prohibited (cargo residues; PCBs; garbage containing heavy metals; refined petroleum products containing halogens; sewage sludge and sludge oil; residues from exhaust gas treatment systems). Shipboard incineration of PVCs shall be prohibited, except in shipboard incinerators for which IMO Type Approval Certificates have been issued. Shipboard incineration of sewage sludge and sludge oil generated during the normal operation of vessel could alternatively be undertaken in main or auxiliary power plant or boilers, but, in those cases, it is not to be undertaken within ports, harbours or estuaries. Required combustion temperature > 850 C.	Most stringent

Topic	National Requirements / Standards	IFI Guidelines / Standards		Adopted Project Standard	Rationale
	RF	IFC General EHS Guidelines (or IFC Performance Standards)	Other applicable guidelines / standards (including IFC Industry Sector Guidelines)		
			alternatively be undertaken in main or auxiliary power plant or boilers, but, in those cases, it is not to be undertaken within ports, harbours or estuaries.		
Sulphur content in furnace fuel oil (for sea vessels) (feed quality requirement)	For bunker fuel and furnace fuel oil (GOST 10585-2013[43]; RD 31.2.07-2001[44]) Sulphur mass fraction shall be 1.0 % to 1.5 % for bunker fuel F5 and 0.5 % to 3.5 % for furnace fuel oil 40 and 10.	No applicable quantitative standards are established.	**IFC EHS Guidelines for Shipping** Compliance with international standards and guidelines in terms of sulphur oxide (SOx) emissions from vessels, including limits for sulphur content in fuel and special limits applicable to vessels navigating in the SO_x Emission Control Areas (SECAs). In accordance with MARPOL Annex IV Regulation 14, sulphur content of any fuel oil used on board ships shall not exceed the following limits: 4.50% m/m till 1 January 2012; 3.50% m/m on and after 1 January 2012; and 0.50% m/m on and after 1 January 2020.	Russian standards for bunker fuel and furnace fuel oil: 1.0 - 1.5 % for bunker fuel, 0.5-3.5% for furnace fuel oil.	Most stringent

[43] GOST 10585-2013 Petroleum fuel. Mazut. Specifications

[44]RD 31.2.07-2001 Fuel, oil, lubricants and specialty fluids for sea transport vessels. Nomenclature and scope of application

Table 3.2: Environmental standards for ambient air quality

Topic	National Requirements / Standards	IFI Guidelines / Standards		Adopted Project Standard	Rationale
	Russia	IFC General EHS Guidelines (or IFC Performance Standards)	Other applicable guidelines / standards (including IFC Industry Sector Guidelines)		
Air quality - Community health	**GN 2.1.6.3492-17**[45] and **GN 2.1.6.2309-07**[46] at the SPZ boundary (mg/m^3): CO 3 (24 hours) CO 5 (20 minutes) H_2S 0.008 (20 minutes) NO 0.06 (24 hours) NO 0.4 (20 minutes) NO_2 0.04 (24 hours) NO_2 0.2 (20 minutes) SO_2 0.05 (24 hours) SO_2 0.5 (20 minutes) Alkanes (C12-C19) 1 (20 minutes) Benz(a)pyrene (3,4-benzpyrene) 0.000001 (24 hours) Petrol (petroleum-based, low-sulphur) 5 (20 minutes) Petrol (petroleum-based, low-sulphur) 1.5 (24 hours) Benzene 0.3 (20 minutes) Benzene 0.1 (24 hours) Xylene 0.2 (20 minutes) Pentane 100 (20 minutes) Pentane 25 (24 hours) Hexane 60 (20 minutes) Mixed saturated hydrocarbons C1-C5 200 (20 minutes)	National quality standards are applied where specifically noted. In absence of national standards, the World Health Organization (WHO) standards are applied. WHO standards (mg/m^3): $PM_{2.5}$ 0.01 (1 year) $PM_{2.5}$ 0.025 (24 hours) PM_{10} 0.02 (1 year) PM_{10} 0.05 (24 hours) NO_2 0.04 (1 year) NO_2 0.2 (1 hour) SO_2 0.02 (24 hours) SO_2 0.5 (10 minutes) Ozone 0.1 (8 hours)	**IFC EHS Guidelines for Onshore Oil and Gas Development** Standards for concentration in air as per the IFC General EHS Guidelines, and also: H_2S: 5 mg/m^3 **Directive 2008/50/EU**[47] CO 100 (15 minutes) CO 10 (8 hours)	Russian standards complemented by certain WHO standards (mg/m^3): Russian standards complemented by certain WHO standards (mg/m^3): CO 3 (24 hours) CO 5 (20 minutes) H_2S 0.008 (20 minutes) NO 0.06 (24 hours) NO 0.4 (20 minutes) NO_2 0.2 (20 minutes) NO_2 0.04 (24 hours) NO_2 0.04 (1 year) SO_2 0.5 (10 minutes) SO_2 0.02 (24 hours) Alkanes (C12-C19) 1 (20 minutes) Benz(a)pyrene (3,4-benzpyrene) 0.000001 (24 hours) Petrol (petroleum-based, low-sulphur) 5 (20 minutes) Petrol (petroleum-based, low-sulphur) 1.5 (24 hours) Benzene 0.3 (20 minutes) Benzene 0.1 (24 hours) Xylene 0.2 (20 minutes) Pentane 100 (20 minutes) Pentane 25 (24 hours) Hexane 60 (20 minutes) Mixed saturated hydrocarbons C1-C5 200 (20 minutes)	Russian standards supplemented by WHO standards as required to adopt the most stringent standard[48]

[45] GN 2.1.6.3492-17. Health (hygienic) standards. Maximum permissible concentrations (MPC) of polluting substances in the atmospheric air of urban and rural settlements (approved by the RF Chief State Sanitary Inspector Resolution of 22.12.2017 No. 165)

GN 2.1.6.2309-07. 2.1.6. Atmospheric air and indoor air, sanitary protection of the air. Tentative safe exposure levels (TSELs) of pollutants in the air of residential areas. Health (hygienic) standards

[47] EU Directive 2008/50/EC of 21 May 2008 on ambient air quality and cleaner air

[48]IFC refers to the WHO atmospheric air quality standard which is normally applied only in situations where national standards are not available. The national standards are available; however, WHO standards are still adopted if more stringent than the national standards.

Topic	National Requirements / Standards	IFI Guidelines / Standards		Adopted Project Standard	Rationale
	Russia	IFC General EHS Guidelines (or IFC Performance Standards)	Other applicable guidelines / standards (including IFC Industry Sector Guidelines)		
	Mixed saturated hydrocarbons C1-C5 50 (24 hours) Mixed saturated hydrocarbons C6-C10 50 (20 minutes) Mixed saturated hydrocarbons C6-C10 5 (24 hours) Toluene 0.6 (24 minutes) PM_{10} 0.3 (20 minutes) PM_{10} 0.06 (24 hours) PM_{10} 0.04 (1 year) $PM_{2.5}$ 0.16 (20 minutes) $PM_{2.5}$ 0.035 (24 hours) $PM_{2.5}$ 0.025 (1 year) Ethylbenzene 0.02 (24 hours) Ozone 0.16 (20 minutes) Ozone 0.03 (24 hours)			Mixed saturated hydrocarbons C1-C5 50 (24 hours) Mixed saturated hydrocarbons C6-C10 50 (20 minutes) Mixed saturated hydrocarbons C6-C10 5 (24 hours) Toluene 0.6 (24 minutes) PM_{10} 0.3 (20 minutes) PM_{10} 0.05 (24 hours) PM_{10} 0.02 (1 year) $PM_{2.5}$ 0.16 (20 minutes) $PM_{2.5}$ 0.025 (24 hours) $PM_{2.5}$ 0.025 (1 year) Ethylbenzene 0.02 (24 hours) Ozone 0.16 (20 minutes) Ozone 0.03 (24 hours)	
Air quality - Protection of plants (sensitive receptors)	No applicable quantitative standards are established.	No applicable quantitative standards are established.	**EU Directive 2008/50/EC**[49]: SO_2 10 µg/m^3 (1 year, for lichen) SO_2 20 µg/m^3 (24 hours, for lichen) NO_x 19.5 – 24 mg/m^3 (1 year)	SO_2 10 µg/m^3 (1 year, for lichen) SO_2 20 µg/m^3 (24 hours, for lichen) NO_x 19.5 – 24 mg/m^3 (1 year)	Only relevant standards
Air quality - Workplace air	GN 2.2.5.3532-18[50]**mg/m³):** CO 20 (one-time) CO_2 27000 (one-time); 9000 (time-weighted workshift average) NO_2 2 (one-time) NO_x (as NO_2) 5 (one-time) SO_2 10 (one-time) H_2S 10 (one-time)	Maintaining levels of concentration of contaminant dust, vapors, and gases in the work environment below those recommended by the ACGIH[51] as TWA-TLV's (threshold limit value)—concentrations to which most workers can be exposed	No applicable quantitative standards are established.	CO 20 (one-time) CO_2 27000 (one-time); 9000 (time-weighted workshift average) NO_2 2 (one-time) NO_x (as NO_2) 5 (one-time) SO_2 10 (one-time) H_2S 10 (one-time) Methane 7000 (one-time)	Most stringent

[49] EU Directive 2008/50/EC on ambient air quality and cleaner air

[50]GN 2.2.5.3532-18. Maximum permissible concentrations (MPC) of harmful substances in the air of the working area (approved by the RF Chief State Sanitary Inspector Resolution of 13.02.2018 No. 25)

[51] Threshold Limit Values for Chemical Substances and Biological Exposure Indices, 2005. ACGIH - American Conference of Governmental Industrial Hygienists

Topic	National Requirements / Standards	IFI Guidelines / Standards		Adopted Project Standard	Rationale
	Russia	IFC General EHS Guidelines (or IFC Performance Standards)	Other applicable guidelines / standards (including IFC Industry Sector Guidelines)		
	Methane 7000 (one-time) Mixed saturated hydrocarbons C1-C4 900 (one-time), 300 (time-weighted workshift average) Pentane 900 (one-time), 300 (time-weighted workshift average) Benzene 15 (one-time), 5 (time-weighted workshift average) Toluene 150 (one-time), 50 (time-weighted workshift average) Xylene 150 (one-time), 50 (time-weighted workshift average) Hexane 900 (one-time), 300 (time-weighted workshift average) Mixed saturated hydrocarbons C6-C10 900 (one-time), 900 (time-weighted workshift average) Mercury 0.01 (one-time), 0.005 (time-weighted workshift average) Chlorine 1 (one-time) Methanol 5 (time-weighted workshift average)	repeatedly (8 hours/day, 40 hrs/week, week-after week), without sustaining adverse health effects TWA-TLV, ppm: CO 25 (29.4 mg/m^3) TWA[52] CO_2 5000 (9242.1 mg/m^3) TWA; 30000 (55452.6 mg/m^3) STEL[53] NO_2 3 (0.3864 mg/m^3) TWA; 5 (9.6 mg/m^3) STEL SO_2 2 (6 mg/m^3) TWA; 5 (13.4 mg/m^3) STEL H_2S 10 (15 mg/m^3) TWA; 15 (21.5 mg/m^3) STEL C1-C4 1000 (714 mg/m^3) TWA Pentane 600 (1930 mg/m^3) TWA Benzene 0.5 (1.7 mg/m^3) TWA; 2.5 (8.2 mg/m^3) STEL Toluene 50 (205 mg/m^3) TWA Xylene 100 (220 mg/m^3) TWA; 150 (661 mg/m^3) STEL Hexane 50 (181 mg/m^3) TWA Chlorine 0.5 (1.5 mg/m^3) TWA; 1 (3 mg/m^3) STEL Methanol 200 (270 mg/m^3) TWA; 250 (336 mg/m^3) STEL		Mixed saturated hydrocarbons C1-C4 900 (one-time), 300 (time-weighted workshift average) Pentane 900 (one-time), 300 (time-weighted workshift average) Benzene 0.5 (1.7 mg/m^3) TWA; 2.5 (8.2 mg/m^3) STEL Toluene 150 (one-time), 50 (time-weighted workshift average) Xylene 150 (one-time), 50 (time-weighted workshift average) Hexane 50 (181 mg/m^3) TWA Hexane 300 (time-weighted workshift average) Mixed saturated hydrocarbons C6-C10 900 (one-time), 900 (time-weighted workshift average) Mercury 0.01 (one-time), 0.005 (time-weighted workshift average) Chlorine 1 (one-time) Chlorine 0.5 (1.5 mg/m^3) TWA Methanol 5 (time-weighted workshift average)	

[52] TWA - 8-hour, time-weighted average

[53] STEL – Short-term exposure limit (during 15 minutes)

Table 3.3: Environmental standards for water quality and pollution discharges to water bodies

Topic	National Requirements / Standards	IFI Guidelines / Standards		Adopted Project Standard	Rationale
	Russia	IFC General EHS Guidelines (or IFC Performance Standards)	Other applicable guidelines / standards (including IFC Industry Sector Guidelines)		
Water Quality	MPC list for fishery water bodies[54] (mg/l): Suspended solids (to background) +0.25 Dissolved O_2 6.0 mg/l BOD5 (at t 20°C) 2.1 mg/l BODtot (at t 20°C) 3 mg/l Background pH of the water body Chloride 300 Sulphate 100 Ammonium 0,5 Phosphate (as P) 0.05 for oligotrophic, 0.15 for mesotrophic, 0.2 for eutrophic water bodies Iron (Fe) 0.1 Copper (Cu) 0.001 Nitrate (NO_3) 40 Nitrite (NO_2) 0.08 Manganese 0.01 Lead 0.06 Strontium 0.4 Nickel 0.01 Zinc 0.01 Cobalt 0.01 Chromium 0.07 Cadmium 0.005 Mercury (Hg) nil (0,00001) Potassium (K) 50 Calcium (Ca) 180 Magnesium (Mg) 40 Sodium 120.0 (7100[55]) Petroleum products 0.05 Phenols 0.001 Synthetic surfactants 0.5 Methanol 0.1	No applicable quantitative standards are established.	No applicable quantitative standards are established.	Russian standards, (mg/l) MPC list for fishery water bodies (mg/l): Suspended solids (to background) +0.25 Water temperature shall not increase by more than 5 °C compared to natural temperature of the water body, with the total temperature increase: - to a maximum of 20 °C in summer and 5 °C in winter, for the water bodies providing habitats for cold water fish (salmonids and whitefishes); to a maximum of 28 °C in summer and 8 °C in winter in all other cases. The winter water temperature at burbot spawning grounds shall not be increased by more than 2 °C. Dissolved O_2 6.0 mg/l BOD5 (at t 20°C) 2.1 mg/l BODtot (at t 20°C) 3 mg/l Background pH of the water body Chloride 300 Sulphate 100 Ammonium 0,5 Phosphates (as P) 0.2 Iron (Fe) 0.1 Copper (Cu) 0.001 Nitrate (NO_3) 40 Nitrite (NO_2) 0.08	Most stringent

[54]RF Ministry of Agriculture Order of 13.12.2016 No. 552 "On approval of water quality standards for fishery water bodies including standards for maximum permissible concentrations of harmful substances in fishery water bodies"

[55] For sea water at 13-18 %

Topic	National Requirements / Standards	IFI Guidelines / Standards		Adopted Project Standard	Rationale
	Russia	IFC General EHS Guidelines (or IFC Performance Standards)	Other applicable guidelines / standards (including IFC Industry Sector Guidelines)		
	Ethylbenzene 0.001 Quality standards for 15.05.00.002 water management area (river of the Kara Sea basin stretching from the northwestern part of the Taz river basin to the boundaries of the Yenisei Gulf basin)[56] Suspended solids 8.13 Total iron 0.3 Sulphate ion 50 Chloride ion 50 Dry residue 300 Manganese 0.1 Phosphates (as phosphorus) 0.2 COD 30			Manganese 0.01 Lead 0.06 Strontium 0.4 Nickel 0.01 Zinc 0.01 Cobalt 0.01 Chromium 0.07 Cadmium 0.005 Mercury (Hg) nil (0,00001) Potassium (K) 50 Calcium (Ca) 180 Magnesium (Mg) 40 Sodium 120.0 (7100) Petroleum products 0.05 Phenols 0.001 Synthetic surfactants 0.5 Methanol 0.1 Ethylbenzene 0.001 Additional regional standards for the rivers of the Gydan Peninsula: Suspended solids 8.13 Total iron 0.3 Sulphate ion 50 Chloride ion 50 Dry residue 300 Manganese 0.1 COD 30	
Inland wastewater discharge to surface water bodies: Wastewater	The limit values for permissible discharge of polluting substances are set by calculation depending on position of the reference section (subject to approval by the state supervision authorities) downstream of the wastewater discharge point (maximum 500 m). The surface	<u>Domestic wastewater:</u> pH 6 – 9 BOD: 30 mg/l COD: 125 mg/l Total nitrogen: 10 mg/l Total phosphorus: 2 mg/l	**IFC EHS Guidelines for LNG Facilities and for Onshore Oil and Gas Development** Formation water / water from hydraulic testing: Petroleum products: 10 mg/l pH 6 – 9	The limit values for permissible discharge of polluting substances are set by calculation depending on position of the reference section (subject to approval by the state supervision authorities) downstream of the wastewater	The most appropriate - Requirements of the Russian law

[56] Standards on permissible impact on water bodies in the Taz river basin within the water management areas (approved by the Federal Water Resources Agency on 08.18.2014)

Topic	National Requirements / Standards	IFI Guidelines / Standards		Adopted Project Standard	Rationale
	Russia	IFC General EHS Guidelines (or IFC Performance Standards)	Other applicable guidelines / standards (including IFC Industry Sector Guidelines)		
(industrial, domestic and storm water, including wastewater from power plants)	water quality standards (MPC) shall be met at the reference section (refer to the line above). Suspended solids (to background) +0.25 In fishery water bodies with natural suspended solids concentration in water during low-water season higher than 30 mg/dm^3, its increase up to 5% is permissible. It is prohibited to discharge return (waste-) water containing suspended solids with a settling velocity of more than 0.4 mm/s into streams; with a settling velocity exceeding 0.2 mm/s - into water bodies. Water temperature shall not increase by more than 5 °C compared to natural temperature of the water body, with the total temperature increase: - to a maximum of 20 °C in summer and 5 °C in winter, for the water bodies providing habitats for cold water fish (salmonids and whitefishes); to a maximum of 28 °C in summer and 8 °C in winter in all other cases. The winter water temperature at burbot spawning grounds shall not be increased by more than 2 °C. Discharge of any wastewater or other wastes is completely prohibited at the spawning and wintering grounds and rookeries of aquatic and semi-aquatic species.According to the Fisheries Regulation for the West-Siberian fishing basin (approved by the RF Ministry of Agriculture, Order No. 402 of 22.10.2014), the Gulf of Ob, Taz Estuary, and Gydan Bay, as well as the Ob River including tributaries, belong to the	Petroleum hydrocarbons: 10 mg/l TSS: 50 mg/l Total coliform bacteria : 400 MPN[57]/100 ml <u>Process wastewater:</u> Temperature increase by less than 3°C at a distance of 100 m from the mixing zone edge	BOD: 25 mg/l COD: 125 mg/l TSS[58]: 35 mg/l Phenol: 0.5 mg/l Sulphide: 1 mg/l Heavy metals[59] (total): 5 mg/l Chloride: 600 mg/l (average), 1200 mg/l (maximum) <u>Cooling water:</u> Temperature increase by less than 3°C at a distance of 100 m from the mixing zone edge <u>Storm runoff:</u> Storm water shall be treated at the oil and water segregation system to achieve petroleum products concentration of 10 mg/l, maximum **IFC EHS Guidelines for Thermal Power Plants:** pH 6-9 TSS 50 Oil and lubricants 10 Total residual chlorine 0.2 Total chromium (Cr) 0.5 Copper (Cu) 0.5 Iron (Fe) 1.0 Zinc (Zn) 1.0 Lead (Pb) 0.5 Cadmium (Cd) 0.1 Mercury (Hg) 0.005 Arsenic (As) 0.5	discharge point (maximum 500 m). The surface water quality standards (MPC) shall be met at the reference section.	

[57] MPN - Most Probable Number

[58] TSS - Total suspended solids

[59] Ag, As, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, Tl, Zn

Topic	National Requirements / Standards	IFI Guidelines / Standards		Adopted Project Standard	Rationale
	Russia	IFC General EHS Guidelines (or IFC Performance Standards)	Other applicable guidelines / standards (including IFC Industry Sector Guidelines)		
	migratory routes and spawning grounds of salmonids, whitefishes, and sturgeons.				
Discharges from vessels to sea	2-020101-100 Rules for the prevention of pollution from ships intended for operation in sea areas and inland waterways of the Russian Federation (developed on the basis of MARPOL 73/78). According to 155-FZ[60] (Art.37) discharge of polluting substances (including contaminated wastewater) from ships and other vessels, artificial islands, installations and structures in the internal marine waters and territorial sea is prohibited.	No applicable quantitative standards are established	**IFC EHS Guidelines for Shipping** Provisions of the regulations in Annexes I and IV of MARPOL shall be complied with. Domestic wastewater: All sanitary wastewater shall be collected in on-board tanks and transferred to reception facilities in ports for subsequent treatment onshore. Bilge water: All bilge water, separated oil residues and sludge shall be transferred to onshore reception facilities, except for when the ship is equipped with certified water-and-oil segregation systems, which treat water to the standard allowable for discharge to the marine environment in compliance with provisions of the MARPOL Convention 73/78. Ballast water: Appropriate international regulations and ballast water management guidelines shall be adhered to. MARPOL: Oil content in non-diluted wastewater discharged to sea from ships shall not be greater than 15 ppm. MARPOL Annex IV establishes limits in relation to treatment	Requirements of 155-FZ, MARPOL, Polar Code, and Convention for the Control and Management of Ship's Ballast Water and Sediments	Most appropriate

[60]Federal Law of 31.07.1998 No. 155-FZ "On internal marine waters, territorial sea, and contiguous zone of the Russian Federation"

Topic	National Requirements / Standards	IFI Guidelines / Standards		Adopted Project Standard	Rationale
	Russia	IFC General EHS Guidelines (or IFC Performance Standards)	Other applicable guidelines / standards (including IFC Industry Sector Guidelines)		
			systems and treated wastewater discharge conditions. Treated wastewater shall meet the following requirements: Total soluble solids content - 35 mg/l, Coliform bacteria - 100/100 ml BOD5 - 25 mg/l COD - 125 mg/l pH - 6 – 8.5 **International Convention for the Control and Management of Ships' Ballast Water and Sediments** The ballast water quality standard: less than 10 viable organisms per cubic metre greater than or equal to 50 micrometres in minimum dimension and less than 10 viable organisms per millilitre less than 50 micrometres in minimum dimension and greater than or equal to 10 micrometres in minimum dimension; and discharge of the indicator microbes shall not exceed the specified concentrations: - Toxicogenic Vibrio cholerae (O1 and O139) with less than 1 colony forming unit (cfu) per 100 millilitres or less than 1 cfu per 1 gram zooplankton sample; - Escherichia coli less than 250 cfu per 100 millilitres; - Escherichia coli less than 100 cfu per 100 millilitres; **Polar Code**		

Topic	National Requirements / Standards	IFI Guidelines / Standards		Adopted Project Standard	Rationale
	Russia	IFC General EHS Guidelines (or IFC Performance Standards)	Other applicable guidelines / standards (including IFC Industry Sector Guidelines)		
			Any discharge into the sea of noxious liquid substances (NLS), or mixtures containing such substances is prohibited. Discharges of wastewater within polar waters are prohibited except when performed in accordance with MARPOL Annex IV and the following requirements: - the ship is discharging comminuted and disinfected wastewater in accordance with regulation 11.1.1 of MARPOL Annex IV at a distance of more than 3 nautical miles from any ice-shelf or fast ice and as far as practicable from areas of ice concentration exceeding 1/10; or - the ship is discharging sewage that is not comminuted or disinfected at a distance of more than 12 nautical miles from any ice-shelf or fast ice and as far as practicable from areas of ice concentration exceeding 1/10; or - the ship has in operation an approved certified wastewater treatment plant while being as far as practicable from the nearest land, any ice-shelf, fast ice or areas of ice concentration exceeding 1/10.		

Table 3.4: Drinking water quality standards

Parameter	Unit	RF Standard[61]	WHO Standard[62]	Project Standard[63]	
Physical properties					
Acidity (pH)	---	6-9	6–9	RF	6-9
Total soluble solids	mg/l	1000 (1500)*	---	RF	1000 (1500)*
Hardness	mg-eqv/l	7.0 (10)*	---	RF	7.0 (10) mg-eqv/l/
Turbidity	EMF (formazine) or mg/l (kaolin)	**2.6 (3.5)*** 1.5 (2)*	---	RF	2.6 (3.5)* 1.5 (2)*
Taste	point	2	---	RF	2
Odour	point	2	---	RF	2
Colour	degree	20 (35)*	---	RF	20 (35)*
Microbiological characteristics					
Total coliform	coli / ml	Not detected in 100 ml sample	---	RF	Not detected in 100 ml sample
Escherichia coli or thermotolerant coliform bacteria	coli / 100 ml	Not detected in any of the 100 ml samples	Not detected in any of the 100 ml samples	RF	Not detected in any of the 100 ml samples
Inorganic chemical characteristics					
Aluminium (Al)	mg/l	0.5	---	RF	0.2
Ammonia ion (NH4)	mg/l	2.0	---	RF	0.5
Antimony (Sb)	mg/l	0.05	0.02	WHO	0.02
Arsenic (As)	mg/l	0.05	0.01	WHO	0.01
Barium(Ba)	mg/l	0.1	0.7	RF	0.1
Beryllium(Be)	mg/l	0.0002	---	RF	0.0002
Boron(B)	mg/l	0.5	0.5	RF	0.5
Cadmium (Cd)	mg/l	0.001	0.003	RF	0.001
Calcium ion (Ca^{2+})	mg/l		---	RF	
Chloride ion (Cl^{-})	mg/l	350	---	RF	350
Chlorine (Cl)	mg/l	0.3-0.5 (free) 0.8-1.2 (bound)	5	RF	0.3-0.5 (free) 0.8-1.2 (bound)
Chromium (Cr^{+6})	mg/l	0.05	0.05	RF	0.05

[61] SanPiN 2.1.4.1074-01 Drinking water. Hygienic requirements to water quality in central drinking water supply systems. Quality control

[62]Guidelines for drinking-water quality, fourth edition, 2011 https://www.who.int/water_sanitation_health/dwq/gdwq3rev/ru

[63]The Project Standards are based on most stringent requirements for each parameter.

Parameter	Unit	RF Standard[61]	WHO Standard[62]	Project Standard[63]	
(Cr^{+3})		0.5			0.5
Copper (Cu)	mg/l	1.0	2	RF	1.0
Cyanide (CN)	mg/l	0.035	0.07	RF	0.035
Fluoride (F^-)	mg/l	1.5 (1.2)**	1.5	RF	1.5 (1.2)**
Hydrogen sulphide (H_2S)	mg/l	0.003	---	RF	0.003
Iron (Fe)	mg/l	0.3 (1.0)*	---	RF	0.2
Lead (Pb)	mg/l	0.3	0.02	WHO	0.02
Manganese (Mn)	mg/l	0.1 (0.5)*	0.4	RF	0.05
Mercury (Hg)	mg/l	0.0005	0.001	RF	0.0005
Molybdenum (Mo)	mg/l	0.25	0.07	RF	0.25
Nickel (Ni)	mg/l	0.1	0.02	WHO	0.02
Nitrate	mg/l	45	50	RF	45
Nitrite ion	mg/l	3.0	3 or 0.2	RF	3.0
Selenium (Se)	mg/l	0.1	0.01	WHO	0.01
Silver (Ag)	mg/l	0.05	---	RF	0.05
Sodium (Na)	mg/l	200	---	RF	200
Sulphates	mg/l	500	---	RF	500
Strontium (Sr)	mg/l	7.0	---	RF	7.0
Uranium (U)	mg/l		0.015	WHO	0.015
Vinyl chloride (C_2H_3Cl /H_2C)	mg/l	0.05	0.0003	WHO	0.0003
Zinc (Zn)	mg/l	5.0	---	RF	5.0
Radiological characteristics					
Total α radioactivity	Bq/l	0.1	0.5	RF	0.1
Total β radioactivity	Bq/l	1.0	1	RF	0.1

Notes: * may be set for specific region Notes: ** for climatic region III

Table 3.5: Water protection zones and near-shore protective belts and shoreline strips[64]

Water protection zones (WPZ)		Restrictions and Assumptions
for rivers and streams, length from source:	Width of water protection zone:	Among other things, the following activities are prohibited within the boundaries of water protection zones: - use for cemeteries, burial grounds, waste disposal, disposal of chemical, explosive, toxic, poisonous substances, disposal of radioactive waste; - traffic and parking of vehicles (except for except special transport vehicles, traffic on paved roads, and parking in special areas with hard pavement); - construction and renovation of fueling stations, fuel and lubricants warehouses (with an exception of refueling stations and fuel storages at port sites and waterways infrastructure, including mooring facilities (structures) for small vessels and Federal Security Service facilities), technical maintenance workshops for technical inspection, repair, and washing of motor vehicles; - discharge of wastewater, including drainage water; - prospecting for and extraction of common non-metallic minerals (with an exception of cases, when prospecting and quarrying of common minerals is carried out by users of other valuable subsoil resources within the outlines of the mine and/or geological lease areas allocated on the basis of an approved technical project design. Within the boundaries of water protection zones, it is permitted to design, construct, refurbish, and operate any commercial or other facilities provided that such facilities are equipped with means to ensure protection of water bodies against pollution, contamination, siltation, and depletion of water resources in compliance with water and environmental legislation. The type of facility that would ensure protection of a water body against pollution, contamination, siltation, and depletion of water resources is to be selected with due consideration to compliance with the established environmental protection regulations for permissible discharges of polluting substances, other substances and microorganisms. Facilities considered to be equipped with means to provide protection of water bodies against contamination, littering, siltation, and depletion of water resources refer to: 1) Centralised sewage systems and centralized storm water drainage systems; 2) facilities and systems for wastewater disposal (discharge) into centralised wastewater disposal systems (including storm, snowmelt, infiltration, irrigation, and drainage water) designed to receive such water; 3) local treatment facilities for wastewater treatment (including storm, snowmelt, infiltration, irrigation, and drainage water) where it is ensured that wastewater treatment is performed in compliance with the standards established to meet the requirements of environmental and this Code; 4) facilities for collection of production and consumption waste, as well as facilities and systems for wastewater (including storm, snowmelt, infiltration, irrigation, and drainage water) disposal (discharge) into receiving tanks made of waterproof material; 5) facilities providing protection of water bodies and adjacent territories from oil spills and other adverse environmental impacts.
up to 10 km	50 m	
10 to 50 km	100 m	
50 km and more	200 m	
for river, stream source	radius of water protection zone - 50 m	
for lake, water reservoir, except for lake in a bog or lake, water reservoir with total water area less than 0.5 km^2	50 m	
for seas	500 m	

[64]RF Water Code of 03.06.2006 No. 74 FZ

Near-shore protective belt:		**Additional Restrictions**
Slope:	Width of near-shore protective belt	Within the near-shore protective belts, alongside with the restrictions established for water protection zones, the following is prohibited: 1) ploughing of lands; 2) disposal of erodible waste banks; 3) use the land for grazing, resting and washing of farm animals.
Reverse or zero	30 m	
<3 °	40 m	
≥ 3 °	50 m	
for flow-through and open lakes in bogs and associated streams	50 m	
for lakes, water reservoirs of high fishery value (spawning, feeding, wintering grounds of fish and other aquatic biological resource, irrespective of slope of adjacent land areas)	200 m	
Width of shoreline strip		
For public water bodies, except for channels, and for rivers and streams longer than 10 km from source to discharge	20 m	Shoreline strip is a strip of land along the shoreline of a public water body intended for public use. Every citizen is entitled to use (without using mechanical vehicles) the shoreline strips of public water bodies for movement and stay near them, including for amateur and sport fishing and the mooring of floating equipment.
For rivers and streams with a maximum length from source to discharge of 10 km	5 m	

Table 3.6: Key environmental requirements for waste management

Topic	National Standards / Requirements	International Guidelines / Standards IFC General EHS Guidelines	Project Standard
Waste recycling and disposal	Waste management, recycling, and disposal is regulated by the Federal Law on Production and Consumption Waste (of 24.06.1998 No. 89-FZ). Waste hazard classes: Class 1 - Extreme hazard; Class 2 - High hazard; Class 3 - Moderate hazard; Class 4 - Low hazard; Class 5 - practically non-hazardous. The waste storage shall be arranged in compliance with the SanPiN 2.1.7.1322-03 - Hygienic standards for disposal and treatment of production and consumption waste. Depending on the technological, physical and chemical characteristics of waste it can be temporarily stored at the following facilities: •industrial and auxiliary indoor facilities; •non-stationary storage facilities (under inflatable, open-work structures and sheds); •in tanks, accumulation vessels, reservoirs, and other dedicated above-ground and buried holding capacities; •in cars, tankers, tip wagons, on platforms and other mobile vehicles; •at open sites equipped for storage of waste. Closed storage facilities used for temporary storage of waste of hazard class I and II shall be designed to provide spatial isolation and segregate storage of substances in separate compartments on trays. On-site accumulation and temporary storage of industrial waste may be arranged at individual workshop or at a common centralized facility. Solid waste of hazard class I shall be stored in tight returnable (exchangeable) tanks (containers, drums, cisterns); hazard class II - in securely closed packaging (polyethylene bags, plastic packages); III - in paper bags and bins, cotton bags, textile bags; IV - in bulk, in banks. In case of waste storage at non-stationary facilities, outdoor sites without containers (in bulk) or in untight containers, the following rules shall be followed: •waste storage sites shall be located downwind in relation to residential premises; •site surface shall be hard-paved with impermeable and chemically stable material (asphalt, expanded-clay concrete, polymer concrete, ceramic tiles, etc.); •perimeter bunding and an isolated storm water system shall be provided and connected to dedicated treatment facilities or other wastewater treatment plant; •surface of waste stored in bulk or open collection containers shall be protected from atmospheric precipitation and wind (covered with tarpaulin, shed, etc.). Open storage of finely dispersed waste (in bulk) at the industrial premises without application of dust suppression systems is prohibited. Disposal of waste in natural or artificial topographic lows (depressions, pits, quarries, etc.) is allowed only after special bed preparation. Low-hazard waste may be stored in or outside the main industrial site in adequately planned heaps and banks.	No applicable quantitative standards are established. Treatment/recycling or transportation to dedicated and adequately equipped landfills/dumps. Waste storage shall be arranged using adequate methods to prevent mixing or contact of incompatible wastes, allowing for inspection of storage containers integrity and identification of potential leaks and spills. Storage in closed vessels isolated from sunlight, wind and rain. Secondary spill containment systems shall be constructed using materials corresponding to the stored waste, to prevent potential damage to the environment. Secondary spill containment systems are required for storage of more than 220 l of liquid waste. Volume of the secondary spill containment facilities shall be at least 110% of capacity of the largest storage container, or 25% of the total design storage volume (the larger value shall be adopted). Storage facilities for highly-volatile waste shall be provided with adequate ventilation systems.	Most appropriate - Russian regulations supplemented with GIIP

Topic	National Standards / Requirements	International Guidelines / Standards IFC General EHS Guidelines	Project Standard
Waste disposal from vessels, including bilge water (sludge)	No applicable quantitative standards are established by the Russian law MARPOL 73/78 standards are applied. The MARPOL Convention does not specify quantitative standards of discharge (for nearshore waste).	**IFC EHS Guidelines for Shipping** Compliance with the applicable international regulations and guidelines for waste management, as well as requirements and practices adopted by the port of destination, including: MARPOL 73/78 Annex V and Basel Convention.	Most appropriate - Russian regulations supplemented with GIIP

Table 3.7: Environmental standards for noise

Topic	National Requirements / Standards	International Guidelines / Standards		Adopted Project Standard	Rationale
	Russia	IFC General EHS Guidelines	IFC EHS Guidelines for LNG production, transportation and re-gasification		

Maximum permissible night time noise levels for protection of community health	Night time noise level (23:00-07:00) shall not exceed the following limits (SN 2.2.4/2.1.8.562-96 - Noise at workplaces, in the premises of residential and public buildings, and outdoor noise in residential areas, p.5.3.1.):
	• In residential and public buildings:
	– Hospitals, health centres: 25 dB(A);
	– Accommodation premises: 30 dB(A);
	– Hotel and dormitory rooms, areas adjacent to hospitals and health resorts: 35 dB(A);
	– Areas adjacent to residential houses, dispensaries, outpatient clinics, health centres, rest homes, resorts, assisted living facilities for elderly people and persons with disabilities, pre-school education institutions, schools and other educational institutions, libraries: 45 dB(A);
	– Halls of cafeteria, restaurants, canteens: 55 dB(A);
	– Floor space of stores, waiting rooms at the airports and train stations, lobby areas of consumer services providing companies: 60 dB(A).
		The noise level shall not exceed the limits specified below, or cause an increase of background noise levels by more than 3 dB in the nearest point of receptor beyond the site boundaries:
		
		Residential, office and training premises:
		night time (22:00-07:00): 45 dB(A);
		Industrial and commercial, educational premises:
		night time (22:00-07:00): 70 dB(A);
			No applicable quantitative standards are established	Russian standards and standards introduced by the IFC General EHS Guidelines defining night time as 22:00 – 07:00	Most stringent standards providing complete coverage of all relevant measurement criteria

Topic	National Requirements / Standards	International Guidelines / Standards		Adopted Project Standard	Rationale
	Russia	IFC General EHS Guidelines	IFC EHS Guidelines for LNG production, transportation and re-gasification		
Maximum permissible day time noise levels	Day time noise level (07:00-23:00) shall not exceed the following limits in the premises of residential and public buildings and in residential areas: - 55 dB(A) and 45 dB(A) In office buildings – 60 dB(A), inside industrial facilities – 80 dB(A) (SanPiN 2.1.2.2645-10, p. 6.2.1).	The noise levels shall not exceed the limitations specified below, or cause an increase of background noise levels by more than 3 dB in the nearest point of receptor beyond the site boundaries: Residential, office and training premises: Day time (07:00 – 23:00): 55 dB(A) Industrial and commercial premises: night time (22:00-07:00): 70 dB(A);	No applicable quantitative standards are established	Russian standards and standards introduced by the IFC General EHS Guidelines defining night time as 22:00 – 07:00	Most stringent standards providing complete coverage of all relevant measurement criteria

Table 3.8: Soil Quality Standards

Parameter	Unit	RF Standard (GN 2.1.7.2041-06) [65]	Dutch standards[66]	Project Standard (the most stringent)
Oil and petroleum products	mg/kg of soil	1000[67]	5000	1000
Benz(a)pyrene	mg/kg of soil	0.02	-	0.02
Petrol	mg/kg of soil	0.1		0.1
Benzene	mg/kg of soil	0.3	1.1	0.3
Vanadium	mg/kg of soil	150.0	-	150.0
Vanadium+Manganese	mg/kg of soil	100+1000	-	100+1000

[65] (approved by the RF Chief State Sanitary Inspector Resolution of

[66] Soil Remediation Circular 2013 http://rwsenvironment.eu/subjects/soil/legislation-and/soil-remediation/

[67] No MPC for petroleum products is set by Russian standards. However if the level is higher than 1000 mg/kg, state supervision authorities may impose penalty for contamination of soil. Procedure for determination of extent of damage caused by chemical contamination of soil. Moscow, 1993.

Parameter	Unit	RF Standard (GN 2.1.7.2041-06) [65]	Dutch standards[66]	Project Standard (the most stringent)
Dimethylbenzenes (1,2-dimethylbenzene; 1,3-dimethylbenzene; 1,4-dimethylbenzene)	mg/kg of soil	0.3	-	0.3
Polynutrient pelleted fertilizers	mg/kg of soil	120.0	-	120.0
Polynutrient liquid fertilizers	mg/kg of soil	80.0	-	80.0
Manganese	mg/kg of soil	1500	-	1500
Methanal	mg/kg of soil	7.0	-	7.0
Methylbenzene	mg/kg of soil	0.3	-	0.3
(1-methylethenyl) benzene	mg/kg of soil	0.5	-	0.5
(1-methylethyl) benzene	mg/kg of soil	0.5	-	0.5
Arsenic	mg/kg of soil	2.0	76	2.0
Nitrate (as NO_3)	mg/kg of soil	130.0	-	130.0
Coal flotation tailings	mg/kg of soil	3000.0	-	3000.0
Mercury	mg/kg of soil	2.1	-	2.1
Lead	mg/kg of soil	32.0	530	32.0
Lead + Mercury	mg/kg of soil	20.0 + 1.0	-	20.0 + 1.0
Sulfur	mg/kg of soil	160.0	-	160.0
Sulphuric acid (as S)	mg/kg of soil	160.0	-	160.0
Hydrogen sulphide (as S)	mg/kg of soil	0.4	-	0.4
Superphosphate (as P_2O_5)	mg/kg of soil	200.0	-	200.0
Antimony	mg/kg of soil	4.5	22	4.5
Furan-2-carbaldehyde	mg/kg of soil	3.0	-	3.0
Potassium Chloride	mg/kg of soil	360.0	-	360.0
Chromium VI	mg/kg of soil	0.05	78	0.05
Ethanal	mg/kg of soil	10	-	10
Ethenylbenzene	mg/kg of soil	0.1	-	0.1
Cobalt	mg/kg of soil	5.0	190	5.0
Copper	mg/kg of soil	3.0	190	3.0
Nickel	mg/kg of soil	4.0	100	4.0
Lead	mg/kg of soil	6.0	530	6.0
Flourine	mg/kg of soil	2.8	-	2.8
Chromium III	mg/kg of soil	6.0	180	6.0
Zinc	mg/kg of soil	23.0	720	23.0
Flourine	mg/kg of soil	10.0	-	10.0

Table 3.9: Regional Environmental Quality Standards (background concentrations of polluting substances in snow cover, bottom sediments of surface water bodies, and vegetation in the Tazovsky Municipal District)[68]

	Unit	Environmental quality standard														
		Pb	Mn	Cu	Zn	Cd	As	Hg	Cr (VI)	Ni	petroleum hydrocarbons	phenols	Cl^-	SO_4^{2-}	NH_4^+	NO_3^-	Fe
Snow cover	mg/dm	<0,0002	0.008	0.0028	0.012	-			<0.008	0.0016	0.041	0.0048	1.04	0.88	<0.50	1.398	0.15
Bottom sediments	mg/kg	-	382.71	8.59	46.11	-			-	29.64	7.22	-	-	-	-	-	-
Vegetation	mg/kg	2.5	530.4	2.1	33.94	0.26	0.0925	0.088	1.1	3.51	-	-	-	-	-	-	-

Table 3.10: Social environment and working conditions (minimum age for admission to employment)

National Requirements / Standards	International Guidelines / Standards		Project Standard
RF Labour Code of 30.12.2001 No. 197-FZ	**ILO Convention: No. 138**	**IFC Performance Standard 2: Labor and working conditions**	
Persons entitled to create employer-employee relationships as employees shall be 16 years or older. Persons at the age of 15 who have received or are receiving general education may be employed in contract work for light labour not associated with adverse health effect. Under consent of a parent (caregiver) and guardianship and wardship authority, a labour contract may be signed with a person at the age of 14, who have received or is receiving general education, for performance of light tasks during non-study time, with no risk of adverse health effect or impairment of his/her ability to cope with the educational programme. Reduced working hours are established for the following categories: workers aged less than 16 years - maximum 24 hours per week; workers aged 16 - 18 years - maximum 35 hours per week; Employment of persons younger than 18 years for harmful and/or hazardous jobs, underground works is prohibited. The list of jobs where employment of persons under 18 is prohibited is issued by the RF Government Resolution of 25.02.2000 No. 163 "On approval of the list of heavy work and work in harmful and/or dangerous conditions where the use of labour of persons younger than 18 years of age is prohibited".	The minimum age for admission to employment or work shall not be less than the age of completion of compulsory schooling and, in any case, shall not be less than 15 years. The minimum age for admission to any type of employment or work, which by its nature or the circumstances in which it is carried out is likely to jeopardise health, safety or morals of young persons, shall not be less than 18 years.	The client shall identify the presence of all persons under the age of 18. Where national laws have provisions for the employment of minors, the client shall follow those laws applicable to the client. Children under the age of 18 will not be employed in hazardous work. All work of persons under the age of 18 will be subject to an appropriate risk assessment and regular monitoring of health, working conditions, and hours of work.	The minimum age for admission to employment or work shall not be less than 15 years. The minimum age for admission to any type of employment or work, which by its nature or the circumstances in which it is carried out is likely to jeopardise health, safety or morals of young persons, shall not be less than 18 years.

[68]The Order of the Department of Natural and Resource Regulation, the Forest Relations, and Development of the Oil and Gas Complex of the Yamal-Nenets Autonomous Okrug No. 348 of 27.03.2017 "On the Establishment of Environmental Quality Standards "Background concentrations of polluting substances in snow cover, bottom sediments of surface water bodies, and vegetation in the Yamal-Nenets Autonomous Okrug".

Table 3.11: List of BATs applicable to natural gas production and treatment, LNG[69] production, and gas condensate stabilization[70]

BAT index	BAT description
Environmental Management Systems	
BAT 1	Improvement of environmental performance (efficiency) by introducing and maintaining Environmental Management System (EMS) compliant to GOST R ISO 14001 or ISO 14001 requirements, or application of EMS tools
Energy Management Systems	
BAT 2	Improvement of energy efficiency by introducing and maintaining Energy Management System compliant to GOST R ISO 50001 or ISO 50001:2011, or its application of tools
Construction of wells	
BAT 3	Pitless drilling technology (the technology is based on deep treatment of drilling wastewater with four-stage treatment of drilling wastewater and drilling muds using vibrating screens, mud desander, desilter, and centrifuge for solid phase separation allowing for treated wastewater to be reused in the technological process).
BAT 4	Well drilling technology with the use of mud pits (mud tanks) (the technology involves the construction of mud pits in a natural soil area provided with mandatory effective waterproof coating to prevent filtration of drilling fluids).
BAT 5	Technology for the collection, transportation, and conditioning of drilling mud waste with its further return to the technological process, as well as for the production of technical fluids for various purposes
BAT 6	Recycling and use of the solid phase of drilling mud.
Well operation	
BAT 7	Well operation technologies without air pollution emissions
BAT 8	Technologies of intensification of gas inflow to the well
BAT 9	Use of preliminary separation of formation gas
Pretreatment of combustible natural gas for transport	
BAT 10	Technology of pretreatment of combustible natural gas for transport using absorption gas dehydration
BAT 11	Technology of pretreatment of combustible natural gas for transport using adsorption gas dehydration
BAT 12	Technology of pretreatment of combustible natural gas for transport, unstable gas condensate treatment using low-temperature separation method
BAT 13	Technology of pretreatment of combustible natural gas for transport using low-temperature absorption method
НДТ 14	Optimization of booster compression stations
Production of liquefied combustible natural gas	
BAT 15	LNG production technology BAT for LNG production involve implementation of technological solutions ensuring reduction of air pollutant emissions, including: - the use of isothermal tanks for initial storage of LNG providing for removal and use of boil-off gas as fuel; - the use of flare units, that allow to exclude emissions of non-ignited hydrocarbon gas into the ambient air.
BAT 16	Associated petroleum gas utilization
Gas condensate stabilization	
BAT 7	BAT involves gas condensate stabilization technologies providing for the use of combined condensate stabilization units (separation and fractionation), multistage degassing and stabilization in fractionation columns.

[69]ITS 29-2017 Natural gas production

[70]ITS 50-2017 Processing of natural and accompanying gas

Table 3.12: BAT Technological indicators for air pollutant emissions applicable to natural gas production[71]

Production process	Polluting substance	Unit[72]	Value
BAT 7,8 Well operation (gas, gas condensate, oil and gas condensate fields)	Nitrogen oxides (NO_x in NO_2 equivalent)	Kg/TOE of product (year)	≤0.7
	Carbon monoxide	Kg/TOE of product (year)	≤5.0
	Methane	Kg/TOE of product (year)	≤1.0
BAT 9 Preliminary separation of formation gas	Nitrogen dioxide	Kg/TOE of product (year)	≤0.005
	Carbon monoxide	Kg/TOE of product (year)	≤0.05
	Methane	Kg/TOE of product (year)	≤25.0
BAT 10 Pretreatment of combustible natural gas for transport using absorption gas dehydration	Nitrogen dioxide	Kg/TOE of product (year)	≤0.03
	Carbon monoxide	Kg/TOE of product (year)	≤0.03
	Methane	Kg/TOE of product (year)	≤0.2
BAT 11 Pretreatment of combustible natural gas for transport using adsorption gas dehydration	Nitrogen dioxide	Kg/TOE of product (year)	≤0.05
	Carbon monoxide	Kg/TOE of product (year)	≤0.2
	Methane	Kg/TOE of product (year)	≤0.01
BAT 12 Pretreatment of combustible natural gas for transport, unstable gas condensate treatment using low-temperature separation method	Nitrogen dioxide	Kg/TOE of product (year)	≤0.03
	Carbon monoxide	Kg/TOE of product (year)	≤0.05
	Methane	Kg/TOE of product (year)	≤0.2
BAT 13 Pretreatment of combustible natural gas for transport using low-temperature absorption method	Nitrogen dioxide	Kg/TOE of product (year)	≤0.05
	Carbon monoxide	Kg/TOE of product (year)	≤0.2
	Methane	Kg/TOE of product (year)	≤0.01
BAT 14 Optimization of booster compression stations	Nitrogen dioxide	Kg/TOE of product (year)	≤0.7
	Carbon monoxide	Kg/TOE of product (year)	≤1.0
	Methane	Kg/TOE of product (year)	≤1.0

Table 3.13: BAT Technological indicators most commonly applicable to operation of surface facilities in the course of natural gas production[73]

Polluting substance	Specific emission value, kg/TOE of product (year)
Low-temperature absorption	
Application of BAT 1, 6, 7, 12, 13	
Nitrogen oxides (NO_x in NO_2 equivalent)	≤0.7
Carbon monoxide (CO)	≤2.0
Methane (CH_4)	≤0.5
Particulate matter (PM)	≤0.02
Preliminary separation, low-temperature absorption	
Application of BAT 1, 8, 12, 13	
Nitrogen oxides (NO_x in NO_2 equivalent)	≤1.5
Carbon monoxide (CO)	≤3.0
Methane (CH_4)	≤2.0

Table 3.14: BAT Technological indicators for air pollutant emissions applicable to gas condensate stabilization[74]

Polluting substance	Specific emission value, kg/t of product (year)
Nitrogen oxides (in NO_2 equivalent)	≤0.06
Carbon monoxide (CO)	≤0.2
Methane (CH_4)	≤0.02
Saturated hydrocarbons (C1-C5) (except methane)	≤0.02
Sulphur dioxide (SO_2)	≤0.001

[71] In line with the Order of the RF Ministry of Natural Resources of 17.07.2019 No.471 "On approval of environmental regulation document "Process parameters of the best available technologies for natural gas production"

[72]TOE - tonne of oil equivalent (1,000 m3 of natural gas equivalent to 0.8 TOE, 1 tonne of condensate/ oil equivalent to 1 TOE)

[73] In line with the Order of the RF Ministry of Natural Resources of 17.07.2019 No.471 "On approval of environmental regulation document "Process parameters of the best available technologies for natural gas production" and ITS 29-2017

[74] In line with the Order of the RF Ministry of Natural Resources of 21.05.2019 No.319 "On approval of environmental regulation document "Process parameters of the best available technologies for natural and accompanying gas processing" and ITS 50-2017

APPENDIX 1
OVERVIEW OF THE KEY RUSSIAN AND YNAO LEGISLATION

National legislation

The legislation of the Russian Federation, which regulates, to a greater or lesser extent, requirements in the field of the use and protection of natural resources, protection of environmental sites, health and safety, working and leisure conditions, is very extensive. This Section lists only the main federal and regional laws and regulating documents adopted in their development, the requirements of which shall be met in the course of design and operation of the Arctic LNG 2 Project. The list of key environmental and social legislation of the Russian Federation is provided in Appendix 3.

The Constitution of the Russian Federation is the main law, that enshrines the right of Russian citizen to a favourable environment, reliable information on the state of the environment, and compensation for damage caused to his/her health or property by violations of environmental laws" (Article 42). The law also states that the natural resources shall be utilized and protected in the Russian Federation as the basis of life and activity of the peoples living in the corresponding territories (Article 9) and obliges to preserve nature and the environment (Article 58).

The Federal Law of 10.01.2002 No. 7-FZ "On Environmental Protection" lays down principles in the field of environmental protection, including the use of natural wealth for a pay and the reimbursement of a harm inflicted to the environment; the requirement to conduct environmental impact assessment in respect of a planned economic or another activity capable of exerting a direct or indirect effect on the environment (Article 32); the general provisions governing environmental protection in the case of location determination, design, construction, and operation of facilities intended for economic activities (Article 34), including requirements for facilities intended for processing, transportation, storage, and selling oil, gas, and petroleum/gas products (Article 43); obligation of legal entities and natural persons, who have inflicted damage to the environment by polluting, depleting, damaging, destroying it, by irrational use of natural resources, degrading and destroying natural ecological systems, natural complexes and natural landscapes, and another violation of the environmental protection legislation, to compensate it in full (Article 77).

In line with the Article 4.2, facilities causing adverse environmental impact are classified into four categories according to the scale of their impact. According to the classification established by the RF Government Decree No. 1029 of 28.09.2015 "On approval of criteria for classification of facilities causing adverse environmental impacts as operations of category I, II, III, and IV", enterprises engaged in crude oil and natural gas production, including natural gas processing, are classified as category I facilities, which cause significant adverse environmental impact and relate to a field of application of BAT.

The Federal Law No. 52-FZ of 30.03.1999 "On the sanitary and epidemiological welfare of the population" regulates relations arising in the sphere of the sanitary and epidemiological welfare of the population as one of the main conditions of the implementation of the rights of citizens to health protection and favourable environment granted by the RF Constitution.

In particular, legal entities are obliged to ensure the safety of performed works and rendered services for human health, exercise production control over the observance of sanitary and counterepidemic (preventive) measures during the performance of work and the rendering of services, inform the population, local government authorities, the bodies engaged in state sanitary and epidemiological supervision in a timely manner about emergency conditions, production stoppages, and breaches of technological processes endangering the sanitary and epidemiological welfare of the population (Article 11).

The Urban Planning Code of the Russian Federation No. 190-FZ of 29.12.2004 regulates relations arising in the field of territorial planning, urban planning and zoning, architectural and civil engineering design, site planning, construction of capital facilities, their modernisation, as well as their major renovation affecting design and other characteristics in relation to safety and reliability of such facilities, establishes requirements for conducting of engineering surveys, development and structure of project design documentation for construction and renovation facilities, procedure for approval of project design documentation, performance of expert review and construction supervision.

More specifically, according to Article 47 of the Code, engineering (including environmental engineering) surveys of the area of planned activities shall be performed in order to prepare project design documentation for construction, renovation, and modernization of facilities. Project design documentation prepared and engineering survey results are subject to State expert review, which is to assess their compliance with the requirements of technical regulations, including sanitary, epidemiological, and environmental requirements, state requirements for protection of cultural heritage sites, requirements for fire and industrial safety, and other safety requirements. The State expert review is carried out by the RF government authorities (Glavgosexpertiza of Russia).

RF Government Decree *No. 87 of 16.02.2008* ***"On the structure of project design documentation and requirements to its content"*** establishes requirements to include a special Section entitled "List of Environmental Protection Measures" containing the results of Environmental Impact Assessment (EIA) and proposed mitigation measures, as well as environmental monitoring and control program in the project design documentation. The required approvals and references from various environmental agencies and other executive authorities are attached as Supplementary Materials. The implementation of a project is possible only after the said documentation has been approved by the State Environmental Expert Review Board.

Order of the RF State Committee for Environmental Protection (Goscomecologia) of 16.05.2000 No. 372 "On the Regulation on environmental impact assessment of planned economic and other activities in the Russian Federation" sets out requirements for preparation of EIA materials. The above order is the only document in force in the Russian Federation, which regulates EIA precess. RF EIA process includes development and discussion of EIA materials with stakeholders.

The Federal Law *No. 174-FZ of 23.11.1995* ***"On Ecological Expertise"*** regulates relations in the field of environmental expert review and is aimed at the realization of the constitutional right of RF citizens to a favorable environment through preventing the adverse environmental impacts associated with economic and other activities. In accordance with Article 11, economic and other activities of all types in internal waters and territorial sea, as well as project design documentation for capital facilities, which are classified as category I facilities causing adverse environmental impact, are subject to the State environmental expert review and can be conducted only if its positive conclusion is obtained.

The Land Code of the Russian Federation No. 136-FZ of 25.10.2001 regulates the relations of use and preservation of land in the Russian Federation as the basis of life and activities of the peoples residing on a given territory. The use of land shall be performed by methods ensuring conservation of ecological systems, the ability of land to be means of production in agriculture and forestry, the basis of economic and other types of activity (Article 12).

The Code establishes the obligation of owners of plots of land, users of land, landowners, tenants, and lessees of plots of land to implement measures for land preservation, as well as to prevent chemical contamination, industrial and consumption waste dumping, and other adverse (harmful) impacts on land resulting in land deterioration; to eliminate the aftermath of pollution and waste dumping.

The Federal Law No. 89-FZ of 24.06.1998 "On production and consumption waste" regulates relations in the field of waste management. In particular, in the process of construction of new facilities (Article 10), legal entities shall:

- observe federal rules and regulations for waste management;
- provide for waste accumulation area in compliance with established federal rules and regulations and other waste management requirements

Waste management measures shall be developed taking into account waste hazard classes and regulatory requirements applicable to their treatment and disposal.

The Water Code of the Russian Federation No. 74-FZ of 03.06.2006 establishes a legal framework for management in the field of use and protection of water bodies, basic requirements for the use of water bodies, as well as liability for violation of water legislation. Surface water bodies include seas and parts of seas (straits, gulfs, including bays, estuaries, and so on), watercourses (rivers, streams, canals), reservoirs (lakes, ponds, flooded quarries, storage reservoirs), swamps, natural groundwater discharge locations (springs, geysers), glaciers and snowfields (Article 5). The use of water bodies is performed for a fee (Article 20)

The use of surface water bodies is performed on the basis of water use agreements for the following purposes:

- water intake (withdrawal) from water bodies (with or without the return of water into water bodies);
- use of the water areas (unless otherwise provided in Sections 3 and 4 of Article 11).

The use of surface water bodies is performed on the basis of a decision to grant a water body for use for the following purposes:

- discharge of effluents;
- construction and modernisation of bridges, submerged or underground crossings, pipelines, and other linear facilities associated with changes to the bottom and shores of surface water bodies;

- performing dredging, blasting, drilling, and other activities associated with changes in the bottom and shores of surface water bodies.

In order to prevent contamination, littering, and siltation of said water bodies and depletion of their water reserves, as well as to protect habitats of aquatic biological resources, wildlife, and vegetation, water protection zones with special conditions of economic or other activities are set up along shorelines of the water bodies (Article 65).

Near-shore protective belts are provided within water protection zones where additional restrictions apply to economic or other activities. In particular, in addition to the above restrictions, it is prohibited to dispose of erodible waste banks within the boundaries of near-shore protective zones.

Federal Law of 31.07.1998 No. 155-FZ "On internal marine waters, territorial sea, and contiguous zone of the Russian Federation" establishes legal regime of internal marine waters, territorial sea, and contiguous zone of the Russian Federation; sets out the boundaries of internal waters, territorial sea, legal regime of seaports, the passage through the territorial sea, the exercise of marine scientific research, protection and preservation of the marine environment and natural resources of internal sea waters and territorial sea.

Disposal of waste and other materials, with the exception of disposal of soil extracted during dredging, as well as discharge of pollutants (including effluents containing polluting substances) from vessels and other watercraft, artificial islands, installations, and structures in internal waters and territorial sea is prohibited.

Federal Law No. 96-FZ of 04.05.1999 "On Air Protection" establishes a legal framework in ambient air protection, including requirements concerning air protection measures to be taken by those engaged in economic activity of any kind. Construction projects for facilities used for economic and other activities shall include measures aimed at reduction of air emissions of noxious (polluting) substances and their neutralization.

In order to protect ambient air in residential areas, enterprises (or their groups) are required to establish Sanitary Protection Zones (SPZ) around their sites. The standard size of such Sanitary Protection Zones is determined on the basis of air pollutant dispersion modeling and in line with the industry sanitation classification.

Federal Law On Wildlife No. 52-FZ of 24.04.1995 (21.11.2011 version) regulates relationships in the field of protection and use of animal resources, as well as preservation and remediation of habitats, in order to conserve biological diversity, keep intact the wildlife gene pool, and otherwise protect wild animals as an integral part of the natural environment.

According to Article 22 of the Law, measures to ensure preservation of migration routes of animal species and locations with their large concentration, including during their breeding and wintering, shall be developed and implemented for location, design, and construction of airports, railways, highways, pipelines and other traffic arteries, power and communication lines. In order to protect habitats of rare and endangered animal species, as well as species valuable from the commercial and scientific viewpoints, the land and water protection zones of local significance but critical for the life cycle of these species (reproduction, rearing their young, feeding, resting grounds, migration routes, etc.) are allocated. Time frames and technologies for planned activities within the land and water protection zones are regulated in case they disturb the life cycles of animal species.

In compliance with Article 24, it is prohibited to undertake activities that may result in loss, reduction of populations, or damage being caused to habitats of the animal species listed in the Red Data Books (Article 24).

The law provides a priority right to use wildlife resources for indigenous low-numbered peoples and ethnic communities, as well as citizens belonging to these communities, whose authentic culture and lifestyle include traditional methods of wildlife use and protection (Article 49).

In accordance with the law, legal entities and citizens guilty of violating habitat protection regulations, killing animals of rare or endangered species, breaching regulations established for hunting or fishing, failing to meet the requirements aimed at prevention of loss of wildlife resources as a result of economic activities or transport operations, can be charged under civil, administrative, or criminal law (Article 55).

Legal entities and citizens, who caused damage to animal species and their habitats, are to compensate damage caused on a voluntary basis or by court order. The damage is determined on the basis of the approved rates and methods, and in their absence - at the actual costs of compensation for damage caused to animal species and their habitat, taking into account the losses sustained, including loss of profit (Article 56).

RF Government Resolution of 13.08.1996 No. 997 "On approval of Requirements for the prevention of animal loss as a result of implementation of industrial processes, as well as operation of transport links, pipelines, communication and power lines" regulates industrial activities so as to prevent animal population losses as a result of: altered habitats and disrupted migratory routes, getting into water intake installations, parts of industrial equipment, under moving vehicles and agricultural machines; construction of production and other types of facilities, extraction, processing, and transportation of raw materials; colliding with power lines and electrocution, impacts from electromagnetic fields, noise, and vibrations.

Federal Law No. 166-FZ of 20.12.2004 "On fishery and conservation of aquatic biological resources" regulates relations in the field of fishery and conservation of aquatic biological resources. The law provides for the implementation of necessary measures on conservation of aquatic biological resources and their habitat during construction, modernisation, major renovation of capital construction facilities (Article 50), as well as compensation for damage caused to aquatic biological resources (Article 53), which is performed on a voluntary basis or pursuant to a court order, and is calculated either in accordance with the rates and methodologies approved in the prescribed manner, or on the basis of aquatic bioresources' restoration costs.

RF Government Decree No.380 of 29.04.2013 "On the endorsement of Provision on measures for conservation of aquatic biological resources and their habitats" sets out measures aimed at conservation of the aquatic biological resources and their habitats that shall be implemented in the course of the activities with both direct and indirect impact on the biological resources and habitats. Some of these measures are:

- operational environmental control over the impact from the activities on biological resources and their habitats;
- use of effective fish screens to prevent bioresources from entering water intake facilities;
- compliance with water quality standards and water regime requirements established for fishery water bodies;
- eliminating negative effects through artificial hatching, acclimation of biological resources, or rehabilitation of fisheries.

Federal Law No. 33-FZ of 14.03.1995 "On specially protected natural areas" regulates relations in organization, protection, and use of specially protected natural territories in order to preserve unique and typical natural complexes and sites, natural landmarks, flora and fauna, and their gene pool, in research concerning natural processes in the biosphere and monitoring of changes in it, as well as environmental education of the public.

Federal Law On Guaranteed Rights of Indigenous Low-Numbered Peoples of the Russian Federation of 30.04.1999 No. 82-FZ. In line with Article 4 of the Law, state government and local government authorities ensure special rights of low-numbered peoples to social, economic, and cultural development, protection of their original habitats, traditional ways of life and economic activities. More specifically, indigenous low-numbered peoples have the right (Article 8):

- to own and use lands of different categories, as may be required to pursue traditional husbandry and engage in traditional crafts and occupations, free of charge at the territories of their traditional residence and economic activities.
- to take part in environmental and ethnological expert assessments during the development of federal and regional State programmes for development of natural resources and environmental protection in the areas of traditional residence and traditional economic activities of the low-numbered peoples;
- to receive a redress for losses associated with damage inflicted on the traditional areas of residence of the indigenous small-numbered peoples by economic activities of enterprises of any form of ownership, by natural persons, etc.

Federal Law 49-FZ of 07.05.2001 "On Areas of Traditional Natural Resource Use of the Indigenous low-numbered peoples of the North, Siberia and Far East of the Russian Federation" is aimed at protection of original habitats and traditional ways of life of indigenous peoples, preservation and development of their authentic cultures, and preservation of biodiversity in areas of their traditional natural resource use.

The Law provides for certain restrictions on economic and other activities within the boundaries of the areas of traditional use of natural resources. More specifically, natural resources located within these areas shall be used by persons belonging to indigenous small-numbered peoples to sustain their traditional way of life and by communities of indigenous peoples in accordance with their customs and traditions (Article 13). Historical and cultural heritage sites within the areas of traditional use of natural resources (ancient

settlements, other historical and cultural monuments, sacred sites and structures, ancestors' burial sites, and other sites of cultural and historical value) can be used only in accordance with their intended purpose (Article 15). There is legislation adopted by the YNAO at the regional level in support of this Federal Law.

Federal Law No. 68-FZ of 21.12.1994 "On protection of the population and of the territories from environmental and technological emergencies" sets out organizational and legal standards for protection of the population, the entire land, water, and airspace within the Russian Federation, industrial and social facilities, and natural environment from natural and technogenic emergencies. The law obliges organizations:

- to ensure the development, preparation, and maintenance of preparedness for the use of forces and means to prevent and eliminate emergencies, to provide emergency response trainings for employees of organizations;
- to ensure organisation and performance of emergency response and other urgent measures at subordinate industrial and social facilities and in the territories adjacent to them in accordance with emergency response plans;
- to create reserves of financial and material resources for emergency response, etc. (Article 14).

Citizens of the Russian Federation have the right to protection of life, health, personal property in the event of emergency, to compensation for damage caused to their health and property (Article 18).

The Federal Law 116-FZ of 21.07.1997 "On industrial safety of hazardous industrial facilities" defines the legal, economic, and social framework to ensure safe operation of hazardous industrial facilities (HIF) and is aimed at prevention of emergencies and ensuring preparedness of HIFs operating organizations to localize and eliminate the consequences of these emergencies.

According to the classification established under Annex 1 to this Federal Law, the facilities designated for hydrocarbons production, processing, handling, storage, and shipment are classified as hazardous production facilities. Technical units used at hazardous production facilities in the operation process are subject to undergo the industrial safety review in line with the established procedure (Article 13). Organizations intending to engage in operation of hazardous industrial facility shall develop a declaration for industrial safety as part of project design documentation for the purposes of emergency risk assessment (Article 14).

The Federal Law No. 117-FZ of 21.07.1997 "On the Safety of Hydraulic Structures" regulates relations arising from the implementation of safety activities in the design, construction, overhaul, operation, modernisation, mothballing, and closure of hydraulic structures, sets out responsibilities of state government authorities, owners and operators of hydraulic structures for ensuring safety of hydraulic structures.

Article 8 sets out the general safety requirements for hydraulic structures. Among the main requirements, there are submitting of declarations of safety of hydraulic structures and implementation of federal state supervision in the field of safety of hydraulic structures. As indicated in Article 7, hydraulic structures are to be registered into the Russian State Register of hydraulic structures.

RF Government Resolution of 15.04.2002 No.240 approves the Procedure for organization of oil spills prevention and response measures in the Russian Federation. Organizations with hazardous industrial facilities shall develop oil spill prevention and response plan. Such organizations are to establish an oil spill response division, conduct qualification assessment of its stuff, and provide it with designated technical equipment or sign agreements with professional emergency response teams (services).

The Federal Law No. 384-FZ of 30.12.2009 "The technical regulation about safety of buildings and constructions" establishes minimum necessary requirements for buildings and structures (including associated engineering networks and systems), and for the processes of design (including research), construction, installation, adjustment, operation and utilization (demolition) related to the buildings and structures. Buildings and structures shall be designed to avoid risks of an adverse environmental impacts in the course of their construction and operation.

Federal Law No. 123-FZ of 22.07.2008 "Technical Regulation of fire safety" is adopted to protect life, health, property of persons and legal entities, state and municipal property against fires; it determines main provisions of technical regulation related to the fire safety, and specifies general fire safety requirements for the protected objects (products), including buildings and facilities, industrial objects, fire-fighting technical products and general use products.

Federal Law No. 73-FZ of 25.06.2002 "On cultural heritage sites (historical and cultural monuments) of peoples of the Russian Federation" establishes requirements for the implementation of activities within the boundaries of cultural heritage sites; a special status of the use of a land plot, a water body or a part thereof, within the boundaries of which the archaeological heritage site is located (Article 5.1); measures to ensure preservation of the identified cultural heritage sites, sites possessing the characteristics of a cultural heritage site, which are to be taken in the course of survey, design, excavation, construction, ameliorative, economic activities and other types of works (Article 36).

Labor relations and labor protection are regulated by the *Labor Code of the Russian Federation No. 197-FZ of December 30, 2001*. The Code contains provisions aimed at establishment of the state guarantees of labor rights and freedoms of citizens, to create favourable working conditions, and to protect the rights and interests of workers and employers. The labor code covers all aspects of the regulation of labour relations:

- collective bargaining and agreements;
- conclusion, amendment, and termination of the employment contract;
- working time and leisure time, daily time of rest, work-free holidays (leaves), payment and work standardization, wages;
- guarantees and compensation;
- labour discipline;
- occupational safety and ensuring the rights of workers in relation to occupational safety, etc.

Federal Law No. 125-FZ of 24.07.1998 "On compulsory social insurance against industrial accidents and occupational diseases" sets forth the legal, economic, and organizational basis for compulsory social insurance against accidents and occupational diseases suffered in the workplace and establishes the procedure by which workers may seek compensation for damage caused to life and health in the course of their contractual duties, and in other circumstances defined by law.

Yamalo-Nenets Autonomous Okrug Legislation

The environmental, health, and safety legislation of the Yamal-Nenets Autonomous Okrug (YNAO) is focused on addressing issues typical of the region and is constantly evolving. The key regional laws and regulations containing YNAO specific requirements, which are to be taken into account in the course of this Project implementation, are provided below.

YNAO Law No.53-ZAO of 27.06.2008 "On Environment Protection in the Yamal-Nenets Autonomous Okrug" is aimed at ensuring favorable environment, environmental safety, biodiversity conservation, creating conditions needed to protect natural environment and critical needs of the population from potential adverse impacts coming from economic or other activities, acts of God, natural and technogenic accidents and their consequences.

The law provides for the development of regional environmental quality standards and standards for permissible levels of impact on the environment from economic or other activities, which are to be below the federal standards.

Pursuant to the Law, the YNAO Red Data Book is established to protect and keep track of rare and endangered species of animals, plants, and other organisms within the Okrug[75]. There is a Red Data Book of Soils of the Autonomous Okrug established in order to take stock of and protect rare and endangered soils.[76]

YNAO Law No. 114-ZAO of 28.12.2005 "Concerning State support of the Indigenous low-numbered peoples of the North and organizations engaged in traditional economic activities within Yamal-Nenets Autonomous Okrug" lays down legal foundations and types of governmental support to ILNP communities and organizations engaged in traditional economic activities within YNAO and registered as a legal person therein.

As part of State support, YNAO executive authorities ensure that:

- ILNP exercise their rights to use biological resources in areas of their traditional residence and traditional economic activities practiced for food self-sufficiency;
- support for the production and sale of traditional products (traditional economic economic activities include reindeer herding, reindeer product processing, including collection, storage, and currying

[75] Red Data Book of the YNAO is available online athttps://www.yanao.ru/documents/other/11405/. Provision for the Red Data Book is approved by the Resolution of the YNAO Government of 11.05.2018 No. 552-P "On Red Data Book of the *Yamal-Nenets Autonomous Okrug*"

[76] Red Data Book of Soils has not been developed for the YNAO

of skins, ossified antlers, velvet antlers, endocrine glands, meat, and byproducts; fishing and selling of aquatic biological resources; fur farming, processing and selling of fur farming products; commercial hunting, processing and selling of hunting products; gathering of edible forest resources and medicinal plants);
- development of local popular arts and crafts (production of kitchenware, house appliances, boats, sledges (narts), other traditional means of transport, musical instruments, birch bark products, souvenirs from reindeer fur, animal skins, bird feathers, etc.).

The law makes it mandatory to disclose information to ILNP communities and organizations engaged in traditional economic activities about planned use of areas of their residence and economic activities for the purposes not relevant to ILNP activities.

YNAO Law N 49-ZAO of 06.10.2006 "On the protection of traditional habitats and lifestyles of the Indigenous low-numbered peoples of the North (ILNP) in Yamal-Nenets Autonomous Okrug" sets out guidelines for implementing governmental policy on protection of traditional habitats and lifestyles of ILNP, including:

- preservation of traditional habitats and lifestyles of ILNP, including environment protection;
- ensuring conservation and development of ILNP traditional types of natural resource use;
- creating conditions for preservation and revival of authentic traditional lifestyles of ILNP in order to support the development of authentic culture of the Indigenous small-numbered peoples of the North, preserving their customs and beliefs.

The law provides for mandatory environmental assessment of impacts on traditional habitats and lifestyles of ILNP.

YNAO Law No. 52-ZAO of 05.05.2010 "On the areas of traditional natural resource use of regional significance in Yamal-Nenets Autonomous Okrug" sets out the rules for establishment, use, and protection of the areas of traditional natural resource use. Traditional Natural Resource Use subjects within such areas are:

- persons representing the Indigenous low-numbered peoples of the North and communities of the Indigenous low-numbered peoples of the North in the YNAO;
- persons not belonging to the Indigenous low-numbered peoples of the North, but permanently dwelling in the ares of their traditional residence or economic activities, and engaged in the same traditional types of natural resource use and leading the same traditional way of life as the ILNP in the Autonomous Okrug.

Subjects of the traditional types of natural resource use are given precedence in the use of natural resources. In case of acquisition of land plots and other isolated natural sites within such areas for state or municipal needs, the subjects of traditional types of natural resource use shall receive compensation.

The YNAO Law No. 1-ZAO of 27.02.2017 "On aquaculture (fish farming), fishing, and conservation of aquatic biological resources in the Yamal-Nenets Autonomous Okrug" regulates relations in the field of fisheries and the conservation of aquatic biological resources (including for the purposes of maintaining traditional way of life and the traditional economic activities of the ILNP) in the YNAO.

Indigenous people are entitled to practice fishing in order to maintain the traditional way of life freely and free of charge in all water bodies of commercial fishing importance within the Autonomous Okrug, except as otherwise provided by federal legislation.

YNAO Law No. 36-ZAO of 18.04.2007 "Yamal-Nenets Autonomous Okrug Urban Planning Statute" regulates urban planning activities within the Autonomous Okrug, and stipulates that the primary objectives of such activities, inter alia, include:

- ensuring health and safety, as well as protection of the areas from the impacts of hazardous natural and technogenic processes and phenomena;
- preservation of traditional business and lifestyles of the Indigenous low-numbered peoples of the North and ethnic communities, historical territories of their residence and activities;
- conservation of cultural heritage sites (cultural and historical monuments) of the peoples of the Russian Federation;
- creating conditions for development of the production sector of the area.

YNAO Law No. 12-ZAO of 10.01.2007 "On Health Care in the Yamal-Nenets Autonomous Okrug" provides for social support, including health care support of Indigenous low-numbered peoples of the North and other ethnic communities that lead traditional lifestyles within YNAO, including providing free medical services.

YNAO Law No. 56-ZAO of 26.06.2012 "On Subsoil use in the Yamal-Nenets Autonomous Okrug" establishes the authorities of the executive bodies of the Autonomous Okrug, regulates the aspects of the use of subsoil areas of local importance (types, terms, licences, accrual, transfer, and termination of rights to use) and subsoil rational use and protection.

YNAO Law No. 52-ZAO of 26.05.2015 "On cultural heritage sites (historical and cultural monuments) of peoples of the Russian Federation within the Yamal-Nenets Autonomous Okrug" regulates relations arising in the field of preservation, use, promotion, and state protection of cultural heritage sites (historical and cultural monuments) of the peoples of the Russian Federation located in the territory of the YNAO.

YNAO Law No. 59-ZAO of 26.06.2012 "On the regulation of certain relations in the field of hunting and conservation of hunting resources within the Yamal-Nenets Autonomous Okrug" specifies the list of hunting resources in the Autonomous Okrug. The objective of the Law is to establish rules and procedures for issuing permits to harvest game (hunting resources) on public hunting grounds: for which harvest limits has been established and not established (Article 5).

YNAO Law N 1-ZAO of 02.03.2016 "On the guarantees of the rights of persons leading the way of life traditional for the Indigenous low-numbered peoples of the North (ILNP) in the Yamal-Nenets Autonomous Okrug". The law provides for the distribution of powers among the authorities of the Autonomous Okrug , as well as financing of the main aspects of guarantees of the rights of persons leading the way of life traditional for the low- numbered peoples of the North, addressed in the text of the Law: public health and safety and social protection of the population; education; material security; legal assistance.

YNAO Law N 34-ZAO of 06.10.2006 "On the protection of traditional habitats and lifestyles of the Indigenous low-numbered peoples of the North (ILNP) in the Yamal-Nenets Autonomous Okrug".

YNAO Government Resolution of 28.12.2017 No. 132-PG "On approval of Popular Programme for the Indigenous low-numbered peoples of the North in the Yamal-Nenets Autonomous Okrug" highlights the importance of environmental protection as one of the factors of the protection of original habitats of the Indigenous low-numbered peoples of the North, provision for reclamation of lands and liquidation of accumulated environmental damage sites, formed in the previous century, in a timely manner, as well as importance of environmental monitoring and its improvement, including engagement of the representatives of the ILNP communities and ILNP civil society organisations into the monitoring process in the areas of traditional residence and practices of indigenous communities.

YNAO Government Decree No. 792-P of 27.10.2011 "On the endorsement of the Requirements on the prevention of loss of wildlife resources related to operation of industrial processes, as well as traffic arteries, pipelines, communication and power transmission lines within the territory of the Yamal-Nenets Autonomous Okrug". The document contains a set of obligatory measures aimed at the prevention of animal losses in the course of performance of different types of economic activities associated with adverse environmental impacts. In particular, specific requirements are applied to design of water intake facilities, traffic arteries, communication systems, minimization of disturbance factors affecting animal species and compliance with standards established for impacts, installation of lighting at sites and structures.

YNAO Government Decree No. 56-p of *14.02.2013* "On the territorial system of environmental monitoring within license areas subject to the right to use subsoil for oil and gas extraction in the Yamal-Nenets Autonomous Okrug" sets out the procedure for implementation and performance of local environmental monitoring within license areas subject to the right to use subsoil for oil and gas extraction in the YNAO. The functions imposed on the enterprises, users of license subsoil areas, regardless of their organizational and legal forms and forms of ownership, include development of the local environmental monitoring programs; ensuring the implementation of territorial monitoring system within the license areas; development of information resources and reports, and provision of monitoring results; incorporation of these results into decision making process and implementation of relevant environmental measures.

YNAO Government Decree No. 429-P of 29.05.2014 "On approval of the Requirements for development of oil spill prevention and response plans in the Yamal-Nenets Autonomous Okrug". The document establishes requirements for the development of oil spill prevention and response plans (Appendix 1), information on emergencies (Appendix 2) and improvement of the report system (Appendix 3 and 4), as well as contains recommendations for organizations operating in the YNAO, regional authorities and heads of the YNAO municipalities.

YNAO Government Resolution No. 69-P of 31.01.2018 "On the approval of regional standards for urban planning design of the Yamal-Nenets Autonomous Okrug", establishes regional standards for urban

planning at the regional level. With respect to gas and oil refineries, this Resolution regulates the minimum density of land development.

YNAO Government Decree No. 2-P of 09.01.2020 has approved the Territorial Planning Scheme of the YNAO.

The Order of the Department of Natural and Resource Regulation, the Forest Relations, and Development of the Oil and Gas Complex of the Yamal-Nenets Autonomous Okrug No. 340 of 01.04.2016 "On the establishment of the methodological guidelines for development of projects for waste generation standards and limits for their disposal for economic and (or) other activities of individual entrepreneurs and legal entities (with the exception of small and middle-sized business entities) associated with waste generation at facilities subject to regional state environmental supervision". The document establishes a unified approach to development of and general requirements for the content and design of the projects for waste generation standards and limits for their disposal, which justifies the proposed treatment of all wastes generated in the process of economic and other activities of individual entrepreneurs and legal entities, through their recycling, decontamination, disposal, and transfer to other individual entrepreneurs and legal entities for their further treatment (recycling, decontamination, disposal).

The Order of the Department of Natural and Resource Regulation, the Forest Relations, and Development of the Oil and Gas Complex of the Yamal-Nenets Autonomous Okrug No. 348 of 27.03.2017 "On the Establishment of Environmental Quality Standards "Background concentrations of polluting substances in snow cover, bottom sediments of surface water bodies, and vegetation in the Yamal-Nenets Autonomous Okrug". The standards have been developed taking into account the environmental conditions of the YNAO and establish the background concentration of polluting substances in snow cover, bottom sediments of surface water bodies, and vegetation to limit and regulate the levels of pollution.

APPENDIX 2
OVERVIEW OF THE APPLICABLE INTERNATIONAL CONVENTIONS

Date of Signature	Title	Comment, brief description
Conventions on flora and fauna protection		
June 5, 1992, Rio de Janeiro	Convention on Biological Diversity, Rio de Janeiro	Ratified by the Federal Law No.16-FZ of 17.02.1995. The Convention sets out the following requirements to be met while pursuing economic activity so as to protect biodiversity: • carry out environmental impact assessment of all proposed projects that may have adverse effects on biodiversity; • ensure public participation in environmental assessment procedures; • take measures to ensure that the environmental consequences of programmes and policies that are likely to have significant adverse impacts on biological diversity are duly taken into account; • facilitate information exchange. The Convention is relevant to this project, since some natural ecosystems fall within the Project AoI.
June 23, 1979, Bonn	Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), Bonn	Russia is not a party to the Convention. Nevertheless, IFC Performance Standard 6 relies on and promotes the observance of the applicable international laws and conventions. The convention is applicable to the Project, if the AoI of the Project and its facilities includes migration routes of species listed in its annexes. The project shall be implemented with due regard to the principle of conservation of migratory species of wild animals and their habitats listed in Annexes I and II of the Convention.
September 19, 1979, Bern	Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), 1979, Bern	Russia has been a party to the Council of Europe since 1995, but is not a party to the Bern Convention. The representative of the Ministry of Natural Resources and the Environment of the Russian Federation participates in the events in the capacity of observer. The Convention is designed to protect the most vulnerable species of wild flora and fauna that are declining in Europe, and also migratory species, by protecting their habitats. Species requiring special protection measures are listed in the Annexes of the Convention. The Convention provides for attainment of the goals in terms of protection of flora and fauna and respective habitats by incorporating appropriate measures into the political plans and economic development projects and through monitoring and control of environmental pollution. The Convention establishes the duty to promote awareness and disseminate information on the importance of conservation of wildlife and habitats. The Convention is applicable if the Project AoI includes habitats of wildlife species protected by the Convention.
2 February, 1971, Ramsar	Convention on Wetlands of International Importance, especially as Waterfowl Habitat	The Convention entered into force for Russia 11 February 1977. The Convention provides the framework for national action and international cooperation for the conservation and wise use of all wetlands and their resources through local, regional, and national actions and international cooperation, as a contribution towards achieving sustainable development. There are no Ramsar (or candidate Ramsar) sites within the Project AoI.
March 3, 1973, Washington	Convention on International Trade in Endangered Species of Wild Flora and Fauna, (CITES), Washington	The Convention entered into force for the USSR 08.12.1976. The Convention endeavours to protect wild plants and animals from threat of vanishing, due to international trade.

Date of Signature	Title	Comment, brief description
Climate Conventions		
May 9, 1992, New York	UN Framework Convention on Climate Change	Produced at the Earth Summit. It expresses in general terms the concern of the world community in view of man-made climate changes, including global warming as a result of the greenhouse effect, and lays down general recommendations on cutting down greenhouse gas emissions. The Kyoto Protocol to the Convention (Kyoto, 1997), ratified by the Russian Federation, sets maximum allowable limits on carbon dioxide and other greenhouse gas emissions, establishes emission allowances for member countries, and emissions trading procedures. The Convention has relevance to this project, since some Project facilities may produce greenhouse gas emissions. Paris Agreement under the UN Framework Convention on Climate Change regulates the carbon dioxide emission control measures for the period starting from 2020. The Agreement was prepared to replace the Kyoto Protocol. The Agreement has been adopted by the RF Resolution of 21.09.2019 No. 1228 "On the adoption of the Paris Agreement"
December 11, 1997, Kyoto	Kyoto Protocol	
December 12, 2015, Paris	Paris Agreement	
Air Protection Conventions		
22 March 1985, Vienna/ 16 September 1987, Montreal	Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer	The Convention entered into force for the USSR 22.09.1988. These are of relevance to this project, since during the construction and operation of new facilities, substances that deplete the ozone layer may be emitted
November 13, 1979, Geneva	Convention on Long-range Transboundary Air Pollution, 1979 (with Protocols)	The Convention was ratified by the USSR 29.04.1980. The Convention's primary objective is to protect the man and his environment from air pollution and to seek to limit, gradually reduce, and prevent the contamination of ambient air, including long-range transboundary air pollution. The Convention is applicable to the Project, as construction and operation of the Project facilities will result in pollution emissions.
Waste		
22 March 1989, Basel	Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention).	The Convention entered into force for Russia 01.05.1995. The provisions of the Convention center around the following principal aims: • the reduction of hazardous waste generation and the promotion of environmentally sound management of hazardous wastes; • the restriction of transboundary movements of hazardous wastes; and • a regulatory system applying to cases where transboundary movements are permissible.
Social Aspects / Consultations		
June, 26 1998, Aarhus	Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters	The Convention has not yet been ratified by the Russian Federation; however, this document is listed here as the Russian Federation contemplates its ratification. The Convention is relevant to the project in view of the need to inform the public of how the project bears on the state of the environment.
16 November 1972, Paris	Convention concerning the Protection of the World Cultural and Natural Heritage	The Convention entered into force for the USSR 12.01.1989. Parties have a duty to the identification, protection, and conservation, of cultural and natural heritage covered by the Convention. Natural heritage includes natural features that are of outstanding universal value from the aesthetic or scientific point of view, and areas that constitute the habitat of threatened

Date of Signature	Title	Comment, brief description
		species of animals and plants of outstanding value from the point of view of science or conservation.
October 17, 2003, Paris	International Convention for the Safeguarding of the Intangible Cultural Heritage	Russia is not a party to the Convention yet.
Main conventions in the sphere of occupational health and safety		
1948, San Francisco	ILO Convention 87 - Freedom of Association and Protection of the Right to Organise	These Conventions are fundamental and shall be taken under advisement during the Project implementation, as hired labor of workers and employees will be used who have certain rights in accordance with the said Conventions
1949, Geneva	ILO Convention 98 - Right to Organise and Collective Bargaining	
1930, Geneva	ILO Convention 29 concerning Forced Labor	
1957, Geneva	ILO Convention 105 concerning the Abolition of Forced Labour	
1973, Geneva	ILO Convention 138 concerning Minimum Age for Admission to Employment	
1999, Geneva	ILO Convention 182 - Worst Forms of Child Labour	
1951, Geneva	ILO Convention 100 concerning Equal Remuneration for Men and Women Workers for Work of Equal Value (Equal Remuneration Convention)	
1958, Geneva	ILO Convention 111 concerning Discrimination in Respect of Employment and Occupation (Discrimination (Employment and Occupation) Convention)	
1981, Geneva	ILO Convention 155 - Occupational Safety and Health Convention	The Project will provide for measures to prevent accidents and injury to health arising out of, linked with or occurring in the course of work, by minimising, so far as is reasonably practicable, the causes of hazards inherent in the working environment.
November 20, 1989	UN Convention on the Rights of the Child	The Convention entered into force for the USSR 15.09.1990. Article 32: States Parties recognise the right of the child to be protected from economic exploitation and from performing any work that is likely to be hazardous or to interfere with the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral or social development. In particular, the member states: • establish minimum age(s) of employment; • determine the requirements as to working hours and conditions.

Date of Signature	Title	Comment, brief description
December 18, 1990, New York	International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families	The Convention took effect on July 1, 2003. Russia is not a party to the Convention. The Convention does not introduce any new rights of migrants, but is intended to promote fair treatment and equal working conditions for migrants and citizens of host country. The convention is built around the basic premise that certain minimum rights of all migrants should be protected. The Convention recognises that legal migrants should enjoy broader rights than illegal, however it highlights that basic human rights of illegal migrants should still be respected. At the same time, the Convention suggests that measures should be taken to identify and prevent illegal or secret movements of labour migrants and their family members, including by the following methods: • counteraction to misleading information and abetting people for illegal migration; • application of sanctions against persons, groups or formations engaged with organization, implementation or facilitation of illegal migration, including taking measures against employers of illegal migrants.
Conventions concerning the rights of indigenous peoples		
1989, Geneva	ILO Convention 169 Concerning Indigenous and Tribal Peoples in Independent Countries	The Convention has not been ratified by the Russian Federation. The Convention provides a comprehensive list of minimum standards for indigenous peoples. The Convention obliges the member countries to respect cultural and spiritual values of indigenous peoples attributable to their land and territories. The Convention includes specific articles on non-discrimination of workforce from indigenous peoples, recognition of their culture, and the need for timely and informed participation in events that affect their interests. The Convention is applicable as the Project implementation will affect the areas of customary nature use of indigenous low-numbered peoples of the North.
December 16, 1966	International Covenant on Civil and Political Rights	The Covenant was ratified by the USSR on September 18, 1973. The Covenant confirms political right to self-determination, which entitles all people to independently determine their political stature and free choice of economic, social, and cultural development. The right to self-determination also includes an economic and resource component, which means that interested communities are free to dispose of their natural wealth and resources.
Industrial Safety		
March 17, 1992, Helsinki	Convention on the Transboundary Effects of Industrial Accidents, 1992 (amended in 2008).	The Convention entered into force for Russia on April 19, 2000. This Convention applies to the prevention of, preparedness for, and response to industrial accidents capable of causing transboundary effects, including the effects of such accidents caused by natural disasters, and to international cooperation concerning mutual assistance, research and development, exchange of information and exchange of technology in the area of prevention, preparedness, and response to industrial accidents. For a proposed or existing hazardous activity, the Party of origin shall, for the purposes of ensuring adequate and effective consultations, provide for the notification at appropriate levels of any Party that it considers may be an affected Party as early as possible and no later than when informing its own public about that proposed or existing activity.

Date of Signature	Title	Comment, brief description
"Marine" conventions, shipping		
December 10, 1982, Montego Bay	UN Convention on the Law of the Sea (UNCLOS) (as amended in 1994)	The Convention entered into force for Russia on April 11, 1997. Comprehensive code of laws of the sea and ocean covering the navigation rules, territorial water boundaries, economic jurisdiction, legal status of sea bed resource outside the national jurisdiction, ship journeys through narrow straits, conservation and management of marine bioresources, protection of marine environment, research in sea, and resolution of international disputes.
November 21, 2014	International Code for Ships Operating in Polar Waters (Polar Code)	It is effective from January 1, 2017. The Polar Code took effect with the amendments to MARPOL and SOLAS Conventions made by the resolutions of the International Maritime Organization (IMO) MSC.386(94) and MEPC.265(68). The International Code for Ships Operating in Polar Waters has been developed to supplement existing IMO instruments in order to increase the safety of ships' operation and mitigate the impact on the people and environment in the remote, vulnerable and potentially harsh polar waters. The existing ships shall verify their compliance to provisions of the Code not later than the first intermediate or renewal survey after January 1, 2018. Part II-A is devoted to pollution prevention measures including prevention of pollution with oil, harmful liquids, waste, and garbage from ships (operational requirements, structural requirements). In order to minimize the transfer and introduction of aquatic invasive species through ships' biofouling, the application of measures aimed at minimization of the risk of accelerated degradation of the anti-fouling coating systems associated with operation in polar ice-covered waters, should be considered. In particular, the reference is made to the Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species (Resolution MEPC.207(62)).
June 17, 1983	International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code)	Provisions of the IBC Code are mandatory due to the amendments to MARPOL 73/78 and SOLAS Conventions. The Code provides an international standard for the safe carriage, in bulk by sea, of dangerous chemicals and noxious liquid substances listed in chapter 17 of the Code through prescribing the design and construction standards of ships, regardless of tonnage, involved in such carriage and the equipment they shall carry to minimize the risk to the ship, its crew and the environment, having regard to the nature of the products involved.
May 22, 2014	International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code)	Provisions of the IGC Code are mandatory due to the amendments to MARPOL 73/78 and SOLAS Conventions. The Code provides an international standard for safe carriage, in bulk by sea, of liquefied gases and certain other substances listed in chapter 19 of the Code. The Code prescribes the design and construction standards of ships involved in such transport and the equipment they should carry so as to minimize the risk to the ship, its crew and to the environment, having regard to the nature of the products involved.
1973, with amendments by Protocol of 1978	International Convention for the Prevention of Pollution from Ships (MARPOL 73/78)	Russia joined the Convention in 1983. The main international convention for prevention of marine environment pollution from ships during their normal and emergency operation, including rules for prevention and minimisation of pollution from ships in case of emergency spills, as well as during normal operation, including pollution with oil (Annex I) and pollution with toxic substances (Annex II) (two mandatory annexes).

Date of Signature	Title	Comment, brief description
1972 and Protocol of 1996	Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention)	The Convention was ratified by the USSR on December 15, 1975. The Convention prohibits discharge of certain hazardous materials and requires that permits should be obtained in relation to certain materials, other wastes and substances specified by the Convention. The Protocol establishes stringent limits for discharge, based on precautionary approach, and the "polluter pays" principle.
October 5, 2001, London	International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS 2001)	Russia joined the Convention in 2012. The Convention is designed to prohibit the use of organic compounds in anti-fouling paints used on ships, and to provide mechanisms for prevention of potential future use of other harmful substances in anti-fouling systems.
November 30, 1990, London	International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC 90)	Russia joined the Convention in 2009. The Convention is intended to support international cooperation and mutual assistance for preparedness and response to significant pollution accidents, and to assist the Participants in developing and maintaining the resources and facilities needed to eliminate emergency situations. Its provisions are applicable to ships and offshore installations. The Protocol to the Convention that was signed in 2000 extended its applicability to prevention of and response to harmful chemicals spills.
November 29, 1969, Brussels	Convention relating to the Intervention on the High Seas in Cases of Oil Pollution Casualties	The Convention entered into force for the USSR on May 5, 1975. The Convention establishes the rights of the littoral states to adopt measures in open sea for prevention, mitigation or elimination of threat to its coast or coast-related interests due to oil pollution or threat of pollution as a result of catastrophes in sea.
November 29, 1969, Brussels	International Convention on Civil Liability for Oil Pollution Damage (CLC), 1969, and the Protocol of 1992, as amended	The Convention entered into force for the USSR on May 5, 1975. The Civil Liability Convention was adopted to ensure that adequate compensation is available to persons who suffer oil pollution damage resulting from maritime casualties involving oil-carrying ships. The Convention places the liability for such damage on the owner of the ship from which the polluting oil escaped or was discharged. The 1969 Convention covers pollution damage resulting from spills of persistent oils suffered in the territory (including the territorial sea) of a State Party to the Convention. It is applicable to ships, which actually carry oil in bulk as cargo. The 1992 protocol widened the scope of the Convention to cover pollution damage caused in the exclusive economic zone (EEZ) or equivalent area of a State Party. CLC applies to tankers carrying more than 2,000 tons of oil as cargo.
February 13, 2004, London	International Convention for the Control and Management of Ship's Ballast Water and Sediments (BMW 2004)	Russia joined the Convention in 2012. The Convention is aimed to prevent potentially hazardous consequences of transport of foreign organisms between regions with ship ballast waters. In particular, the Convention requires that Ballast Water Management Plans are developed for ships of the State Parties. The Convention took effect on September 8, 2017.
October 20, 1972, London	Convention on the International Regulations for Preventing Collisions at Sea (COLREG)	The Conventions and its associated international rules which were issued under the same name make up a key element in the legislative framework for international navigation safety regulations. COLREG-72 applies to all vessels upon the high seas and all waters connected to the high sea. The Convention establishes the main steering and sailing rules, such as the right to maintain heading, safe speed, avoidance of collision, procedures for actions in separation zones, in narrow channels, or in limited visibility conditions.

Date of Signature	Title	Comment, brief description
November 1, 1974, London	Convention for the Safety of Life at Sea (SOLAS)	The Convention took effect for the Russian Federation in 1980. The main purpose of this regulation is determination of minimum safety standards to be followed during construction, equipment, and operation of vessels.
May 3, 1996, London	International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea, as amended by the 2010 Protocol (HNS Convention)	Russia joined the HNS Convention by issuing Federal Law No.17-FZ of 02.01.2000, with certain reservations as to its application. The Convention has not yet entered into force. The Convention regulates the issues of liability for damage caused by hazardous or noxious substances in relation to their transportation by sea on board of a ship, and establishes the limits of shipowner's liability. The hazardous and noxious substances in the context of the Convention are any substances, materials and articles carried on board a ship as cargo, in particular: • oil carried in bulk; • noxious liquid substances carried in bulk; • dangerous liquid substances carried in bulk; • dangerous products; • dangerous, hazardous, and harmful substances, materials and articles in packaged form; • liquid substances carried in bulk with a flashpoint not exceeding 60°C (measures by a closed-cup test); • solid bulk materials possessing chemical hazards.
March 23, 2001, London	International Convention on Civil Liability for Bunker Oil Pollution Damage (Bunker Convention)	The Convention entered into force for Russia on May 24, 2009. The Convention introduces mandatory insurance for all ships having a gross tonnage greater than 1,000 that enter waters of the State Parties.
Regional agreements		
November 15, 1973, Oslo	Agreement on the Conservation of Polar Bears	The Agreement between the Governments of the USSR, the USA, Denmark, Canada, and Norway prohibited taking (hunting, killing, and capturing) of polar bears, except when it is carried out for bona fide scientific purposes, to prevent serious disturbance of the management of other living resources, by local people using traditional methods in the exercise of their traditional rights and in accordance with the laws of that Party. Parties of the Agreement further undertook to take appropriate action to protect the ecosystems of which polar bears are a part, with special attention to habitat components such as denning and feeding sites and migration patterns, and shall manage polar bear populations in accordance with sound conservation practices based on the best available scientific data.
June 1991, Rovaniemi	Arctic Environmental Protection Strategy (AEPS) and Declaration on the Protection of the Arctic Environment (Rovaniemi Declaration)	The objectives of the Arctic Environmental Protection Strategy are: to protect the Arctic ecosystem including humans; to provide for the protection, enhancement and restoration of environmental quality and the sustainable utilization of natural resources, including their use by local populations and indigenous peoples in the Arctic; to recognize the traditional and cultural needs, values and practices of the indigenous peoples related to the protection of the Arctic environment; to identify, reduce, and, as a final goal, eliminate pollution of the Arctic.
September 16, 1993, Nuuk	Nuuk Declaration on Environment and Development in the Arctic	The Declaration is devoted to strategic planning of environmental protection activities in the Arctic Region, considering the traditional life style and interests of the indigenous peoples of the Arctic Region. The Arctic Monitoring and Assessment Program (AMAP) was adopted as part of the Declaration.
May 15, 2013, Kiruna	Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic	Agreement of the Arctic Council to enhance cooperation, coordination and mutual assistance between the Parties in the sphere of oil spills prevention and response in Arctic, and protection of the marine environment from pollution with oil.

Date of Signature	Title	Comment, brief description
October 22, 1992	Declaration of Friendship and Cooperation between Canada and the Russian Federation	The Parties agreed, in particular: - to promote the activities of the mixed commissions on economic, agricultural, environmental, and Arctic and northern cooperation.
August 3, 1992	Agreement between the Governments of the Kingdom of Norway and the Russian Federation on Cooperation in Environmental Matters	The spheres of cooperation were identified as follows: - protection of air from pollution, including long-range transboundary air pollution; - protection and conservation of marine environment; - protection of water bodies, including those in neighbour border areas, arrangement of nature conservation areas, protection of environment, rare plants and animals, including species living in both countries and migrating between them, conservation of marine bioresource; - prevention of environmental accidents; - environmental monitoring; - environmental impact assessment; - sharing findings of research studies, project documentation, and other information on methods, standards, and measures in the sphere of treatment of exhaust gas and effluents from industrial and housing facilities, processing of industrial and domestic wastes, and zero-waste technologies; - environmental awareness raising and education; - improvement of regulation and law in the sphere of environmental protection.
December 11, 1994	Agreement between the Government of the United States of America and the Government of the Russian Federation on Cooperation in the Prevention of Pollution of the Environment of the Arctic, 1994.	Parties of the Agreement cooperate in the sphere of pollution prevention, reduction, and control and of combating pollution of the Arctic environment due to accidental or intentional injection of pollutants into the environment. The cooperation is implemented through research activities, monitoring, and assessment of impact on the environment.

APPENDIX 3
LIST OF THE MAIN APPLICABLE LEGISLATION AND REGULATIONS OF THE RUSSIAN FEDERATION

- The Constitution of the Russian Federation of 12.12.1993
- RF Urban Development Code of 29.12.2004 No. 190-FZ
- RF Land Code of 25.10.2001 No. 136-FZ
- RF Water Code of 03.06.2006 No. 74 FZ
- RF Forest Code of 04.12.2006 No. 200-FZ
- RF Labour Code of 31.12.2001 No. 197-FZ
- Federal Law On Environmental Protection of 10.01.2002 No. 7-FZ
- Federal Law On Air Protection of 04.05.1999 No. 96-FZ
- Federal Law of 23.11.1995. No.174-FZ "On the Environmental Review"
- Federal Law of 21.02.1992. No. 2395-1 "On subsoil resources"
- Federal Law of 24.06.1998 No. 89-FZ "On production and consumption waste"
- Federal Law On Animals of 24.04.1995 No. 52-FZ
- Federal Law of 20.12.2004 No.166-FZ "On fishery and conservation of aquatic biological resources"
- Federal Law of 14.03.1995 No. 33-FZ "On Specially Protected Natural Areas"
- Federal Law of 30.03.1999 No. 52-FZ "On the sanitary and epidemiological welfare of the population"
- Federal Law of 21.11.2011 No.323-FZ "On basic provisions for protection of health of the citizens of the Russian Federation"
- Federal Law of 09.01.1996 No. 3-FZ "On radiation safety"
- Federal Law of 07.12.2011 No. 416-FZ "On water supply and wastewater discharge"
- Federal Law of 31.07.1998 No. 155-FZ "On internal marine waters, territorial sea, and contiguous zone of the Russian Federation"
- Federal Law of 30.11.1995 No. 187-FZ "On the continental shelf of the Russian Federation"
- Inland Water Transport Code of the Russian Federation of 07.03.2001 No. 24-FZ
- Federal Law of 17.12.1998 No. 191-FZ "On the exclusive economic zone of the Russian Federation"
- Federal Law of 25.06.2002 No. 73-FZ "On cultural heritage (Historical and Cultural Sites) of the Peoples of the Russian Federation"
- Federal Law of 21.12.2004 No. 172-FZ "On reclassification of lands and land plots"
- Federal Law of 27.12.2002 No.184-FZ "On Technical Regulations"
- Federal Law of 04.05.2011 No. 99-FZ "On licensing of certain activities"
- Federal Law of 21.12.1994 No. 68-FZ "On the protection of the public and territories against emergencies of natural and technogenic origin"
- Federal Law of 21.07.1997 No. 116-FZ "On industrial safety of hazardous industrial facilities"
- Federal Law On Hydraulic Structures' Safety of 21.07.1997 No. 117-FZ
- Federal Law On Technical Regulations on Safety of Buildings and Structures of 30.12.2009 No. 384-FZ
- Federal Law On Fire Safety of 21.12.1994 No. 69-FZ
- Federal Law of 27.07.2010 No. 225-FZ "On mandatory insurance of civil liability of hazardous facility owners for damage caused as a result of an emergency at hazardous production facility"
- Federal Law On Guaranteed Rights of Indigenous Low-Numbered Peoples of the Russian Federation of 30.04.1999 No. 82-FZ
- Federal Law of 07.05.2001 No. 49-FZ "On areas of traditional natural resource use of Indigenous Low-Numbered Peoples of the North, Siberia, and Far East of the Russian Federation"

- Federal Law of 23.11.2009 No. 261-FZ "On energy savings and improvement of energy efficiency and on amendments to certain laws and regulations of the Russian Federation"
- Federal Law of 24.07.2009 No. 209-FZ "On hunting and conservation of hunting resources and on amendments to certain laws and regulations of the Russian Federation"
- RF Government Resolution of 28.09.2015 No. 1029 "On approval of criteria for classification of facilities causing adverse environmental impacts as operations of category I, II, III, and IV"
- RF Government Resolution of 23.06.2016 No. 572 "On approval of the rules for establishing and keeping the State Register of facilities causing adverse environmental impacts"
- RF Government Resolution of 28.08.2015 No. 903 "On approval of criteria for determination of facilities subject to Federal Environmental Supervision"
- RF Government Resolution No. 426 of 08.05.2014 "On the Federal Environmental Supervision"
- RF Government Resolution of 16.02.2008 No. 87 "On the structure of the project design documentation and requirements to its contents"
- RF Government Resolution of 05.03.2007 No. 145 "On the procedure for organization and conduction of the State Expert Review of project design documentation and engineering surveys' findings"
- RF Government Resolution of 07.05.2003 No. 262 "On adoption of rules for compensation to owners of land plots, land users and tenants of land plots for damage caused by withdrawal or temporary occupation of land plots, limitation of land owners' rights or by worsening land quality as a result of other persons' activities"
- RF Government Resolution On Land Remediation and Conservation of 10.07.2018 No. 800 (together with "Rules for Land Reclamation and Conservation")
- RF Government Resolution of 05.02.2016 No. 79-FZ "On approval of Rules for protection of surface water bodies"
- RF Government Resolution of 11.02.2016 No. 94-FZ "On approval of Rules for protection of Underground Water Bodies"
- RF Government Resolution of 30.12.2006 No. 844 "On the procedure for drafting and making a decision on allocation of a water body for use"
- RF Government Resolution of 12.03.2008 No. 165. "On water use agreement preparation and conclusion"
- RF Government Resolution of 23.07.2007 No. 469 "On the procedure for adoption of standards for permissible discharges of substances and microorganisms into water bodies for users of the water bodies"
- RF Government Resolution of 06.10.2008 No. 743 "On approval of Rules for allocation of fish protection zones"
- RF Government Resolution of 29.04.2013 No. 380 "On approval of Regulation on measures aimed at conservation of aquatic biological resources and their habitats"
- RF Government Resolution of 10.01.2009 No.17 "On approval of Rules for demarcation of boundaries of water protection zones and near-shore protective belts"
- RF Government Resolution of 30.04.2013 No. 384 "On approval of construction and renovation of capital facilities, implementation of new technological processes, and conduction of other activities affecting aquatic biological resources and their habitats by the Federal Agency for Fishery"
- RF Government Resolution of 02.03.2000 No. 183 "On maximum permissible (pollution) emissions into and adverse physical impacts on the atmospheric air"
- RF Government Resolution of 03.03.2018 No. 222 "On approval of rules on allocation of sanitary protection zones and use of land plots within the boundaries of sanitary protection zones"
- RF Government Resolution of 19.02.1996 No. 158 "On the Red Data Book of the Russian Federation"

- RF Government Resolution of 13.08.1996 No. 997 "On approval of Requirements for the prevention of animal loss as a result of implementation of industrial processes, as well as operation of transport links, pipelines, communication and power lines"
- RF Government Resolution of 13.02.2019 No. 143 "On the procedure for issuing, re-issuing, review, introduction of changes, and revocation of integrated environmental permits"
- RF Government Resolution of 13.03.2019 No. 262 "On approval of Rules for development and operation of automated systems of monitoring of pollutant emissions and/or discharges"
- RF Government Resolution of 13.03.2019 No. 263 "On requirements for automatic equipment for measurement and registration of pollutant emission and/or discharge indicators, requirements for equipment for registration and transfer of data on pollutant emission and/or discharge indicators to the State Register of facilities causing an adverse environmental impact"
- RF Government Resolution of 30.12.2003 No. 1081 "On approval of Rules for mothballing and liquidation of hydraulic structures"
- RF Government Resolution of 14.02.2000 No. 128 "On approval of the Regulation on disclosure of information on environmental status, pollution and technogenic emergencies, that caused, are causing or may cause an adverse environmental impact"
- RF Government Resolution of 24.03.1997 No. 334 "On the Procedure for collection and exchange of information on protection of the public and territories against natural and technogenic emergencies in the Russian Federation"
- RF Government Resolution of 30.12.2003 No. 794 "On unified state system of prevention and elimination of emergency situations"
- RF Government Resolution of 01.03.1993 No. 178 "On establishment of local warning systems in the areas, where potentially hazardous facilities are located"
- RF Government Resolution of 10.11.1996 No. 1340 "On the procedure for establishment and use of material reserves for response to natural and technogenic emergencies"
- RF Government Resolution of 21.05.2007 No. 304 "On classification of natural and technogenic emergencies"
- RF Government Resolution of 26.08.2013 No. 730 "On approval of the Regulation on development of action plans for containment and liquidation of the consequences of emergencies at hazardous production facilities"
- RF Government Resolution of 10.06.2013 No. 492 "On licensing the operation of explosion, fire, and chemically hazardous industrial facilities of hazard class I, II, and III" (combined with "Regulation on licensing the operation of explosion, fire, and chemically hazardous industrial facilities of hazard class I, II, and III")
- RF Government Resolution of 24.11.1998 No. 1371 "On registration of facilities in the State Register of hazardous industrial facilities"
- RF Government Resolution of 10.03.1999 No. 263 "On organization and performance of industrial monitoring of compliance with the industrial safety requirements at the hazardous industrial facility"
- RF Government Resolution of 11.05.1999 No. 526 "On approval of Rules for submission of the declaration of industrial safety for hazardous industrial facilities"
- RF Government Resolution of 26.06.2013 No. 536 "On approval of requirements for documentation support of industrial safety management systems"
- RF Government Resolution of 21.08.2000 No.613 "On emergency oil spill response measures in the Russian Federation"
- RF Government Resolution of 15.04.2002 No.240 "On the Procedure for organization of oil spills prevention and response measures in the Russian Federation"
- RF Government Resolution of 25.02.2000 No. 162 "On approval of the list of types of heavy-labour jobs and jobs with harmful or dangerous conditions, in which the use of female labour is prohibited"

- RF Government Resolution of 24.03.2000 No.251 "On approval of the list of noxious substances prohibited for discharge from ships and other vessels, aircraft, artificial islands, installations and structures within the exclusive economic zone of the Russian Federation"
- RF Government Resolution of 03.10.2000 No. 748 "On approval of maximum permissible concentration levels and conditions for discharge of noxious substances within the exclusive economic zone of the Russian Federation"
- RF Government Decree of 08.05.2009. No. 631-r "On approval of the list of ares of traditional residence and traditional economic activities of the indigenous low-numbered peoples of the Russian Federation and the list of their customary economic activities"
- RF Government Decree of 13.03.2019 No. 428-p "On approval of types of technical devices, equipment or combination of thereof (installations-units) for category I facilities, where stationary sources of pollution emissions/discharges are to be equipped with automatic equipment for measurement and registration of pollutant emission and/or discharge indicators and equipment for registration and transfer of data on pollutant emission and/or discharge indicators to the State Register of facilities causing an adverse environmental impact"
- RF Government Decree of 08.01.2015 No.1316-r "On approval of the list of pollutants subject to state environmental regulation"
- Decree of the President of the Russian Federation of 17.12.2009 No. 861-rp "On the Climate doctrine of the Russian Federation"
- RF Government Decree of 02.04.2014 No. 504-r "On approval of the action plan aimed at reduction of GHG emissions down to a maximum level of 75% of GHG emissions in 1990 by 2020"
- Executive Order of the President of the Russian Federation of 30.09.2013 No. 752 "On reduction of greenhouse gas emissions"
- RF Government Decree of 22.04.2015 No. 716-r "On the approval of the Concept for development of the system of monitoring, reporting, and verification of GHG emission volumes in the Russian Federation"
- Order of the RF State Committee for Environmental Protection (Goscomecologia) of 16.05.2000 No. 372 "On the Regulation on environmental impact assessment of planned economic and other activities in the Russian Federation"
- Rostechnadzor Order of 06.11.2013 No. 520 "On approval of the Federal norms and regulations in the field of industrial safety "Safety rules for hazardous industrial facilities of trunk pipelines""
- Rostechnadzor Order of 11.04.2016 No. 144 "On approval of the Safety Guidelines "Methodological baseline for hazard analysis and emergency risk assessment at hazardous industrial facilities"
- Rostechnadzor Order of 29.11.2005 No. 893 "On approval of the "Procedure for the execution of the declaration on industrial safety of hazardous industrial facilities" and the list of data to be included in the above" (RD-03-14-2005)
- Rostechnadzor Order of 25.03.2014 No. 116 "On approval of the Federal norms and regulations in the field of industrial safety "Industrial Safety Rules for Hazardous Industrial Facilities Using Overpressure Equipment"
- Rostechnadzor Order of 19.08.2011 No. 480 "On approval of the procedure of technical investigation of causes of accidents, incidents, and cases of loss of industrial explosives at facilities supervised by the Federal Service for Environmental, Technological, and Nuclear Supervision"
- Rostechnadzor Order of 15.07.2013 No.306 "On approval of the Federal norms and regulations on industrial safety "General requirements for justification of hazardous industrial facility safety"
- Rostechnadzor Order of 29.01.2007 No. 37 "On the Procedure for training and qualification assessment of employees of organisations supervised by the Federal Service for Ecological, Technological, and Nuclear Supervision"
- Rostekhnadzor Order of 12.03.2013 No.101 "On approval of the Federal norms and regulations in the field of industrial safety "Safety rules in oil and gas industry"

- RF Ministry of Natural Resource Order of 30.06.2015 No.300 "On approval of "Guidelines and instructions on quantitative assessment of GHG emissions from entities conducting business operations and other activities in the Russian Federation"
- RF Ministry of Natural Resource Order of 29.06.2017 No.330 "On approval of "Guidelines and instructions on quantitative assessment of indirect GHG emissions"
- RF Ministry of Natural Resource Order of 25.02.2010 No. 50 "On the Procedure for development and adoption of standards for waste generation and limits of their disposal"
- RF Ministry of Natural Resources Order of 21.05.2019 No.319 "On approval of environmental regulation document "Process parameters of the best available technologies for natural and accompanying gas processing"
- RF Ministry of Natural Resources Order of 17.07.2019 No.471 "On approval of environmental regulation document "Process parameters of the best available technologies for natural gas recovery"
- RF Ministry of Natural Resources Order of 24.04.2019 No.270 "On approval of environmental regulation document "Process parameters of the best available technologies for thermal disposal of waste (waste incineration)"
- RF Ministry of Natural Resources Order of 17.12.2007 No. 333 "On approval of methodology for development of standards for permissible discharges of substances and microorganisms into water bodies for users of the water bodies "
- RF Ministry of Natural Resources Order of 28.02.2018 No. 74 "On approval of requirements for the content of the Operational Operational Environmental Control, the procedure and schedules for submitting a report on organization and on results of Operational Environmental Control"
- RF Ministry of Natural Resources Order of 06.06.2017 No. 273 " On approval of methods for calculation of air pollutant dispersion"
- RF Ministry of Natural Resources Order of 03.03.2003 No. 156 "On approval of Guidelines on determination of lower threshold level of oil spills for attribution of accidental spill to emergency situation"
- RF Ministry of Natural Resources Resolution of 22.09.2015 No. 25-r "On approval of the list of flora and fauna species serving as indicators of stability of marine ecosystems in the Arctic zone of the Russian Federation"
- Rosprirodnadzor Order of 22.05.2017 No. 242 "On approval of the Federal Waste Classification Catalogue"
- RF Ministry of Agriculture Order of 13.12.2016 No. 552 "On approval of water quality standards for fishery water bodies including standards for maximum permissible concentrations of harmful substances in fishery water bodies"
- RF Ministry of Agriculture Order of 22.10.2014 No. 402 "On approval of Fisheries Regulation for the West-Siberian fishing basin"
- RF Fisheries Agency Order of 04.08.2009 No. 695 "On approval of the Methodological guidelines for development of water quality standards for fishery water bodies, including standards for maximum permissible concentrations of harmful substances in fishery water bodies"
- RF Ministry of Health and Social Development Order of 16.02.2009 No. 45n "On approval of norms and conditions for provision of working in harmful conditions employees with milk and other equivalent food products at no cost; of the Procedure for compensation payment equivalent to the cost of milk and equivalent food products; of the List of harmful occupational factors under exposure to which it is recommended to consume milk and other equivalent food products, as a preventive measure against adverse effects"
- Order of the Ministry of Health and Social Development of 12.04.2011 No. 302n "On approval of lists of harmful and/ or hazardous occupational factors and works, which require initial and regular medical examinations, and the Procedure of compulsory initial and regular medical examinations for personnel employed for heavy work and those working in harmful and/or hazardous conditions"
- RF Gosgortechnadzor Resolution of 06.06.2003 No. 71 "On approval of Rules for protection of subsoil resources"

- RF EMERCOM Order of 28.12.2004 No. 621 "On approval of Rules for development and approval of oil spill prevention and response plans in the Russian Federation"
- RF Ministry of Transport Order of 10.09.2013 No.285 "On determination of measures to ensure navigation safety within the designated safety zones of artificial islands, structures and installations in the continental shelf of the Russian Federation"
- RF Ministry of Transport Order of 26.10.2017 No.463 "On approval of General rules for navigation and mooring of vessels in the seaports of the Russian Federation and approaches to them"
- RF Ministry of Transport Order of 24 December 2002 No.158 "On approval of fire safety regulations for the inland water transport vessels of the Russian Federation"
- SP 47.13330.2012 Engineering survey for construction. Main provisions. Updated version of SNiP 11-02-96 (approved by the Minstroy RF Order of 30 December 2016 No. 1033)
- SP 115.13330 "SNiP 22-01-95 Hazardous Natural Impact Geophysics" (approved by the Minstroy RF Order of 16.12.2016 No. 956)
- SP 116.13330.2012 Engineering protection of territories, buildings and structures from dangerous geological processes. Main provisions. Updated version of SNiP 22-02-2003
- SP 11-102-97 Engineering survey code for construction. Environmental engineering surveys for construction projects, 1997
- SP 51.13330.2011 Noise protection. Updated version of SNiP 23-03-2003
- SP 131.13330.2012 Building climatology. Updated version of SNiP 23-01-99
- SP 116.13330.2012 Engineering protection of territories, buildings and structures from dangerous geological processes. Main provisions. Updated version of SNiP 22-02-2003
- SanPiN 2.1.7.1038-01 Hygienic Standards for construction and operation of solid domestic waste landfills.
- SP 2.1.7.1038-01. 2.1.7. Soil, cleaning of residential areas, production and consumption waste, health safety of soil. Hygienic Standards for construction and operation of solid domestic waste landfills. Sanitary regulations (approved by the RF Chief State Sanitary Inspector Resolution of 30.05.2001 No. 16)
- SP 58.13330.2012 Hydraulic Structures. Main provisions. Updated version of SNiP 33-01-2003
- SanPiN 2.1.7.1322-03 Hygienic standards for disposal and treatment of production and consumption waste.
- SanPiN 2.2.4.3359-16 Health (sanitary and epidemiological) requirements for physical factors at workplaces (approved by the RF Chief State Sanitary Inspector Resolution of 21.06.2016 No. 81)
- SanPiN 2.2.1/2.1.1.1200-03 Sanitary protection zones and sanitary classification of enterprises, structures, and other facilities (approved by the RF Chief State Sanitary Inspector Resolution of 25.09.2007 No. 74)
- SanPiN 2.1.5.980-00. 2.1.5. Wastewater disposal from residential areas, sanitary protection of water bodies. Hygienic requirements for surface water protection. Sanitary rules and regulations
- SanPiN 2.1.4.1074-01 Drinking water. Hygienic requirements to water quality in central drinking water supply systems. Quality control
- SanPiN 2.1.4.1110-02. 2.1.4. Drinking water and residential areas water supply. Sanitary protection zones of water supply sources and potable water pipelines. Sanitary rules and regulations
- SanPiN 2.6.1.2523-09 Radiation safety standards (NRB-99/2009).
- SanPiN 2.1.8/2.2.4.1383-03. 2.1.8. Environmental physical factors. 2.2.4. Physical factors of the production environment. Hygiene requirements for the siting and operation of radio transmission facilities. Sanitary and epidemiological rules and standards
- SanPiN 2.1.2.2645-10 Sanitary and epidemiological requirements for living conditions in residential buildings and premises

- SanPiN 2.5.2-703-98. 2.5.2. Water transport. Inland and mixed (river-sea) navigation vessels. Sanitary rules and regulations (approved by the RF Chief State Sanitary Inspector Resolution of 30.04.1998 No. 16)
- SanPiN 2.1.5.2582-10 Sanitary and epidemiological requirements to protection of sea coastal waters from pollution in population water use places
- Rules for the prevention of pollution from ships intended for operation in sea areas and inland waterways of the Russian Federation ND 2-020101-100
- GN 2.1.6.3492-17. Maximum permissible concentrations (MPC) of polluting substances in the atmospheric air of urban and rural settlements (approved by the RF Chief State Sanitary Inspector Resolution of 22.12.2017 No. 165)
- GN 2.1.6.2309-07. 2.1.6. Atmospheric air and indoor air, sanitary protection of the air. Tentative safe exposure levels (TSELs) of pollutants in the air of residential areas. Health (hygienic) standards
- GN 2.2.5.3532-18. Maximum permissible concentrations (MPC) of harmful substances in the air of the working area (approved by the RF Chief State Sanitary Inspector Resolution of 13.02.2018 No. 25)
- GN 2.1.7.2041-06. 2.1.7. Soil, cleaning of residential areas, production and consumption waste, health safety of soil. Maximum permissible concentrations (MPC) of chemical substances in soils. Health (hygienic) standards
- GOST 12.1.005-88 Occupational safety standards system. General sanitary requirements for working zone air (with amendment No. 1)
- GOST 12.1.001-89 Occupational safety standards system. Ultrasound. General safety requirements
- GOST R 50831-95 Boiler plant. Heat-mechanical equipment. General technical requirements
- RD 52.04.52-85 Methodological Guidelines. Emission regulation during adverse meteorological conditions
- RD 07-291-99 Instruction on the procedure of liquidation and mothballing of hazardous industrial facilities associated with the use of subsoil resources (approved by the RF Gosgortechnadzor Resolution of 02.06.1999 No. 33)
- Guidelines for the application of the provisions of the Technical Code for the control of nitrogen oxide emissions from marine diesel engines ND 2-030101-025
- Guidelines for the implementation of the provisions of the International Safety Management Code (ISM Code) ND 2-080101-013
- Guidelines for the inspection of ships in accordance with the requirements of the ILO Conventions No. 92 and No. 133 ND 2-080101-017
- Guidelines for the application of the provisions of the MARPOL International Convention 73/78 (2016 edition) ND 2 030101-026
- Rules for the prevention of pollution from ships intended for operation in sea areas and inland waterways of the Russian Federation ND 2-020101-100
- Instructions for the development of shipboard guidelines for safe ballast replacement at sea ND 2-029901-003
- RD 31.81.17-77 Safety Regulations for works on service and auxiliary fleet vessels
- RD 31.04.23-94 Instruction on prevention of pollution from ships
- SN 2.2.4/2.1.8.583-96. 2.2.4. Physical factors of the production environment. 2.1.8. Environmental physical factors. Infrasound at workplaces, in residential and public buildings, and in residential areas. Sanitary regulations
- SN 2.2.4/2.1.8.566-96. 2.2.4. Physical factors of the production environment. 2.1.8. Environmental physical factors. Industrial vibration. Vibration in premises of residential and public buildings. Sanitary regulations

- SN 2.2.4/2.1.8.562-96. 2.2.4. Physical factors of the production environment. 2.1.8. Environmental physical factors. Noise at workplaces, in the premises of residential and public buildings, and outdoor noise in residential areas. Sanitary regulations
- ITS 29-2017 Natural gas production
- ITS 50-2017 Processing of natural and accompanying gas
- ITS 38-2017 Fuel combustion on large plants for production of energy
- ITS 8-2015 Wastewater treatment in the production of products (goods), performance of works and provision of services at large enterprises
- ITS 15-2016 Recycling and disposal of waste (except for thermal disposal of waste (waste incineration))
- ITS 9-2015 Thermal waste treatment (waste incineration)
- ITS 17-2016 Disposal of production and consumption waste
- ITS 22-2016 Purification of atmospheric discharge (pollutants) in manufacturing of products (goods), as well as performing works and providing services at large enterprises
- ITS 22.1-2016 General principles of industrial environmental monitoring and its metrological support
- ITS 46-2019 Reduction of pollution emissions and discharges from storage of products (goods)
- ITS 48-2017 Increasing energy efficiency of economic and/or other activities
- VSN 014-89 (Minneftegazstroy) Construction of trunk and infield pipelines. Environmental Protection
- Standards on permissible impact on water bodies in the Taz river basin within the water management areas (approved by the Federal Water Resources Agency on 08.18.2014)

ANNEX 2

ARCTIC LNG 2 LLC POLICY ON HEALTH, SAFETY, ENVIRONMENT AND SOCIAL RESPONSIBILITY

[PDF]

ANNEX 3

LIST OF IDENTIFIED SACRED SITES OF THE INDIGENOUS SMALL-NUMBERED PEOPLE OF THE NORTH IN AND AROUND THE SALMANOVSKIY (UTRENNIY) LICENSE AREA

No.[77]	Name	Coordinates WGS-84		Description
		Latitude, deg. n	Longitude, hail vd	
According to the Purgeocom survey (Tyumen, 2015)				
1.	Vasily Khebidya-ya ('Vasiliy's Sacred Place')	71.341204	73.610763	Located outside (to the north of) the field. A small hill revered as a sacred place, found by the local reindeer herder Vasily Salinder, who saw "something strange" nearby. According to reports, the site has a small rawhide tent with a metal rod frame and sacrificial deer antlers.
2.	Khebidya-ya ('Sacred Place')	71.245638	73.543412	A sacred place on a hill in the headwaters of the river Nado-Yakha, 8 km north of the mouth of the river Syabutayakhi 3.
3. (97)	Nganorakha ("Boat-like")	71.248118	74.118802	An elongated hill resembling a capsized boat from the east side. The sacred place has a pile of sacrificial deer antlers. The site is located in the pasture lands owned by the Salinder family. The headwaters of the rivers Levaya Yarayakha and Ngarka Khortiyakh adjoin the site.
4.	Lylyk Soty ('Goose Cry Hill)	71.241895	74.38688	A place of worship on a high hill near the river Lalyk-Yakha (tributary of the middle Yaro-Yakha). The name of the hill is connected with the legend about how people cruelly treated a goose at this place in the distant past. On the site, sacrificial rites are performed by members of Nenets tribes, including the Yadneh clan. There are sacred sled and piles of antlers of sacrificial deer.
5. (95)	Nyada Soty ('Reindeer Moss Hill)	71.195333	73.960405	Located on an elevated piece of land, adjacent to the headwaters of several rivers – the Ngarka-Khortiyakh, Middle Yarayakh and Haltsanayakh. One of the most revered sacred sites in the northern part of the Yavasala tundra. It is located on the path traveled by many groups of reindeer herders. On the site, sacrificial rites are performed by members of Nenets tribes, including the Yadneh clan. There are several sacred sleds and piles of antlers of sacrificial deer.
6.	Tadibe-ya Seda ('Shaman Land Hill')	71.153638	73.766757	Located on the hill at the source of the river Syabutoyakha 2, 300 m south-west of the prominent Shapka-Seda hill (a famous landmark). An ancient sacred place. Clan affiliation unknown; No sacrificial rites have been performed probably since the late 1980s. On the site, antlers of sacrificial deer are piled.
7.	Nya'n Pai Khebidya-ya ('Crooked Mouth Sacred Place')	71.074696	75.416339	Located at the source of the river Esyayah, near Lake Peresotypo. It is located outside the boundaries of the field (to the east). According to reports, some person's mouth was twisted near this hill, which was taken as a sign of the presence of the host spirit.
8.	Varku 'Ngeva Khebidya-ya ('Brown Bear Head Sacred Place')	70.97889	74.1229498	Located in the headwaters of the river Nyanyakha 2, near a small river called Varkungayvayah by the Nenets. On the site, sacrificial rites are performed by members of several clans, including Vanuito and Yadne. The site has 3-4 skulls of brown bears, wooden anthropomorphic figurines, antlers of sacrificial deer.
9. (158)	Tatngamla ('Tranquil' or 'Standstill')	70.967637	74.076529	Located on a small elevation in the upper reaches of the river Parailak-yakha surrounded by cliffs. A legend is connected with the sacred place, according to which in the old days a group of Nenets-heroes stayed here to rest after the victory over the Manta (Enets). The site has piles of horns of sacrificial deer, old shamanic attributes. Clan affiliation is unknown, sacrificial rites were last performed a long time ago.
10.	Neu-to Khebidya-ya ('Head Lake Sacred Place')	70.951611	75.103725	A hill near the northwestern shore of a large lake at the confluence of the Neyvoyakha and the Neytayaha. The place is associated with the Yando clan, who regularly make sacrificial offerings there. The site has piled horns on it.
11.	Oleg Khebidya-ya ('Oleg's Sacred Place')	70.927451	74.107611	A small hill in the upper reaches of the river Parailakyakha, near one of its left tributaries. A small lake and an old oil well are located nearby. An individually revered sacred place, it was marked as such about 20

[77] The number assigned to the sacred site according to the survey is specified for the Purgeokom data. If the sacred place is also marked on the map "Tazovskiy District Sacred Sites. Scale 1: 400 000. Salekhard: Department of Information Technology and Communications of the Yamal-Nenets Autonomous Okrug", the number denoting the site on the map is shown in parenthesis.

For the Department of Information Technology and Communications of the YNAO data, the number of the sacred place by which it is denoted on the map "Sacred Sites in the Tazovskiy District. Scale 1:400 000" is specified.

No.[77]	Name	Coordinates WGS-84		Description
		Latitude, deg. n	Longitude, hail vd	
				years ago by a local reindeer breeder from the Salinder clan, who saw "something strange" there. The site has a small rawhide tent with an iron rod frame, and several pairs of deer horns.
12.	Syara Mantu ('Syara Enets') or Syara Seda ('Syara hill')	70.907789	74.344732	Located on a prominent hill between two tributaries of the Yaromichuyakh River - Nyanyaha 1 and Nyanyaha 2. A place of worship associated with the legendary events of the past. According to legend, in the distant past, on this hill, the ancestors of the local Nenets killed one of the strongest warriors of the Enets people. The warrior (or just his head) was subsequently buried along with his fighting bow. The remains of the burial sled, positioned with their runners up according to the funeral tradition, are visible on the site.
13.	Tavys-ngo Khebidya-ya ('Nganasan Islet Sacred Place')	70.888668	74.653435	A small hill located in a lowland, 5 km north-west of the place where the Yaromichuyakha flows into the Sappadayakha. Clan affiliation is unknown. Perhaps the site was revered as a memorable place of legendary fighting with the Nganasans. There are antlers and, according to some, a boulder.
14. (98)	Pare-lakha ('Drill-like')	70.743709	74.478037	A hill near the headwaters of the river Lutiganyakha. The name was given because of the unique, drill-like, shape of the channel of the nearby river. One of the most revered sacred sites of the central part of the Yavaisalinsk tundra. According to the Nenets lore, the site was previously used for rites of divination about the future welfare of reindeer herders. Currently, sacrificial rites are rare. The site has sacred sleds, an old rawhide tent with a metal frame about 40-50 cm high, a huge pile of sacrificial deer antlers.
According to the map "Tazovskiy District Sacred Sites. Scale 1: 400 000. Salekhard: Department of Information Technology and Communications of the Yamal-Nenets Autonomous Okrug"				
25.	Ngev' to	70.821473	75.145663	-
26.	Habt' seda	70.937881	75.541640	-
28.	Paravy to	70.984262	75.871397	-
96.	Vasilei' khekho' ya	71.153327	74.035140	-
99.	Sambna (Sambdama)	71.452915	73.596459	-
102.	Khor' soty	71.392947	74.854811	-
103.	Syadei	71.334372	73.552063	-
104.	Lyrui	71.301043	73.718504	-
107.	Nyahar'' yakha' khebidya-ya	71.453992	75.349289	-
121.	Yava (Yavo') seda	70.719195	75.049279	-
126.	Murlyk	70.687430	75.131776	-
131.	Ngev" to' Khebidya-ya	70.855145	75.401411	-
132.	Nyarme" (Nyarme''e)	70.776718	74.827613	-
136.	Lake Yaroto - Yar Clan Lake	70.688652	76.004761	-
140.	Lake Khar'to - Lake of the Knife	70.854271	75.192811	-
142.	Ser'' ngo' Khebidya-ya	71.518488	73.284517	-
145.	Sylava	70.694286	75.784819	-
146.	Nyudya sylava	70.784297	75.832870	-
156.	Yumbure'' (Yumbure''e)	71.429634	73.182371	-
157.	Huryokho' seda	70.848300	73.923789	-
165.	Sacred place of Yando Nikolay Khasavovich	70.760141	75.421368	-
195.	Khalete (Khalete''e)	71.091341	75.987013	-
199.	Id 'Erv' hehe'' ya	70.834014	74.099175	-

No.[77]	Name	Coordinates WGS-84		Description
		Latitude, deg. n	Longitude, hail vd	
230.	Sacred place of Yando Nept Padurivich	70.696598	74.791187	-

ANNEX 4

LIST OF WASTE MANAGEMENT SERVICE PROVIDERS THAT CAN BE INVOLVED AS SUBCONTRACTORS AT THE ARCTIC LNG 2 PROJECT CONSTRUCTION AND OPERATION STAGES

No.	Name of the legal entity – the holder of the waste management license	Places of licensed activities
1	Limited Liability Company "TyumenVtorSyrye"	Tyumen city
2	LLC "Innovatsionnyye Technologii"	Yamalo-Nenets AO, Salekhard city
3	LLC "KTA.LES"	Arkhangelsk region, Severodvinsk city
4	LLC PKF "TECH-Service"	1) Arkhangelsk region, Novodvinsk city 2) Arkhangelsk region, Velsky district, Zelyony Bor sttl.
5	LLC Research and Production Enterprise "Soyuzgaztechnologiya"	1) Tyumen city; 2) Purovsky district of YNAO (Industrial base KTP-8); 3) South-Tambey gas condensate field waste landfill
6	LLC "NOV-Ecologiya"	Tyumen city
7	LLC "NEK"	Yaroslavl city
8	JSC "Polygon"	Tomsk city
9	LLC "TEO"	1) Tyumen city (Vylegzhaninsky waste landfill); 2) Tobolsk city, ZKSM, waste landfill
10	OJSC "Mortechservice"	Arkhangelsk city
11	LLC "ORKO-Invest"	Murmansk city
12	LLC "Stroykomplekt"	YNAO, Noyabrsk city, Peley industrial hub
13	LLC "Yamalvtormet"	YNAO, Novy Urengoy city
14	CJSC "Polygon-LTD"	Khanty-Mansi AO, Surgut district
15	JSC "Ecotechnologiya"	YNAO, Novy Urengoy city
16	OJSC "Yamalskaya Metallurgicheskaya Company"	YNAO, Novy Urengoy city
17	MUP "Urengoyskoye municipalnoe khozyaystvo" – solid waste landfill	YNAO, Novy Urengoy city
18	LLC NPP "AREAL"	Republic of Bashkortostan, Ufa city
19	LLC "Omega-Eco"	Yekaterinburg city
20	LLC "Utilitservice"	Khanty-Mansi AO, Surgut district, Bely Yar township
21	LLC "Vtorresurs"	YNAO, Noyabrsk city, Noyabrskaya station industrial hub
22	MUP "Spetsavtokhozyaystvo po uborke goroda"	Tyumen city
23	LLC "Arkhangelsk Waste Processing Plant"	Arkhangelsk city
24	LLC "Syndicate Polymer"	Tyumen city
25	LLC "Promyshlennaya Company"	YNAO, Nadym city

ANNEX 5
CUMULATIVE ASSESSMENT SCOPING PHASE I AND PHASE II

VEC		Type of impact	Specific sensitivity / susceptibility	Residual impact of the Arctic LNG 2 Project	Location of VEC	Temporal characteristics of impact	Potential impact of non-industrial influences / trends	Potential impact of other development projects	Discussion	Included in CIA
General	Specific									
Air	People (ISPN / local communities)	Human health	Potentially, slightly increased sensitivity of indigenous people to air quality	Negligible	Along migration routes	Mainly at the operation phase		Further three LNG process trains (potentially under the Arctic LNG 1 project) Construction and operation of the Utrenniy Terminal for the Arctic LNG 1 project	Cumulative impact is expected in connection with the Arctic LNG 1 project. Included in CIA.	Yes
	People (workforce)	Human health	There is a potential for increased sensitivity to cold environment	Low	Project area					
	Reindeer pastures	Pollution emissions and precipitation of nitrogen - impact on lichens	Lichens are sensitive to the impact and slow to regenerate	Negligible	Whole area of the peninsula		Pastures in certain areas of the peninsula are overexploited			
	Climate Change	Greenhouse gases		Not applicable			Climate Change		Assessment in a broader context is provided in Section 9.9	No
Geological environment / Soil	Soil, ground, permafrost	Mechanical and thermal impacts, development of DEGP&HP	Permanent disturbance is possible	From low to high	Permafrost in the whole area of the peninsula	Potential long-term impact	Climate Change	Arctic LNG 1 project, all other oil and gas industry projects on Gydan Peninsula	Impacts at local level, however, construction of multiple linear facilities may enhance the cumulative effects.	Yes
		Chemical impacts		Low	Territory of the peninsula	Potential long-term impact		Arctic LNG 1	Local impacts requiring project-specific management.	No
Ground water	Shallow water-bearing horizons	Chemical impacts		Low	Whole area of the peninsula	Potential long-term impact		All other oil and gas industry projects	Local impact Cumulative impacts are unlikely.	
Fresh water	Water quality	Precipitation of solids, chemical pollution. Impact on fresh water quality and fresh water biota		Low	Multiple rivers / lakes throughout the peninsula	Potential impacts throughout the operation phase, at the construction phase impacts are likely to be more significant		All other oil and gas industry projects have a potential to impact river systems. The nearest LAs are located outside catchment basins of major rivers flowing through the Project's license area. Construction of the linear facilities may affect catchment basins of the same rivers.	Local impacts requiring project-specific management, in terms of water quality. Cumulative impacts on drinking water and fresh-water biota are covered below.	No
	Fresh-water phytoplankton, benthos			Low	Multiple rivers / lakes throughout the peninsula	More serious at the construction phase			Impacts will affect catchment areas of different, not the same rivers.	No

VEC		Type of impact	Specific sensitivity / susceptibility	Residual impact of the Arctic LNG 2 Project	Location of VEC	Temporal characteristics of impact	Potential impact of non-industrial influences / trends	Potential impact of other development projects	Discussion	Included in CIA
General	Specific									
	Fresh-water fish fauna	Contamination of water, water abstraction, disturbance of hydrology and river bed morphological structure	Potential impact on protected and commercial species in the regional waters	Low	Multiple rivers / lakes throughout the peninsula		Fish kills, poaching	All other oil and gas industry projects have a potential to impact river systems. The nearest LAs are located outside catchment basins of major rivers flowing through the Project's license area.	Impacts will affect catchment areas of different, not the same rivers. Link with marine environment exists (e.g. anadromous fish species). However, considering the low level of impact and relatively small affected area, and given the scale of impacts of geological exploration activities, no significant cumulative impact is expected.	No
	Drinking water	Water pollution		Low	Nomadic migration areas	Potential impacts throughout the operation phase, most serious impacts at the construction phase		Oil and gas industry projects in the area of Gyda Tundra	Impacts will affect catchment areas of different, not the same rivers. However, potentially affected migration routes may be the same. The impacts should be managed at the level of individual projects.	No
	Water availability	Water abstraction		Negligible				It is not planned to take fresh water for other projects from the same sources. Local issue.	Excluded from the assessment, as residual impact of the planned activities is negligible.	No
Marine water	Water quality	Precipitation of solids, chemical pollution.		From negligible to moderate (dredging)	Ob Estuary	most serious impacts at the construction phase		Arctic LNG 1, Yamal LNG, Obsky LNG Potentially, all projects in the Ob Estuary. Vessels traffic	Included in CIA.	Yes
	Marine phyto- / zooplankton, zoobenthos	Contamination of water, water abstraction, noise impact		From negligible to moderate (dredging)	Ob Estuary	Construction, operation		Arctic LNG 1, Yamal LNG, Obsky LNG Potentially, all projects in the Ob Estuary.	Included in CIA.	Yes
	Marine fish fauna	Contamination of water, water abstraction, noise impact	Potential impact on protected species in the regional waters	From negligible to moderate (dredging)	Ob Estuary			Arctic LNG 1, Yamal LNG, Obsky LNG Potentially, all projects in the Ob Estuary.	Potential cumulative impact on the same fish populations in the Ob Estuary	Yes
	Marine mammals	Noise impact, nuisance, death in collisions with vessels	Potential nuisance caused by noise impacts Vulnerable marine mammals species	Low	Ob Estuary	Construction (most significant), operation	Climate change - potential change of migration routes / areas	Arctic LNG 1, Yamal LNG, Novy Port, Obsky LNG, vessels traffic, seismic studies within the existing license areas in the Ob Estuary, Arctic LNG 3.	Cumulative impact is possible. Included in CIA.	Yes
	Marine ecosystems, endemic species, fish fauna	Introduction of invasive species		Negligibly small to low	Ob Estuary	Throughout the Project life cycle	Climate Change	Vessels traffic	Cumulative impact is possible. Included in CIA.	Yes

VEC		Type of impact	Specific sensitivity / susceptibility	Residual impact of the Arctic LNG 2 Project	Location of VEC	Temporal characteristics of impact	Potential impact of non-industrial influences / trends	Potential impact of other development projects	Discussion	Included in CIA
General	Specific									
Waste management facilities	Third parties' facilities	Impact on capacity		Moderate	Regional facilities	Throughout the Project life cycle		All other projects will generate more wastes.	The airport wastes will be disposed at the waste landfill of the Arctic LNG 2 Project with a limited capacity (refer to Section 9.8 for details). Cumulative impact with other development projects is possible if other projects will be implemented without provision of own waste management systems.	No
Physical impacts	People (workforce)	Noise impact		Low	License area	Construction, operation		Arctic LNG 1	Impacts on local receptors should be managed at the level of individual projects.	No
	People (ISPN / local communities), fauna	Noise impact		Low to moderate (for areas exposed to air traffic)	Along migration routes	Construction, operation		Arctic LNG 1	Irregular and short-term impacts on indigenous communities. Refer to impacts on bird fauna	No
	Marine mammals, fish fauna	Underwater noise		Low				Arctic LNG 1, Yamal LNG, Obsky LNG, Arctic LNG 3, Novy Port, vessels traffic	Refer to impacts on marine mammals and fish fauna	No
Terrestrial fauna	Bird fauna	Noise, illumination, loss of habitats	Vulnerable bird species are present. LA	Low	Whole area of the peninsula (certain bird species)	Throughout the Project life cycle	Overgrazing, climate change	Development of nearby fields may cause impacts on the same habitats.	Cumulative impacts are possible. Included in CIA.	Yes
	Mammals	Noise, human interference / factor of nuisance, physical loss and fragmentation of habitats	Vulnerable / protected species are present (e.g. Gydan population of reindeer)	See. below Onshore habitats	Certain migrating mammals (e.g. polar bears) are more common in the north of the peninsula	Throughout the Project life cycle, however the impacts and the factor of nuisance will be stronger at the construction phase.	Climate change - potential change of migration routes / areas	All other oil and gas industry projects on Gydan Peninsula	Loss of habitats is considered in general sense below, as "terrestrial habitats"	See below
Vegetation	Natural tundra habitats	Physical loss of habitats	Sensitivity of natural tundra vegetation, low regenerative capability.	Moderate	Gydan Peninsula	Throughout the Project life cycle	Overgrazing, climate change	Habitats in the area of potential development of fields in the north of Gydan Peninsula are similar to those in the Salmanovskiy (Utrenniy) LA and adjacent territories.	Included in CIA.	Yes
Landscapes	Visual attractiveness	Visual impact		Negligible	Area of the region	Throughout the Project life cycle		Arctic LNG 1. All projects will have visual impacts. However, given the distance between the projects' areas, no cumulative impact is expected.	Implementation of the Arctic LNG 1 project in the Utrenniy Terminal will not result in any significant change of visual impacts compared to the planned visual impact of the Arctic LNG 2 Project.	No
Community health and safety	People (ISPN / local communities)	Infection diseases	Potentially, increased sensitivity to certain diseases	Low	Nomadic migration areas	Throughout the Project life cycle		Potentially – all other oil and gas industry projects on Gydan Peninsula	Cumulative impacts are possible. Included in CIA.	Yes

VEC		Type of impact	Specific sensitivity / susceptibility	Residual impact of the Arctic LNG 2 Project	Location of VEC	Temporal characteristics of impact	Potential impact of non-industrial influences / trends	Potential impact of other development projects	Discussion	Included in CIA
General	Specific									
		Stress and psychological health	Living in a remote area may increase sensitivity to stress related to changes in natural environment and traditional life style	Low / Moderate	Nomadic migration areas	Throughout the Project life cycle		Potentially – all other oil and gas industry projects on Gydan Peninsula	Cumulative impacts are possible. Included in CIA.	Yes
		Impact of construction/operation site activities and linear facilities on safety conditions	Lack of experience in dealing with the risks	Low	Nomadic migration areas	Throughout the Project life cycle		Potentially, all fields on Gydan Peninsula, but fields in the north of the peninsula (Gydanskoye, Shtormovoye, Geofizicheskoye) to a larger extent	Cumulative impacts are possible. Included in CIA.	Yes
		Project hazards / emergency situations		Low	Nomadic migration areas	Throughout the Project life cycle		Potentially, all fields on Gydan Peninsula, but fields in the north of the peninsula to a larger extent	The local impacts are unlikely to produce any significant cumulative effect	No
		Contacts with security personnel	Dogs may pose risk to reindeer	Low	Nomadic migration areas	Throughout the Project life cycle		Potentially, all fields on Gydan Peninsula, but fields in the north of the peninsula to a larger extent	Cumulative impacts on reindeer herders	Yes
		Immigration flow (tensions)	Living in a remote area may increase sensitivity to stress related to changes in traditional life style	Low / Moderate	Nomadic migration areas	Throughout the Project life cycle, however the impacts will be stronger at the construction phase		Potentially, all fields on Gydan Peninsula, but fields in the north of the peninsula to a larger extent (Gydanskoye, Shtormovoye, Geofizicheskoye)	Cumulative impacts on reindeer herders	Yes
People's life style	People (ISPN / local communities)	Immigration flow (load on services)		Low	Camping sites, regional centres, trading stations	Throughout the Project life cycle, however the impacts will be stronger at the construction phase		Potentially - all projects	A Health Support Provision Concept has been developed for the Project. Serious incidents / emergency situations at specific project sites which may create short-term load on the regional medical services are not considered as factors contributing to cumulative effects, for the following reasons: (1) temporal coincidence of incidents at different sites is extremely unlikely; and (2) the identified development projects are located far apart, therefore no domino effect in terms of potential emergency scenarios is expected. Measures to prevent spread of infections (e.g. COVID-19) at the level of individual projects.	No

VEC		Type of impact	Specific sensitivity / susceptibility	Residual impact of the Arctic LNG 2 Project	Location of VEC	Temporal characteristics of impact	Potential impact of non-industrial influences / trends	Potential impact of other development projects	Discussion	Included in CIA
General	Specific									
		Reindeer Herding	Blockage and/or restriction of herd migration routes, physical loss and/or restriction of access to pastures and fawning sites	Moderate	Potentially - whole area of the peninsula	Throughout the Project life cycle	Signs of overgrazing	Utrenniy Airport, other projects, first of all development of fields within the Gyda Tundra, potential influence of all oil and gas projects implemented on the peninsula	Activities in the nearby fields (Gydanskoye, Shtormovoye, Geofizicheskoye, Soletsko-Khanaveyskoye, Trekhbugornoye) may influence migration routes, along with the impacts of the Project. Alteration of the migration routes may result in indirect impact on other routes/pastures. Implementation of other projects may cause regional-level impacts on wider communities, and may also aggregate to produce indirect impacts, in case of displacement (relocation) of local communities.	Yes
		Fishing and wild crops gathering	Fishing provides an important contribution to food supply and incomes of indigenous communities	High	Nomadic migration areas	Throughout the Project life cycle		First of all - fields in the area of Gyda Tundra; potentially - impact of all oil and gas industry projects implemented on the peninsula	Impacts will affect catchment areas of different, not the same rivers. However, potentially affected migration routes may be the same. Also refer to "impact on fresh-water fish".	Yes
Labour & Working Conditions	People (workforce)	Various		From low to moderate	License area	Throughout the Project life cycle			Project-specific	No
Economy and employment	People (ISPN / local communities)	Direct and indirect employment opportunities and economic development		Beneficial	ISPN in the region	At the construction phase (main effect) and at the operation phase (limited)		All projects in the region	Potential benefits.	No
	People (workforce)	Recruitment of workforce		Low					Project-specific	No
Cultural Heritage	Heritage of ISPN	Potential physical damage, loss or restriction of access to sacred sites and burial grounds		Moderate	Potentially - whole area of the peninsula	Throughout the Project life cycle		All projects in the region	Aggregated impacts on migration routes of indigenous communities are included. Potential impact on indigenous communities at the regional level	Yes
		Impact on intangible cultural heritage		Low	Potentially - whole area of the peninsula	Throughout the Project life cycle		All projects in the region	Damage shall be prevented at the level of individual projects. However, aggregation is possible before appearance of cumulative impacts.	Yes
		Potential physical loss or damage of identified archaeological sites		Negligible	Potentially - whole area of the peninsula	At the construction phase		All projects in the region	Negligible - Excluded from CIA	No

ANNEX 6
REFERENCE LIST

1 DOCUMENTATION PROVIDED BY PJSC "NOVATEK"

1.1 Reports of engineering surveys

1.1.1 GBS LNG and SGC Plant

LNG Plant 2 on concrete gravity-based structure (CGBS) in Salmanovskoye (Utrenneye) OGCF in Ob Estuary water area. Engineering environmental surveys. Report. - LLC "NOVATEK-YURHAROVNEFTEGAZ", LLC "Krasnoyarsk neftegazproject", CJSC "SPF "DIEM", 2014. 254 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Geological engineering surveys. Technical report on work conduction "Laboratory studies of grounds in the framework of complex engineering surveys for objects "Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading". Stage ПД. Document code АСПГ-030-ЛИ1.2, Volume 2, Edition - 1. Text part. Text annex. - LLC "Inzhgeo", 2017. 304 p.

Conduction of survey works for project "LNG Plant 2 on concrete gravity-based structure (CGBS) in Salmanovskoye (Utrenneye) OGCF in Ob Estuary water area". Hydrometeorological and ice analytical researches. Analysis of ice regime based on archive materials. Development of scenarios of interaction of stationary structures with ice formations. Contract No. 19/08/05-1. - SPb.: AANII. 2014. 126 p.

Conduction of survey works for project "LNG Plant 2 on concrete gravity-based structure (CGBS) in Salmanovskoye (Utrenneye) OGCF in Ob Estuary water area". Hydrometeorological and ice analytical researches. Wave mode analysis using field data and simulation results. Calculation of wave loads on facilities. Contract No. 19/08/05-1. - SPb. AANII. 2015. 47 p.

Conduction of survey works for project "LNG Plant 2 on concrete gravity-based structure (CGBS) in Salmanovskoye (Utrenneye) OGCF in Ob Estuary water area". Hydrometeorological and ice analytical researches. Physical ice impact simulation on proposed port facilities in Salmanovskoye field area. Calculation of ice loads on facilities. Contract No. 19/08/05-1. - SPb.: AANII. 2015. 71 p.

Conduction of survey works for project "LNG Plant 2 on concrete gravity-based structure (CGBS) in Salmanovskoye (Utrenneye) OGCF in Ob Estuary water area". 2 Stage. Cameral works. Book 1, Explanatory Note and Text annex. Hydrometeorological engineering surveys. Contract No. 24-ЛРК-05/07. - SPb.: LLC "SPF Lenark", 2014. 121 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Historical-cultural research. Final technical report on historical-cultural research. Sea area. - M.: LLC "Inzhgeo", 2017, 111 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Geological engineering surveys. Drilling of geological engineering wells, phase FEED. Stage 4.2, Field report. Volume 1. Text part. LLC "Inzhgeo", 2017. 20 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Geological engineering surveys. Drilling of geological engineering wells, phase FEED. Stage 4.2, Field report. Volume 2. Text part. LLC "Inzhgeo", 2017. 108 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Geological engineering surveys. Drilling of geological engineering wells, phase FEED. Stage 4.2, Field report. Volume 3. Text part. LLC "Inzhgeo", 2017. 4 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Geological engineering surveys. Drilling of geological engineering wells, phase FEED. Stage 4.2, Field report. Volume 4. Graphical part. LLC "Inzhgeo", 2017. 5 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Technical documentation. Geological engineering surveys. Drilling of geological engineering wells, phase FEED. Stage 4.4, Field report. Volume 1. Text part. - LLC "Inzhgeo", 2017. 33 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Technical documentation. Geological engineering surveys. Drilling of geological engineering wells, phase FEED. Stage 4.4, Field report. Volume 2. Text part. - LLC "Inzhgeo", 2017. 38 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Technical documentation. Geological engineering surveys. Drilling of geological

engineering wells, phase FEED. Stage 4.4, Field report. Volume 3. Graphical part. - LLC "Inzhgeo", 2017. 120 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Technical documentation. Geological engineering surveys. Drilling of geological engineering wells, phase FEED. Stage 4.4, Field report. Volume 4. Text part. - LLC "Inzhgeo", 2017. 202 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Technical documentation. Geological engineering surveys. Drilling of geological engineering wells, phase FEED. Stage 4.4, Field report. Volume 5. Graphical part. - LLC "Inzhgeo", 2017. 5 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Geological engineering surveys. Technical report on work conduction "Laboratory studies of grounds in the framework of complex engineering surveys for objects "Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading". Stage FEED. Document code АСПГ-030-ЛИ2.1, Volume 1, Edition - 1. Text part. Explanatory Note. - LLC "Inzhgeo", 2017. 48 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Geological engineering surveys. Technical report on work conduction "Laboratory studies of grounds in the framework of complex engineering surveys for objects "Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading". Stage FEED. Document code АСПГ-030-ЛИ2.2, Volume 2, Edition - 1. Text part. Text annex. - LLC "Inzhgeo", 2017. 252 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Geological engineering surveys. Technical report on work conduction "Laboratory studies of grounds in the framework of complex engineering surveys for objects "Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading". Stage FEED. Document code АСПГ-030-ЛИ2.3, Volume 3, Edition - 1. Text part. Text annex. - LLC "Inzhgeo", 2017. 144 p.

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Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Technical documentation. Geological engineering surveys. Static penetration test, Design documentation stage. Stage 4.4, Field report. Volume 1. Text part, Graphical part. - LLC "Inzhgeo", 2017. 18 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Technical documentation. Geological engineering surveys. Static penetration test, Design documentation stage. Stage 4.4, Field report. Volume 2. Text part, Graphical part. - LLC "Inzhgeo", 2017. 142 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Design documentation. Section 4. Technical report based on engineering and environmental surveys. Part 2. Onshore facilities. Book 1. Text part, Explanatory Note. Document code 2017-423-М-02-ИЭИ2.1. VOLUME 4.2.1. - LLC «CGEI», 2017. 254 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Design documentation. Section 4. Technical report based on engineering and environmental surveys. Part 2. Onshore facilities. Book 2. Text annex. Document code 2017-423-M-02-ИЭИ2.2. VOLUME 4.2.2. - LLC «CGEI», 2017. 314 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Design documentation. Section 4. Technical report based on engineering and environmental surveys. Part 2. Onshore facilities. Book 3. Text annex, Graphical annexes. Document code 2017-423-M-02-ИЭИ2.3. VOLUME 4.2.3. - LLC «CGEI», 2017. 132 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Engineering and environmental surveys technical report for design documentation preparation. - ИЭИ1. - LLC «Inzhgeo», 2017. 277 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Engineering and environmental surveys technical report for design documentation preparation. - ИЭИ2. - LLC «Inzhgeo», 2017. 332 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Engineering and environmental surveys technical report for design documentation preparation. - ИЭИ3. - LLC «Inzhgeo», 2017. 323 p.

Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Design documentation. Section 2. Engineering surveys. Onshore facilities. Part 1. Technical report on all-site geological engineering surveys. Document code 2017-423-M-02-ИИ2.1, VOLUME 2.1.1. - LLC «CGEI», 2017. 603 p.

Complex for production, storage, offloading of liquefied natural gas and stabilized gas condensate on Salmanovskoye (Utrenneye) oil, gas and condensate field. Plant on gravity-based structures for liquefied natural gas and stabilized gas condensate production, storage, and offloading. Technical documentation. Engineering environmental surveys, hydrobiological and ichthyological research. Sea area. Field report. Contract No.АСПГ-030. - LLC «Inzhgeo», 2017. 121 p.

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1.3.4 Setup of Salmanovsky (Utrenniy) OGCF field facilities

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ANNEX 7

CLIMATE CONDITIONS AT THE PROJECT SITE ACCORDING TO OBSERVATION DATA AT METEOROLOGICAL STATIONS TADEBYA-YAKHHA, SEYAKHA, TAMBEY

1. TEMPERATURE REGIME

Temperature (thermal) regime of the territory is characterized by the severe long winter, cold summer, short transitional seasons – spring and autumn, late spring and early autumn frosts, and a short frost-free period.

The severity of the thermal regime is primarily characterized by an average annual air temperature of -10.6°C (Table A7.1). The coldest month is February, the average monthly temperature of which reaches -27.2°C. The average minimum temperature is also observed in February and is -32.2°C. The warmest month is August, with an average monthly temperature of 7.4°C. The highest value of the average maximum temperature is observed in July and amounts to 11.7°C (Figure A7.1). The absolute maximum air temperature reaches 30.1°C, the absolute minimum amounts to -52.0°C.

Table A7.1: The mean multiyear characteristics of the thermal regime of the Tadebya-Yakhha HMS

Month	Air temperature						
	Average	Average minimum	Absolute minimum	Average absolute minimum	Average maximum	Absolute maximum	Average absolute maximum
I	-26,9	-31,4	-50,6	-43,7	-22,3	0,8	-5,9
II	-27,2	-32,2	-52,0	-43,8	-23,3	0,8	-7,9
III	-22,4	-27,3	-47,7	-40,1	-17,9	0,7	-3,9
IV	-16,9	-22,3	-45,2	-35,1	-12,3	3,4	-0,6
V	-7,2	-10,7	-30,9	-22,5	-3,9	9,6	2,4
VI	1,4	-0,8	-14,6	-7,0	4,1	27,8	14,8
VII	7,0	3,7	-2,4	-0,1	11,7	30,1	23,1
VIII	7,4	4,4	-5,0	-0,6	10,7	26,7	18,8
IX	3,4	1,1	-12,7	-5,3	5,7	18,1	12,4
X	-7,1	-10,2	-35,8	-24,8	-4,1	7,8	3,2
XI	-17,0	-21,6	-42,6	-35,2	-13,4	1,6	-2,0
XII	-22,5	-26,9	-50,0	-40,2	-18,2	1,2	-3,6
Year	-10,6	-14,7	-52,0	-46,5	-7,1	30,1	23,8

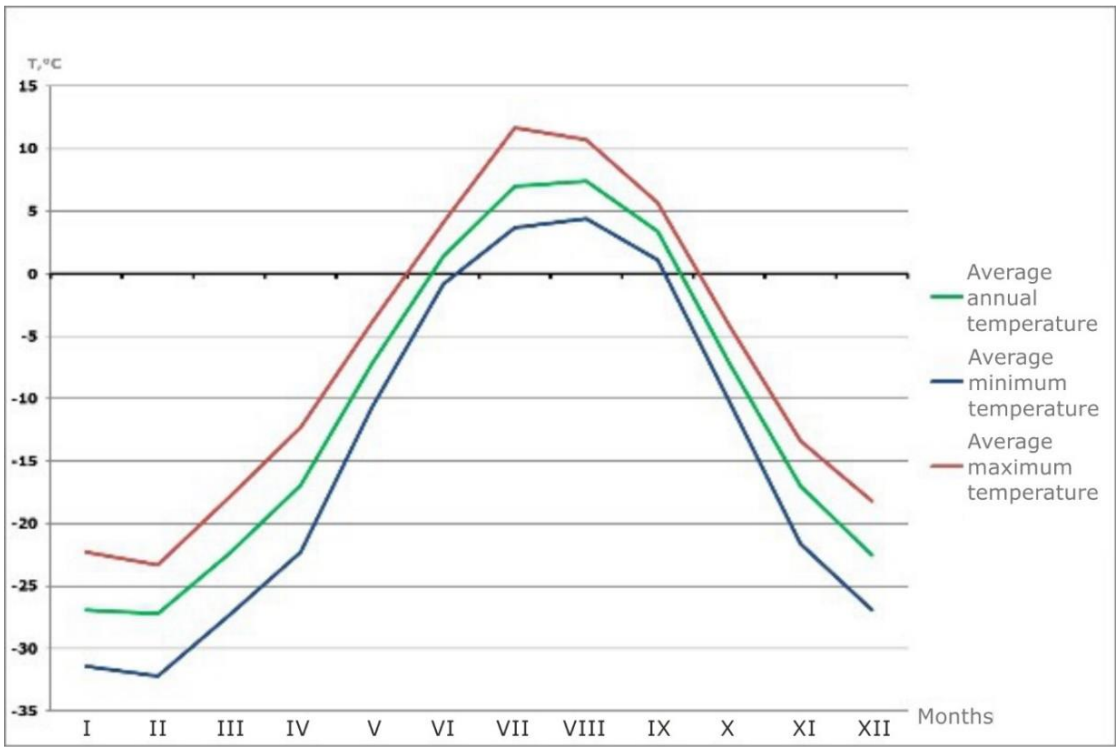

Figure A7.1: Annual course of air temperatures (according to Tadebya-Yakhha HMS)

The transition of air temperature to negative values in autumn occurs in the first half of October. The duration of the period with positive air temperatures (average daily temperatures steadily above 0°C) amounts to 119 days at the considered territory, the number of days with temperature above +5°C is 66 days, the duration of steady frosts – 246 days (over 8 months) (Table A7.2).

Table A7.2: Duration of the periods with different mean daily air temperatures (according to Tadebya-Yakhha HMS)

Indicator	Average date		Duration, days
	of the beginning	of the end	
Period with temperature above 0°C	08.06	05.10	119
Period with temperature above 5°C	09.07	13.09	66
Period with steady frosts	14.09	07.06	246

The number of days with extreme minimum temperatures according to multi-year observations at Tadebya-Yakhha HMS is given in table A7.3. There are 4 frosty days with temperature below -40°C per season. Air temperature drops below -26°C during the third part of the season.

Table A7.3: Number of days with extreme low air temperatures (according to Tadebya-Yakhha HMS)

Temperature, °C	Month						Season
	I	II	III	IV	XI	XII	
Below -40	0,5	1,2	0,4	-	-	1,7	3,8
Below -31	6,8	10,3	8,7	0,1	1,0	5,9	32,8
Below -30	7,0	10,5	9,9	0,3	1,1	6,2	35,0
Below -26	12,7	15,1	14,8	2,4	3,5	10,6	59,1

Steady transition through 8 and 10°C is absent and duration of period with daily average air temperature not above 8 and 10°C is observed during all year due to average monthly temperature of the warmest month, amounting to 7,4°C. Meanwhile average annual air temperature amounts to -10,6°C.

Air temperature of warm period with sufficiency of 0.99 is 19,2°C. Air temperature of the coldest days with sufficiency of 0.99 reaches -51°C.

Air temperature of the coldest five days with sufficiency of 0.99 is -48°C.

2. SOIL TEMPERATURE

Annual course of temperature at soil surface is similar to the annual course of air temperature. According to the Tadebya-Yakhha HMS, the minimum temperature of soil surface is observed in February and reaches -28.0°C, maximum – in July with a value of 9.7°C. The average annual temperature of the soil surface is -10.3°C (Table A7.4).

First frosts on the surface of the soil occur on 28 August, the last – 25 June.

Table A7.4: Average monthly and average annual soil surface temperature, °C (according to Tadebya-Yakhha HMS)

Month												Year
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
-27,1	-28,0	-23,0	-16,8	-6,3	3,4	9,7	8,8	3,1	-6,3	-17,7	-23,9	-10,3

3. MOISTURE REGIME

3.1 Relative air humidity

Relative air humidity φ gives an indication of the degree of saturation of air with water vapor and is very high during the year (above 78 %). The highest relative air humidity in annual course is observed in summer-autumn season with maximum in June (88 %). It reaches the minimum in February (78 %) (Table A7.5). The maximum difference between average monthly values of relative air humidity and mean multiyear values (δ) is observed during cold season with the highest scattering in February (5,0 %), minimum – in September (2,2 %). Average monthly relative air humidity of warmest month (August) is 86%.

Table A7.5: Average monthly and average annual relative air humidity (φ) and mean square deviation (δ) of average monthly relative air humidity (according to Tadebya-Yakhha HMS)

Characteristic, %	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
φ	79	78	80	82	85	88	87	86	87	87	84	81	84
δ	3,9	5,0	4,8	3,9	3,9	2,4	3,5	2,9	2,2	2,3	4,2	3,4	-

In cold season relative air humidity is practically the same during the day, amplitude of daily course amounts to 0-1 % since November to March (Table A7.6). Daily course of relative air humidity is the most noticeable in July-August when the daily amplitude reaches 11-12 %.

Table A7.6: Average monthly relative air humidity (φ, %) with respect to periods of observations and daily amplitude of humidity (A) (according to Tadebya-Yakhha HMS)

Time, hour	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
0	79	78	80	82	87	91	91	92	91	88	84	81
3	79	78	80	82	87	89	90	91	91	88	84	81
6	79	78	80	81	85	87	85	87	89	87	84	80
9	79	78	80	80	83	85	82	82	84	86	84	81
12	79	78	80	80	82	84	80	80	82	86	84	81
15	79	78	80	81	83	85	80	80	83	87	84	81
18	79	78	80	82	85	87	82	85	88	87	84	80
21	79	78	80	82	87	90	88	90	90	87	84	81
A, %	0	0	0	2	5	7	11	12	9	2	0	1

3.2 Precipitation

The amount and distribution of precipitation in this region is determined mainly by features of the general circulation of the atmosphere. In this region 328 mm of precipitation falls per year. Such a relatively low amount of precipitation is associated with the low moisture content of the prevailing Arctic air here. Only 33 % of annual amount of precipitation falls in cold season (since November to March). Thus, winter season is characterized by dryness. The major rainfall takes place in summer and autumn, with a maximum in September (Table A7.7). Minimum of precipitation falls on March-May (Figure A7.2).

Table A7.6: Average monthly and average annual precipitation, mm (according to Tadebya-Yakhha HMS)

Month												Year
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
24	20	17	19	19	28	40	41	43	30	22	25	328

A characteristic feature of precipitation is its low intensity. In the summer-autumn period, characterized by a large number of cloudy days (approximately 20 per month), low stratus cloud dominates, from which drizzle falls. Heavy rainfall and thunderstorms occur on average once during the summer, with a maximum of thrice.

According to the history of observations at Tadebya-Yakhha HMS, falls of liquid precipitation were not observed since November to march, meanwhile falls of solid precipitation were not observed only in July and August.

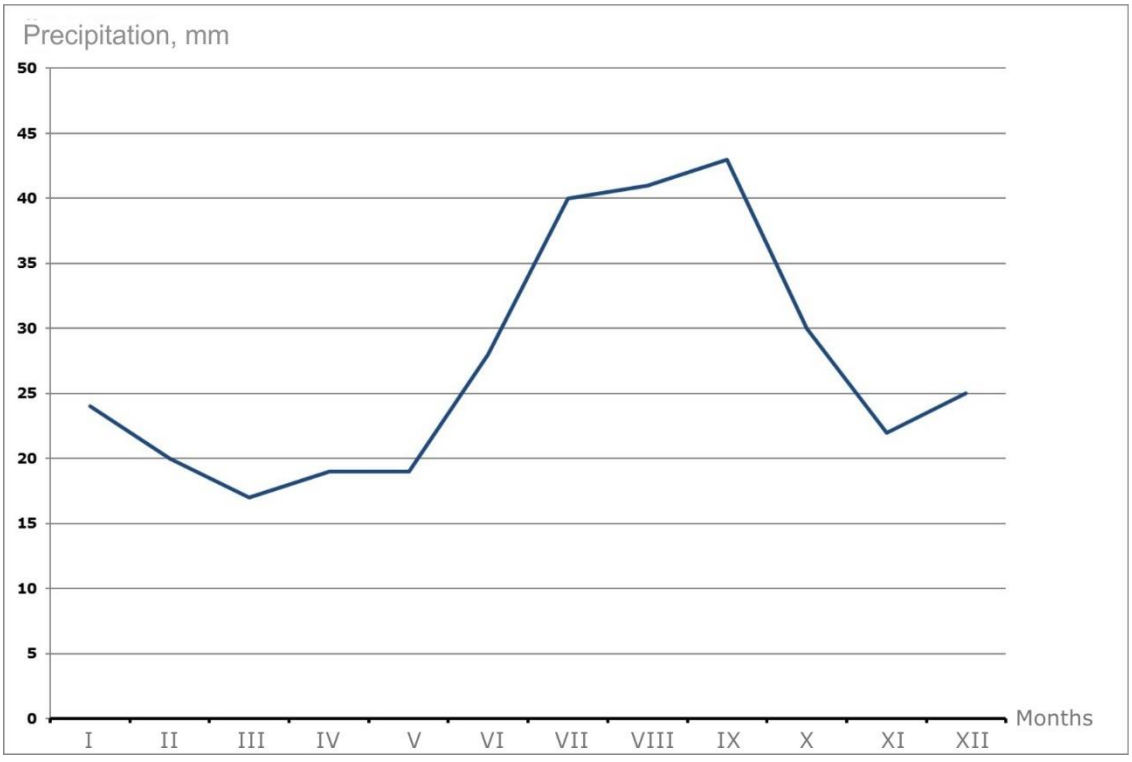

Figure A7.2: Annual course of average monthly precipitation (according to Tadebya-Yakhha HMS)

3.3 Snow cover

Steady snow cover is formed in the first decade of October. Difference between average dates of snowfall and the formation of a steady snow cover is 14 days. The earliest date of formation of steady snow cover is 19 September, the latest date is 11 November. The latest date of destruction of stable snow cover is 30 June, the earliest date is 31 May (Table A7.8). On average, destruction and descending of stable snow cover occur in the middle of the second or in the end of the third decade of June. At the beginning of winter, the height of snow cover is insignificant, its maximum height is observed in the third decade of April-early May[78].

Table A7.7: The timing of formation and destruction of snow cover (according to Tadebya-Yakhha HMS)

Dates of occurrence of snow cover			Dates of formation of stable snow cover			Dates of destruction of stable snow cover			Dates of snow cover descending			Number of days with snow cover
the earliest	average	the latest	the earliest	average	the latest	the earliest	average	the latest	the earliest	average	the latest	
9.09	10.10	1.11	28.09	16.10	3.11	16.05	6.06	4.07	16.05	8.06	4.07	232

At the beginning of winter, the density of snow cover is very unstable due to weather fluctuations, snow density reaches the maximum values before the snow melting – in the first decade of June. While average thickness of snow cover is relatively low, the spatial distribution of snow cover is extremely uneven due to frequent strong winds. Tops of hills can remain with a minimum thickness of snow cover, while in ravines snow with a thickness of more than 3 m is formed during the winter.

Average decade height of snow cover at the permanent rail of Tadebya-Yakhha HMS is given in Table A7.9.

Table A7.8: Average decade height of snow cover at the permanent rail (according to Tadebya-Yakhha HMS)

Month	October			November			December			January			February			March		
Decade	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Snow depth, cm	1	3	7	11	15	18	19	21	24	27	27	29	28	29	30	31	31	32

Month	April			May			June			The greatest		
Decade	1	2	3	1	2	3	1	2	3	average	max	min
Snow depth, cm	32	32	32	28	23	16	6	2	-	40	78	24

[78] Liquified natural gas and stable gas condensate terminal «Utrenniy» Technical report on conducted hydrometeorological engineering surveys. Explanatory note. Annexes with text. Annexes with graphs. Pressmark АСПГ-159-2017-ИГМИ-01. Volume 4. LLC «Uralgeoproekt», 2017. – 61 p.

4. WIND REGIME

A characteristic feature of the Project proposed site is expressed monsoon-like winds: in winter from the cooled continent to the ocean, in summer from the ocean to the land. In winter time South winds dominate. In summer, when the pressure over the Arctic becomes higher than on the mainland, winds of the Northern directions dominate.

Table A7.10 shows the average annual recurrence of wind directions and calm according to Tadebya-Yakhha HMS.

Table A7.10: Recurrence of wind directions and calms, % (according to Tadebya-Yakhha HMS)

Month	Wind direction								Calm
	North	Northeast	East	Southeast	South	Southwest	West	Northwest	
I	6	7	14	21	**23**	14	10	5	4
II	7	7	16	19	**21**	14	10	6	5
III	8	6	16	**19**	16	16	12	7	5
IV	**17**	10	12	12	12	13	14	10	3
V	**20**	13	12	10	11	10	14	10	2
VI	**22**	10	14	7	8	13	14	12	2
VII	**25**	11	12	7	7	15	9	12	2
VIII	**25**	15	14	8	9	10	10	9	2
IX	12	**16**	**16**	15	14	8	13	6	2
X	10	13	**18**	15	14	10	13	7	2
XI	10	9	**18**	16	17	12	13	5	4
XII	7	8	13	19	**21**	13	13	6	4
Year	14	11	14	14	14	12	12	9	3

** Bold – the maximum values of the recurrence in each month*

In winter period south winds have the greatest recurrence (21-23%), in March – Southeast winds (19 %), in warm period (April-August) – North winds (17-25%), in September – Northeast and East winds (16 %), in October and November – East winds (18 %). For the year as a whole winds of North, East, Southeast and South directions have the greatest recurrence (14%) (Figure A7.3).

Figure A7.3: Average annual wind rose (according to Tadebya-Yakhha HMS)

Wind speeds are significant during the year, therefore, the recurrence of calm is small (up to 5 %). Monthly average wind speeds exceed 4 m/s, the value of the average annual speed reaches 5.7 m/s. The highest wind speeds refer to the autumn-winter period, and in November and December reach the value of 6.3 m/s (Table A7.11, Figure A7.4). The minimum wind speeds are observed in summer and amounts to 4.4 m/s in July.

Table A7.9: Average monthly and average annual wind speed, m/s (according to Tadebya-Yakhha HMS)

Month													Year
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		
6,1	5,7	5,6	5,7	6,0	5,3	4,4	5,2	5,9	6,2	6,3	6,3		5,7

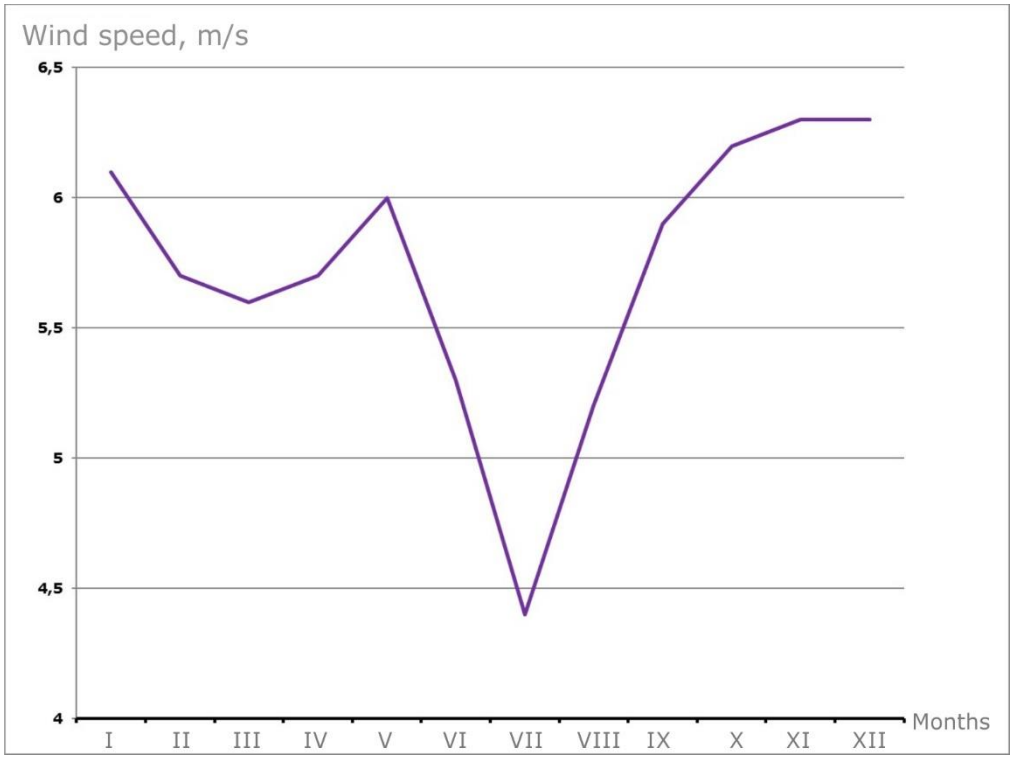

Figure A7.4: Annual course of wind speed (according to Tadebya-Yakhha HMS)

Wind with speeds of 4-5 m/s is characterized by the highest recurrence (24,3 %) for the year as a whole. Significant recurrence of wind with speeds of 2-3 m/s (22 %) and wind with speeds of 6-7 m/s (18,1 %) is also observed (Table A7.12). Such ratio of speed recurrence is practically the same during the year. The exceptions are February and March, when winds with speeds of 2-3 m/s are more frequent than winds with speeds of 4-5 m/s.

Table A7.10: Recurrence of gradations of wind speed, % (according to Tadebya-Yakhha HMS)

Month	Wind speed, m/s										
	0-1	2-3	4-5	6-7	8-9	10-11	12-13	14-15	16-17	18-20	21-24
I	9,6	20,8	21,1	16,2	12,6	9,8	5,8	2,6	1,1	0,4	0
II	11,4	23,0	21,4	15,3	13,0	7,8	4,6	1,8	1,1	0,5	0,1
III	10,0	21,9	20,7	16,7	14,9	8,3	4,5	1,9	0,8	0,2	0,1
IV	8,1	23,6	24,2	16,9	12,6	7,2	3,9	2,0	1,0	0,3	0,2
V	5,0	17,6	25,4	23,5	14,6	7,8	3,7	1,5	0,7	0,2	0
VI	6,3	24,6	29,8	18,5	11,2	5,6	2,8	0,7	0,4	0,1	0
VII	8,3	31,3	32,6	16,5	7,3	2,6	1,2	0,2	0	0	0
VIII	6,7	24,3	28,4	20,3	12,5	5,1	2,1	0,4	0,1	0,1	0
IX	6,0	19,7	25,4	19,9	14,8	7,8	4,2	1,5	0,5	0,2	0
X	6,3	19,0	21,4	18,9	15,9	9,6	6,0	1,8	0,8	0,3	0
XI	8,6	18,7	21,7	18,3	13,6	9,6	5,8	2,1	1,0	0,5	0,1
XII	8,5	19,6	19,8	16,6	14,1	9,9	6,8	3,0	1,2	0,4	0,1
Year	7,9	22,0	24,3	18,1	13,1	7,6	4,3	1,6	0,7	0,3	0,1

The recurrence of winds with speed of 4-5 m/s has the maximum values in summer, while in winter and in the transition seasons there are the maximum values of high speed recurrence (≥10 m/s) (Figure A7.5).

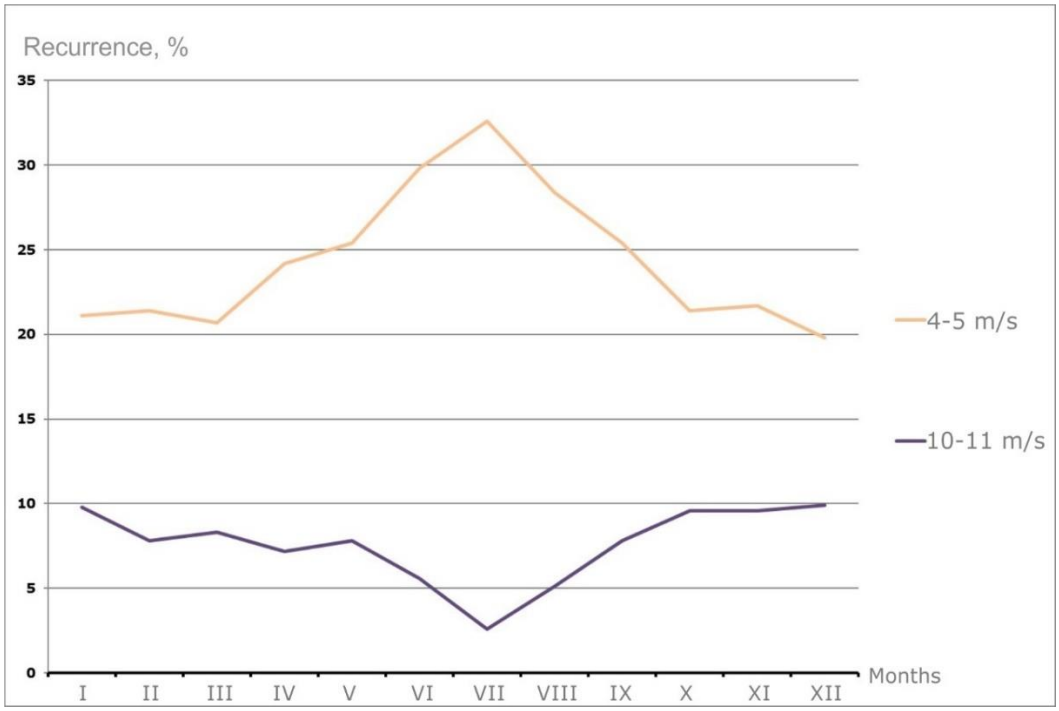

Figure A7.5: Annual course of recurrence of wind speeds grades 4-5 and 10-11 m/s (according to Tadebya-Yakhha HMS)

At the Project proposed territory there are annual wind speeds exceeding 15 m/s. In the annual course of recurrence of wind speeds grades strong winds with speeds above 15 m/s are distributed rather uniformly with increasing recurrence in those seasons when the monthly average wind speeds are higher (Table A7.13, Figure A7.6). On average, strong winds dominate about 72 days in a year, maximum – 84 days. The highest wind speed with frequency of its exceeding up to 5 % per year for considered territory is 14 m/s.

Table A7.11: Average (n) and greatest (N) number of days with wind speed above 15 m/s (according to Tadebya-Yakhha HMS)

	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
n	7,9	6,4	6,5	6,4	5,8	3,2	1,5	3,1	5,6	8,2	7,2	10,1	71,9
N	16	12	13	11	10	8	4	6	18	18	13	16	84

Figure A7.6: Annual course of average and highest number of days with wind speeds above 15 m/s (according to Tadebya-Yakhha HMS)

5. ATMOSPHERIC PRESSURE

Average annual value of atmospheric pressure in the vicinity of the Tadebya-Yakhha HMS is 1010,5 hPa, maximum value reaches 1062,4 hPa, minimum – 955,7 hPa. Average monthly and average annual values, as well as extreme values of atmospheric pressure are given in Table A7.14.

Table A7.12: Average monthly, average annual, maximum and minimum values of atmospheric pressure, hPa (according to Tadebya-Yakhha HMS)

Atmospheric pressure	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Average	1010,6	1013,8	1012,9	1013,0	1012,2	1009,6	1010,5	1009,7	1008,7	1007,2	1009,0	1008,3	1010,5
Maximum	1062,4	1056,8	1055,9	1049,0	1041,0	1030,4	1029,9	1032,3	1037,0	1037,4	1047,0	1061,3	1062,4
Minimum	963,7	967,8	958,2	958,8	975,6	971,9	979,6	981,0	963,7	965,5	966,2	955,7	955,7

6. ATMOSPHERIC PHENOMENA

6.1 Blizzards

Snowstorms are observed in the period from September to June, but the bulk of them occur in the period from November to April. In an average, there are a little more than 100 days of snowstorm during a year. Average duration of snowstorms at considered site amounts to about 1050 hours per season. Maximum duration of snowstorms can reach 1617 hours per year.

Characteristic of annual course of number of days with snowstorm is given in Table A7.15. Table A7.16 shows data on average monthly and maximum duration of snowstorms.

Table A7.13: Number of days with blizzard (according to Tadebya-Yakhha HMS)

Value	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Average	15	13	14	11	9	2	-	-	0,2	8	13	16	101
The greatest	23	21	24	18	15	5	-	-	2	19	23	24	-

Table A7.14: Average monthly and maximum duration of blizzards, h (according to Tadebya-Yakhha HMS)

Value	Month												Year
	IX	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	
Average	1	71	138	177	161	157	139	106	85	15	-	-	1050
The greatest	17	220	244	284	261	245	218	186	140	67	-	-	1617

6.2 Fogs

Fogs refer to harmful atmospheric phenomena, decreasing visibility to 1000 m and less and causing corrosion of metal. Formation and distribution of fogs occur due to proximity of the cold Kara sea, low temperature, high relative air humidity. According to Tadebya-Yakhha HMS, 52 days with fog are noted on average in annual course. The maximum number of days with fog per year can reach 72 (Table A7.17). Average duration of fogs at Project proposed site is about 300 hours per season (Table A7.18).

Table A7.15: Number of days with fog (according to Tadebya-Yakhha HMS)

Value	Month												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Average	1	1	2	3	5	9	13	8	4	3	2	1	52
The greatest	4	3	5	11	10	16	21	15	10	8	8	5	72

Table A7.16: Average monthly duration of fogs, h (according to Tadebya-Yakhha HMS)

Month												Year
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
4	3	4	11	22	60	99	52	18	13	7	32	295

6.3 Thunderstorms

Considered territory is characterized by poorly developed thunderstorm activity. Frequency of thunderstorms reaches one day in summer period and a maximum at 9 days per season. Duration of thunderstorms is up to 3.7 hours in July. Average duration of thunderstorms per day with thunderstorm amounts to 0.6 hour, maximum continuous duration is 1.9 hours.

Average monthly and maximum number of days with thunderstorm according to Tadebya-Yakhha HMS are given in Table A7.19.

Table A7.17: Average monthly and maximum number of days with thunderstorm (according to Tadebya-Yakhha HMS)

Value	Month		
	VI	VII	VIII
Average	0,4	2	0,9
Maximum	3	9	4

ANNEX 8

ASSESSMENT OF POSSIBLE GEODYNAMIC CONSEQUENCES OF THE DEVELOPMENT OF THE SALMANOVSKOYE (UTRENNEYE) OGCF

The preliminary consultations with stakeholders conducted by NOVATEK with the participation of Ramboll CIS LLC in March-April 2018 revealed the concerns of the indigenous people of the Tazovskiy district over possible changes in the terrain within the bounds of the field - depressions, subsidence, etc. The GBS LNG & SGC Plant, which is the focus of the ESHIA, is not a significant source of impacts on the geological environment as compared to the Salmanovskoe (Utrenneye) Field Facilities Setup, therefore the matter of possible geodynamic consequences of the implementation of the Arctic LNG 2 Project is addressed separately in this Appendix in as much detail as possible based on the survey materials and the information on analogous facilities.

The area under review is not a seismic area: for medium soil conditions, the seismic intensity with a 1% exceedance probability is 5 points on the MSK-64 seismic intensity scale; the soils belong to category I in terms of their seismic properties according to the SP 14.13330.2011 criteria; local endogenous processes are moderately dangerous (SP 115.3330.2011). At the same time, the proposed activities associated with the development of the Salmanovskoye (Utrenneye) OGCF may intensify local geodynamic processes, as is often the case in similar circumstances.

During the development of oil and gas fields, **two types of negative geodynamic consequences** are distinguished: deformation and seismic effects (Kuzmin, 1999[79]; Kuzmin, Nikonov, 2002[80]). In most cases, deformation effects of hydrocarbon extraction have two manifestations:

- extensive subsidence of the entire field;
- anomalous intensification of earth-crust movements in the fault zones located within the field.

A large amount of information has been accumulated on the movements of the earth's crust within large oil and gas fields caused by mining operations. In particular, the subsidence amplitude reached 8.8 m for the Wilmington oil field (*Wilmington*, USA), one of the world's highest, 4.1 m for the Lagunillas field (*Lagunillas*, Venezuela), 2.6 m for the Ekofisk field (*Ekofisk*, Norway), 3 m for the Surahani field (Azerbaijan), 0.92 m for the North-Stavropol filed (Russia), etc.

The most dangerous consequences of those movements are intensive deformations of onshore structures, utilities disruption, breaking of casing strings of production wells, field pipelines rupture. Intensive (in excess of 1 m) wide-ranging subsidence of the earth's crust across the entire operational oil or gas field occurs extremely rarely and, as a rule, requires a combination of the following conditions:

- large field area (in excess of 100 km2);
- considerable thickness of productive deposits (as a rule, in excess of 100 meters);
- relatively shallow depth of the developed geological section intervals (up to 2000 meters);
- high porosity of reservoir rocks (about 25-30% or higher);
- abnormally high reservoir pressure which rapidly drops in the course of field development;
- the prevalence of lithostatic stresses over tectonic stresses within the field.

The most dangerous **deformation processes,** as far as liquid hydrocarbon deposits are concerned, are extensive local anomalies of vertical and horizontal movements in fault areas caused by mining operations. These abnormal movements are characterized by high amplitude (50-70 mm/year), short periodicity (0.1-1 years), spatial localization (0.1 - 1 km), and have a pulsating and alternating directionality. They are referred to as super-intensive deformations, and the fault areas in which they are identified are considered dangerous (Kuzmin, 1996; Kuzmin, Zhukov, 2004; Kuzmin, 2005).

Activation of seismic faults within operational oil fields is a widespread phenomenon. To date, it has not been possible to detect a single oil and gas field (among those monitored for deformations), in which no super-intensive deformations of the earth's crust have been observed in fault areas. There are numerous examples of adverse effects of activation of super-intensive deformations in oil and gas fields.

Seismic processes caused by oil and gas field development are divided into technogenic and technogenically induced. The former have low intensity (3-4 points on the Richter scale), with their foci concentrated in close proximity to or inside the reservoir; the latter can be of higher magnitudes, about 6-7 points, with their epicenters normally located much deeper than the mined deposits. Such seismic events have the highest probability when the following conditions combine:

[79] Kuzmin Yu.O. Modern geodynamics and geodynamic risk assessment in subsoil use. - M .: AEH, 1999.

[80] Kuzmin Yu.O., Nikonov A.I. Geodynamic monitoring of oil and gas facilities. In *The foundations of new technologies in the oil and gas industry*. Issue 2. - M .: GEOS, 2002.

- high intensity of field development;
- the deposit is confined to a seismically dangerous area measuring at least 7 on the MSK-64 scale.

Within the context of forecasting induced geodynamics within the Salmanovskoye (Utrenneye) OGCF, it would be interesting to consider the results of the assessment of the level of adverse geodynamic consequences performed earlier for the Bovanenkovskoye field[81] which is located within the West Siberian oil and gas province and has a number of features in common with the Salmanovskoye field: both have similar geological structures, both are confined to seismicity zones measuring up to 5 points on the MSK-64 scale, both have nearly equal initial reservoir pressure in the deposits.

The main **conclusions** obtained for the analogous field and extrapolated to the Salmanovskoye (Utrenneye) OGCF by the Consultant are as follows:

- mining operations are likely to be accompanied by a steady process of subsidence of the surface above the undermined area;
- subsidence of the earth's surface within the field over the entire period of its development will potentially reach tens of centimeters or, less likely, several meters, and it may give rise to local emergencies, changes in the direction and intensity of exogenous processes; but it will have no significant impact on the land use conditions;
- the areas of greatest geodynamic risk will be confined to the intersections of disjunctive disorders, and especially to those of them that are located near the well pads;
- hydrocarbon extraction will be accompanied by a reduction in reservoir pressure, affecting deformation and stress state of the rock mass; according to the RusGasEngineering forecast (2014), those conditions will increase the likelihood of local failures of the geotechnical systems within the field;
- hydrocarbon extraction is not likely to cause any earthquakes strong enough to harm the communities in the Tazovskiy district,
- it would be useful to set up a geodynamic testing ground for monitoring the earth's surface deformations within the field, by analogy with the already existing ones within the Bovanenkovskoye oil and gas condensate field; a combination of ground-based on-site measurements with remote sensing of the surface by means of radar interferometry or high-precision large-scale aerial phototriangulation should be recognized as very promising.

[81] Kuzmin Yu.O., Nikonov A.I. Assessment of geodynamic consequences of the development of the Bovanenkovskoye OGCF// Interexpo Geo-Siberia. 2008. № 2.

ANNEX 9

PROPOSALS OF CONSULTANT ON PREVENTION OF EXOGENOUS GEOLOGICAL PROCESSES AND REMEDIATION OF DISTURBED SOIL AND VEGETATION COVER FOR ARCTIC LNG 2 PROJECT

The measures proposed by the Consultant for land remediation have been developed for the entire territory of Salmanovskiy (Utrenniy) license area and can be used in recovering the soil and vegetation cover in the areas disturbed by the construction of the Plant, Port and Field facilities.

The document is structured as follows:

1. General requirements for remediation of disturbed lands in the Russian Federation and conditions of their application in Yamal-Nenets Autonomous Okrug

2. Land remediation in Salmanovskiy (Utrenniy) License Area: choosing the direction

3. Land remediation in Salmanovskiy (Utrenniy) License Area: main objectives, standard timing, procedure

4. Land remediation in Salmanovskiy (Utrenniy) License Area: technical specifications

5. Land remediation in Salmanovskiy (Utrenniy) License Area: best available practice

5.1. General approach to remediation design

5.2. Activities within the scope of civil works. Organic soils treatment

5.3. Technical stage of remediation

5.4. Biological stage of remediation

6. Assessment of remediation efficiency. Transfer of land plots to the Lessor

1. General requirements for remediation of disturbed lands in the Russian Federation and conditions of their application in Yamal-Nenets Autonomous Okrug

According to the Land Code of the Russian Federation (Article 13), the term "land remediation" implies a set of measures to prevent land degradation and (or) to restore their fertility by bringing the land into a state suitable for its use in accordance with intended purpose and permitted use, including by soil de-pollution, topsoil restoration, and protective forest planting.

The obligation to carry out remediation follows from the negative impact on the land, which resulted in deterioration of its quality (including as a result of pollution and disturbance of the soil layer) and the environmental situation in general; responsibility for land remediation shall be imposed on the persons that use respective land plots (Article 13, 39.35 of the RF Land Code). Non-fulfillment of measures for land remediation and improvement, as well as soil protection can be the ground for terminating the right to use the land (Article 45 of the RF Land Code).

Short-term use of agricultural land or land plots within such land for the construction of linear facilities, without transferring such land to other categories, should be carried out only in accordance with an approved project for such land remediation for agricultural purposes (Article 78 of the RF Land Code).

Due to the fact that the main activities leading to land degradation in the territory of YNAO are exploration and development of mineral resources, the requirements for land remediation established by the federal legislation are specified in the Law of Yamal-Nenets Autonomous Okrug *On Subsurface Management in Yamal-Nenets Autonomous Okrug* (No. 56-ZAO dated June 26, 2012).

In particular, a subsoil user is obliged to carry out remediation of disturbed lands in accordance with the design document, and transfer them to landowner against acceptance act as appropriate, before the right to use the subsoil has been extinct; the criterion for remediation effectiveness is bringing all mines in a state that ensures safety of life and health of the population, and protection of the environment (Article 11, paragraph 2).

When using the industrial land in state ownership of the Yamal-Nenets Autonomous Okrug, a land plot can be provided for use only upon approval of land remediation project (YNAO Law *On Regulation of Specific Land Relations,* revision as of 31 October, 2017, Article 16, p.2).

The requirements for restoration of disturbed forest areas are the most developed in the territory of YNAO. In particular, according to the YNAO Forest Plan (as amended by the Resolution No. 22-PG of the Governor of Yamal-Nenets Autonomous Okrug, dated 21 March, 2018), the direction of remediation should be chosen so that to ensure the maximum possible environmental rehabilitation of disturbed areas, including the restoration of catchment areas, biological remediation, and creating a favorable landscape, taking into account the requirements of territorial authorities for management and supervision of the activities aimed at the observance of environmental, sanitary-epidemiological, and fire-safety standards and rules, providing a favorable effect of the Project on the environment and the population.

2. Land remediation in Salmanovskiy (Utrenniy) License Area: choosing the direction

The direction of remediation is determined by a possibility for ensuring the maximum environmental rehabilitation of disturbed areas, land return to the original land use, and creating a favorable landscape, taking into account the requirements of territorial authorities for management and supervision of the activities aimed at the observance of environmental, sanitary-epidemiological, and fire-safety standards and rules, providing a favorable effect of the Project on the environment and the population.

For the territory of the Project, where the growth of forest vegetation is impossible for climatic and edaphic reasons, the choice of prospective directions for disturbed lands remediation, presented in GOST 17.5.1.02-85, is limited to three main ones:

- **agricultural** — for disturbed agricultural land (reindeer pastures) to be transferred to the lessor upon work completion;
- **construction —** for improvement areas where landscaping is impossible (hard surfaces, filling, drainage facilities), and for other disturbed areas of industrial land[82] intended for construction, including those for capital construction projects or temporary buildings/structures;
- **environmental** — for disturbed land of different categories, where anti-erosion measures and landscaping are implemented as per design, as well as water-logged, technically conserved, and

[82] Full title for this category of lands is "lands of industry, energy facilities, transport, communication facilities, radio and TV broadcasting, information facilities, lands for space activities, defense lands, security lands and lands for other special purposes"

self-vegetating areas (i.e., not landscaped intentionally for economic use) not included in the first two groups.

In accordance with the *Basic Provisions on Land Remediation, Removal, Conservation and Rational Use of Topsoil* (approved by the Order No. 525/67 of Russian Ministry of Natural Resources and the Committee for Land Resources and Land Management, dated 22 December, 1995), remediation of lands requiring restoration or initial formation of fertility and ecological functions of soils (in our case, in agricultural and environmental directions) is carried out consistently in two stages: technical (generally, as a package of earth-moving and engineering works), and biological; land remediation in the construction direction is carried out in one technical stage.

According to paragraph 5 of the *Basic Provisions*, remediation shall be carried out on the lands where the soil has been affected by construction, forest harvesting, surveys, or other works. In this case, the conditions for bringing the land into a condition suitable for further use shall be established by the authority that has granted the use of the land plot and has issued the permit to carry out the works (paragraph 6).

The areas to be restored under this Project are mainly classified as agricultural land; therefore, the chosen direction of these lands remediation is mainly agricultural. General requirements for its implementation are stated in Section 6.1 of GOST 17.5.3.04-83 (Table A9.1).

In addition, Section 5 of the same document contains a number of specific requirements for the remediation of areas disturbed by drilling and related exploration. They basically concern technical remediation activities (see also Table A9.1).

Table A9.1: General requirements for lands remediation in accordance with GOST 17.5.3.04-83, and their applicability to the conditions of Salmanovskiy (Utrenniy) license area

Requirements as per GOST 17.5.3.04-83	Consultant's comments
Requirements for land remediation with regard to agriculture	
Forming the areas of disturbed lands, convenient for use in terms of relief, size and shape, the surface layer of which should be composed of rocks suitable for biological remediation	With regard to the conditions of Salmanovskiy (Utrenniy) license area and especially the territory of the projected construction of the Plant and Port onshore facilities, the requirements for the relief formation should be complemented with the minimum possible violation of the hydrothermal regime of soils and geological environment, effective organization of surface and subsurface runoff, prevention of activation of cryogenic processes and deflation typical of this territory to a greater extent than landslides and water erosion
Recovery of remediated areas	
Grading of disturbed land plots, ensuring the productive use of modern equipment for agricultural works and preventing the development of erosion processes and landslides	
Placing the topsoil on unsuitable rocks to prepare the land for tillage	There is no topsoil in the soil cover of Salmanovskiy (Utrenniy) license area; during remediation, the topsoil can be created from peat, peat-sand mix, humus, and biotextile materials
Use of potentially fertile rocks with special agrotechnical measures if the fertile soil layer is missing or insufficient	
Intensive reclamation with cultivation of annual and perennial gramineous and leguminous crops for restoration and formation of the root layer and its enrichment with organic substances when carrying out special agrochemical, agronomical, agroforestry, engineering and anti-erosion activities	This requirement cannot be fully applied to the conditions of the Gydan Peninsula; reclamation effects should be limited to the minimum necessary measures to provide surface and subsurface runoff, prevent the development of hazardous exogenous processes; the composition of grass mixes for planting should include perennial gramineous herbs (annual gramineous and leguminous plants will not provide the required conditions for soil improvement)
Obtaining the certificates from agrochemical and sanitary and epidemiological authorities confirming no risk of removal of substances toxic for humans and animals by plants	Current legislation does not require obtaining any special certificates from agrochemical and sanitary and epidemiological authorities to confirm no risk of removal of substances toxic for humans and animals by plants (except for the cases when this requirement is initiated by the lessor as one of the conditions for particular land remediation quality control). At the same time, remediation quality control should be supported by the materials of industrial environmental monitoring and control, as well as by certificate of the Standing Committee for Land Remediation of Tazovskiy Municipal District. The certificate of the Standing Committee contains, but is not limited to, the information on the level of compliance with the requirements of environmental, agricultural, sanitary and hygienic, construction standards, norms and regulations, depending on the type of soil cover disturbance and further intended use of

Requirements as per GOST 17.5.3.04-83	Consultant's comments
	the reclaimed land[83]
Requirements for remediation of lands disturbed by exploration works	
During the construction, reconstruction and operation of linear facilities (mains and branch pipelines, railways, roads, canals), it is required to conduct remediation of pipeline routes, quarries along the pipelines, reserves, and soil banks	With regard to the Project, remediation should be also provided for the areas of temporary site facilities (TSF) for the construction period (logistic facilities, temporary accommodation camps, temporary sites for solid waste accumulation, etc.)
Remediation of land plots occupied by agricultural or forest lands provided for construction of linear facilities or reconstruction of the existing ones shall be included in the general package of construction and installation works and ensure the restoration of land fertility	In the conditions of Gydan tundra, the target indicator of lands remediation for agricultural purposes at the initial stage is surface fixation and prevention of activation of hazardous exogenous processes and the hydrological phenomena, while at the subsequent stages, it is restoration of reindeer pastures in terms of species composition and productivity of higher plants and shrubby lichens
Before starting the construction of the main pipelines, transport communications and canals, the topsoil shall be removed and stored in a temporary dump along the construction strip within the limits provided by the land allocation standards; upon the completion of construction and grading, this topsoil shall be used for remediation or earth mulching	According to the engineering survey materials, there are no soils with fertile topsoil within the boundaries of the license area. At the same time, due to the shortage of peat in the area under study, it can be recommended to remove organic soil layers (peat, humus, tirr) in the areas inevitably damaged by construction
At the technical stage of land remediation during the construction of linear facilities, the following works shall be carried out: cleaning the area from construction debris; removal of all temporary structures from the construction strip; backfilling of pipeline trenches, forming a soil bank to ensure smooth surface after compaction; uniform distribution of remaining soil over the remediated area or its transportation to the dedicated places specified in the design; forming the slopes of soil banks, embankments, excavations; backfilling or leveling of ruts and pits; measures to prevent erosion processes; coating the remediated areas with topsoil layer	There is no topsoil in the soil cover of Salmanovskiy (Utrenniy) license area; during remediation, the topsoil can be created from peat, peat-sand mix, humus, and biotextile materials. With regard to the conditions of Salmanovskiy (Utrenniy) license area and especially the territory of the projected construction of the Plant and Port onshore facilities, the requirements for the relief formation should be complemented with the minimum possible violation of the hydrothermal regime of soils and geological environment, effective organization of surface and subsurface runoff, prevention of activation of cryogenic processes and deflation typical of this territory
During the construction of main pipelines on the lands occupied by forests, remediation consists in backfilling of trenches and pits, general grading of the right-of-way, cleaning the site from construction debris, and surface turfing by grass planting	There are no forest lands within the boundaries of Salmanovskiy (Utrenniy) license area
It is prohibited to restore tree and shrub vegetation in the pipeline right-of-way, if this may affect its normal operation.	Forest vegetation cannot grow in the conditions oa the northern part of the Gydan Peninsula
Remediated lands above the underground pipelines, oil and gas storage facilities, and in the pipeline protection zones should be used by land users with prior notice to the enterprises (organizations) operating the pipeline, performing the works and taking measures to ensure safety of the facilities	In the conditions of Gydan tundra, the use of land over the underground linear facilities is complicated by the activation of a wide range of exogenous processes and hydrological phenomena, which can be prevented by restricting any possible physical and mechanical disturbance of the earth fill surface (mound above the pipeline)
On the lands disturbed during exploration, surveys, drilling of production wells, the topsoil shall be removed, dumped and stored in accordance with GOST 17.4.3.02-85	According to the engineering survey materials, there are no soils with fertile topsoil within the boundaries of the license area.
When drilling wells, it is required to provide the tanks for drilling fluids storage and for accumulation of the first test portions of oil and condensate. The tanks constructed in an excavation should be screened	The term "tanks" should be understood as earthen pits for drilling waste accumulation. Currently, such pits are designed, constructed, operated and remediated as waste disposal facilities
After the exploration, survey and operation activities, the following works should be carried out: removal of well facilities, construction wastes, oil products and materials used in drilling, in accordance with the established procedures; backfilling of tanks and surface grading;	

[83] Enactment on Standing Committee for Land Remediation in Tazovskiy Municipal District. Approved by the Resolution No. 493 of the district Administration, dated 16 December, 2010 (amended on 16 June, 2014)

Requirements as per GOST 17.5.3.04-83	Consultant's comments
necessary reclamation and anti-erosion works; coating the surface with topsoil layer	
When remediating land plots contaminated with oil, oil products and oilfield wastewater, it is necessary to take the following environmental measures: to accelerate the degradation of petroleum products; to neutralize high salinity and alkalinity of soils	In the conditions of the Gydan Peninsula, there is no potential possibility for high salinity and alkalinity to become stable properties of contaminated soils due to their excessive moisture content. The processes of hydrocarbon degradation in the soils of the Gydan Peninsula are extremely slow due to low temperatures, weak biochemical activity, lack of free oxygen, and uneven distribution of solar radiation by seasons

3. Land remediation in Salmanovskiy (Utrenniy) License Area: main objectives, standard timing, procedure

The Consultant's comments presented in Table A9.1 are associated with the requirements of GOST 17.5.3.04-83 for disturbed lands remediation, and "bind" them to the Project area which is quite specific in terms of conditions for soil and land restoration.

In the Consultant's opinion, the main objectives of remediation of lands disturbed by the Project are the following:

- **facilitation of natural rehabilitation** of natural ecosystems;
- return of lands to the **initial use of natural resources**, taking into account the limitations associated with the operation of the Project facilities;
- **prevention of the development of adverse changes** in the ecosystems of adjacent territories.

The procedure of disturbed land remediation consists of the following stages:

- obtaining technical specifications for disturbed land remediation;
- development of a project of disturbed lands remediation;
- agreement upon the project of disturbed lands remediation with the lessor of respective land plot prior to the commencement of works involving the soil cover disturbance;
- carrying out the works on disturbed lands remediation before the expiry of the lease agreement for respective land plot;
- control of remediated land plot compliance with the requirements of paragraph 5.10 of the Provisions of the Standing Committee for Land Remediation of Tazovskiy Municipal District (approved by the Resolution No. 493 of the District Administration, dated 16 December, 2010; amended on 16 June, 2014).

The remediation procedure is considered to be completed after all parties have signed the acceptance certificate for respective land plot, which states full acceptance (without comments and postponement of soil restoration) of remediated land and its transfer to the lessor. If, for some reasons beyond control, it is impossible to finalize the biological stage of land remediation before the lease expiry, the lease period can be extended; otherwise, grounds for proposal to change the intended purpose of land can be reflected in the certificate.

Land remediation issues should be settled in working interaction with the Standing Committee of relevant municipality, which usually includes the Head (Chairperson of the Committee), one of the Deputy Heads (Deputy Chairperson of the Committee), a leading specialist of the Administration on housing, architecture, construction and municipal property (Secretary of the Committee), chief specialist of the Administration on property and land issues, and the Head of the Department of Contracts within the Land and Environmental Management Directorate of the Department of Property and Land Relations of the Tazovsky Municipal District Administration.

Upon completion of the remediation, the respective land plots and adjacent territories are included in the industrial environmental monitoring programme, the objective of which, in this case, is to assess the remediation efficiency, to determine the adequacy of design solutions for land remediation and the need for any additional measures.

4. Land remediation in Salmanovskiy (Utrenniy) License Area: technical specifications

Technical Specifications are the direct source of requirements for remediation of land disturbed by construction. They should take into account all the provisions of the federal legislation mentioned above, as well as the specifics of the condition, the intended use (designed activity) and future use (after return to the lessor) of a particular land plot.

In the Russian Federation, there is no established practice of documenting the technical specifications for disturbed land remediation. In some cases (for example, for YNAO forestry areas), the source of relevant

requirements is the District Forest Plan and Forestry Regulations of the forestry area which the area is assigned to; in other cases (for example, in Purovskiy Municipal District), the technical specifications for remediation are a part of more general set of requirements for land remediation projects, which is approved by the Resolution of the municipality Administration and posted on its official website; finally, for example, for the territory of urban and rural settlements in YNAO, the requirements for remediation are specified in the territorial building codes[84]. At the same time, there are some industry-specific sets of requirements for disturbed land remediation, including those referring to a particular region or a group of regions of the Far North[85].

Each of these documents is based on the results of practical implementation of various methods of disturbed lands remediation in the territory of YNAO and neighboring regions of the Russian Federation. For land plots within the Salmanovskiy (Utrenniy) LA, none of them is a source of mandatory requirements; however, when designing remediation, it is advisable to take into account not the provisions thereof, but also the gained experience of land restoration in the tundra zone of the Russian Arctic.

Technical specifications for remediation of lands allocated for the Project under short-term lease (for the period of construction) in Tazovsky Municipal District can be included in the lease agreements for respective land plots (for example, in an appendix), or can be issued by the lessor as a separate document (letter) to the design organizations collecting the initial data for design, land management and town-planning documentation development.

In some cases, the lessee of a land plot or a design organization acting on their behalf can develop a draft project of disturbed land remediation and coordinate it with the lessor and land user of the land plot. The following section contains analysis of the best practices of disturbed land remediation in the tundra zone of YNAO; it is proposed to use the findings of this analysis for technical specifications and land remediation projects to be developed within this Project.

5. Land remediation in Salmanovskiy (Utrenniy) License Area: best available practice

5.1. General approach to remediation design

In the Russian Federation, the traditional practice of land management in construction projects consists in dividing the allocated lands into long-term and short-term lease areas; the former are allocated for permanent buildings and structures, as well as the adjacent territory arrangement for the entire period of operation of the designed structures; the latter are used exclusively at the construction stage, and it is their return to lessors that should be preceded by remediation in appropriate direction: agricultural, forestry, environmental, etc.

Land remediation activities are usually designed with reference to lease agreements (in which case the number of remediation projects is equal to the number of agreements), to lessors, to the boundaries of administrative-territorial division (one consolidated remediation project for each municipality), and to the land categories within these boundaries.

Elemental unit of a remediation project is a technological chart, i.e. a functional sequence of practices for technical and biological stages of remediation, applicable to a specific combination of natural and man-made conditions. Each project can provide for several technological charts, the number of which depends on the diversity of soil conditions on the terrain, options for its use in construction, and other factors.

From the Consultant's point of view, at the design development phase, it is optimal to develop a comprehensive set of charts for technical and biological remediation, which will further form individual remediation projects for particular land plots in short-term lease, as well as all other land plots remediation of which will be necessary (violations of Project footprint boundaries, identified at the stage of industrial environmental monitoring; and long-term remediation of land after the Field, Plant and Port facilities decommissioning).

[84] TSN 30-311-2004. Urban Planning. Planning and development of urban and rural settlements of Yamal-Nenets Autonomous Okrug. Regional Construction Norms. Approved and enforced by the Resolution No. 134 of the Governor of Yamal-Nenets Autonomous Okrug on 18 May, 2002

[85] System of biological remediation of lands disturbed during construction of gas pipelines and restoration of vegetation in degraded pasture lands in tundra and forest tundra zones of the Far North: methodological guidelines. Norilsk: Research Institute of the Far North Agriculture, Northern Branch of Russian Academy of Agricultural Sciences, 2006, 28 p.

Implementation of biological strengthening of slopes, remediation of right-of-way and quarries on motor roads of Yamal-Nenets Autonomous Okrug. Technical specifications. Salekhard: YNAO Road Management Directorate, 2009.

5.2. Activities within the scope of civil works. Organic soils treatment

Since there is no fertile topsoil in the license area, the activities its removal, storage and protection are not required. At the same time, according to the Consultant, due to the general shortage of organic material in the Project area, it will be reasonable to remove the peat-moss layer and store it until the land remediation commencement in the following cases:

- works associated with soil disturbance are carried out in warm season, which makes it impossible to preserve the upper layers of soils in undisturbed condition;
- the site where it is supposed to remove the peat-moss layer is intended for permanent buildings and structures, or will be used for open mining (quarry);
- within the boundaries of solid bogs crossed by communication lines, organic soils are excavated according to the design (peat reclamation);
- the thickness of the peat-moss layer is 0.3 m or more.

In all other cases, the common requirement is to carry out the preparatory and earth-moving works in cold season, without disturbing the peat-moss layer in a frozen state, and, if necessary, to take additional measures to protect it from physical and mechanical damages during subsequent thawing and within the entire period of operation of the designed facilities.

Shortage of organic material necessary for disturbed lands remediation can be compensated by peat production in quarries and its storage on special grounds together with the removed peat-moss soil layer. In this case, measures should be taken to protect the dumps (storage pits) of peat and humus from scouring and dusting, and from organic material mixing with mineral soils and construction wastes.

When using peat, preference should be given to lowland peat which contains more nutrients and compounds in the form available to plants. The best time for peat harvesting in this region is July and August.

5.3. Technical stage of remediation

Before the technical remediation, the following should be provided:

- de-installation of temporary buildings and structures;
- visual route survey of the site to be remediated, in order to identify residual presence of production and consumption wastes, and soils with any signs of chemical contamination, as well as the foci of development of dangerous exogenous processes and hydrological phenomena (within the Industrial Environmental Monitoring Programme);
- remediation territory cleaning from production and consumption wastes;
- collection and removal of soils with signs of chemical contamination, in accordance with the design solutions for relevant waste management.

If it is impossible to collect and remove the soils contaminated with oil products, it is a common practice to use bacterial preparations and sorbents to stimulate their self-purification; today, their efficiency reaches 85% in 10 days at an average daily temperature of +7 °C[86].

Land remediation at this stage provides for two main activities:

- additional engineering preparation of the territory to prevent the development of dangerous exogenous geological processes and hydrological phenomena, the need for which is determined by the results of route surveys within the industrial environmental monitoring and control (see above);
- formation of the designed terrain or restoration of the disturbed natural relief of the territory;
- formation of organic layer of the restored soil by placing the peat or peat-sand mixture, or by laying biotextile materials.

Requirements for the relief on remediation sites are determined by the conditions of their further use:

- for sites remediated in the construction direction (without the biological stage), the relief must meet the requirements for the soil surface shape set in the design documentation;
- for sites remediated in the agricultural direction, even relief without sharp changes in elevations and slopes is most preferable;
- the relief of sites remediated in the environmental direction should be optimal in terms of suppression of dangerous exogenous geological processes and hydrological phenomena.

[86] Pystina, N.B. et al., Improvement of technologies for disturbed and contaminated lands remediation at hydrocarbon fields of the Far North, Nauchnyi vestnik YaNAO [YNAO Research Bulletin], 2016, no. 2 (91), pp. 4-8

The experience of land remediation on the territory of Yamburg gas condensate field shows that for the areas with predicted or actual activation of dangerous exogenous geological processes and hydrological phenomena, the effective techniques of relief stabilization and erosion control are[87]:

- flattening or terracing of erosion-prone slopes;
- elimination of subsidence phenomena by depressions backfilling and soil compacting;
- filling the top areas of small erosion forms with mineral soil;
- making the drainage and water-guiding earth mounds with runoff hollows strengthened with preventive anti-erosion composition[88]; if drilling wastes are available, they can be used for preparing a bentonite-humate mix for fixing sand substrates, the efficiency of which has been practically confirmed, in particular, at the enterprises of Gazprom Dobycha Nadym LLC[89];
- strengthening and control of large erosion-hazardous watercourses and rills (using geotextile, bentonite-polymer compositions, etc.);
- application of heat-insulating materials to control the processes of heat exchange between the soil and the atmosphere, and for soil protection from freezing/thawing, i.e. for thermal conditions optimization in the soil layer.

A general recommendation for the technical stage performed in the warm season is to use mobile pavements preventing irreversible damage to the peat-moss layer by moving vehicles during remediation activities. The choice of specific technical solutions is determined in the design documentation based on the engineering survey materials, taking into account the adopted technology of construction, and availability of equipment and materials.

The composition of peat-sand mixes used for technical remediation is usually formed with the ratio of peat and sand 75% to 25% wt, and the layer thickness after this mix application should be at least 10 cm[90]; the optimal thickness, according to the Consultant, is 15-20 cm.

In the cases where the grain-size composition of soils on the construction site contains loam and clay along with sand, the regional construction norms TSN 30-311-2004 recommend to form multi-layer soil profiles with alternating layers of peat, clay/loam and sand with the general ratio of clayey and sandy soils 1:3-1:5; according to the Consultant, in the territory of Salmanovskiy (Utrenniy) LA, this practice can be applied mainly locally.

After placing the peat-sand mix, it is necessary to compact the soil to reduce the risk of the organic layer destruction by exogenous processes.

The time schedule for the technical remediation of lands is established by the construction Client together with the land user in coordination with the calendar schedule of construction. Unlike the main scope of earthwork that should be performed in the cold season, the works on peat or peat-sand mix application should be carried out in the warm period, after soil dumps thawing and in absence of snow and ice cover on the restored surface. In this case, the best option is to carry out the biological remediation immediately upon completion of the technical stage; this will ensure stabilization of the restored organic soil layer.

5.4. Biological Reclamation

Substrates Preparation. Yamal Agricultural Experiment Station is the organization that has the greatest experience in biological reclamation of disturbed land in the region, its general approach to restoration of soil and vegetation cover in the areas disturbed by technogenesis provides for the following classification of these areas[91]:

[87] Khabibulin, I.L., Lobastova, S.A., Gabbasova, I.M., Margulov, A.R. and Suleimanov, R.Kh. Engineering and biological remediation of disturbed territories at Yamburg GCF, Moscow: VNIIE Gazprom, 1991, 29 p.

Unanyan, K.L., Assessment and prevention of hazardous manifestations of erosion processes in economic development of permafrost zone. Cand. Sc. dissertation abstract, Moscow: Gazprom VNIIGAZ, 2011.

[88] For this purpose, a wide range of structure-forming compounds are used, such as compounds based on latex, water-soluble polymers, xanthan gum, polyvinyl alcohol, and heavy derivatives of oil; to the Consultant's opinion, these substances should be used only in case of accidental activation of hazardous exogenous processes that threaten the safety of buildings and facilities

[89] Medko, V.V. and Cheverev, V.G., Concept of stability provision for dumped facilities in the north of Western Siberia, *Proc. of International Conference "Cryosphere of Oil and Gas Provinces"*, Tymen, 2004, pp. 60-61.

Medko, V.V., Remediation of quarries and protection of soils from erosion in the Far North (by example of Medvezhye gas condensate field), Cand. Eng. Sc. dissertation, Moscow, 2004, 236 p.

[90] Procedure for consideration and approval of remediation projects for land plots located on lands of reserve, industry and agriculture in the territory of Purovskiy Municipal District

[91] Biological Reclamation of Disturbed Land on the Yamal Peninsula: Recommendations of Yamal Agricultural Experiment Station - Novosibirsk: Siberian Branch of the Russian Academy of Agricultural Sciences, 1994. 48 p.

1) peated areas with native vegetation root systems partly preserved (at least 25 %);
2) peated areas with no native vegetation root systems preserved;
3) level surfaces of sand substrate;
4) sloped surfaces of sand substrate.

The differences in methods of these areas reclamation include the following:

- in the areas of the 1-st category, it is suggested to limit the measures by application of mineral fertilizers;
- the areas of the 2-nd category are subject to disking and harrowing before seeding perennial grasses together with planting willows on the slopes;
- the areas of the 3-rd category require application of organic (peat, humus) and mineral fertilizers before seeding perennial grasses;
- the areas of the 4-th category differ from the areas of the 3-rd category by the need for soil stabilization with polymer binders (Universin, latex, polyvinyl alcohol (PVA) - refer to the Consultant remark above) or planting willows.

It is appropriate to combine application of deoxidizing agents and fertilizers with preparation of peat-sand mixture: such compost shall be prepared 30-40 days before the expected time of its application by adding to peat the following: 50 mg of agricultural lime per unit (1 mEq) of hydrolytic acidity, 3 kg/t of ammonium nitrate, 5 kg/t of superphosphate and 3 kg/t of potassium salt. It is recommended to apply the received material at the initial stage of soil freezing when it's free from snow cover (in the autumn). On the Consultant's opinion, separate application of three types of fertilizers can be replaced with a single complex fertilizer without compost quality degradation, the most widespread type of such fertilizer is NPK containing 17 wt% of nitrogen, potassium and phosphorus on an average.

According to the results of long-term studies conducted in the territory of YNAO[92], the amount of peat applied in the reclamation areas shall be 480-720 t/ha[93] or not less than 1.0–1.5 thous. m^3/ha[94], deoxidizing agent (dolomitic meal) shall be applied at a rate of 2–6 t/ha, mineral fertilizers - $N_{90\text{-}135}P_{90\text{-}135}K_{90\text{-}135}$; this in the aggregate ensures dry weight gain of perennial grasses at a level of 2–3 t/ha, as compared to the case without chemical reclamation.

In certain cases, it is not recommended to apply agricultural lime or dolomitic meal on the tundra gley soils, since either the lack of effect of its application, or even the negative effect has been demonstrated[95]. However, in the majority of cases application of agricultural lime and mineral fertilizers has a positive effect on vegetation strengthening, as well as it promotes better introduction of native flora into the reclamation contour[96]. Therefore, on the Consultant's opinion, in the territory Salmanovskiy (Utrenniy) LA, the feasibility of application of 2 t/ha of dolomitic meal and 500 kg/ha of standardized composition NPK (12-18 % N, 16-20 % P_2O_5, 18-20 % K_2O), which is equivalent to the quantity of $N_{75}P_{100}K_{100}$, shall be assumed. A shift away from chemical reclamation is necessary only within the boundaries of water protection zones of the surface water bodies and Ob Bay of Kara Sea, sanitary protection zones of water supply sources.

Usage of complex organomineral mixtures may serve as an alternative to separate application of organic and mineral fertilizers. One of the options of such mixture is liquid potassium humate produced form local

[92] A.N. Tikhanovsky Optimization of Fertilizers Application on the Soils of the Far North of West Siberia. Thesis (Dr. Agr. Sc.) Salekhard, 2004.

Biological Reclamation of Disturbed Land on the Yamal Peninsula: Recommendations / Yamal Agricultural Experiment Station - Novosibirsk: Siberian Branch of the Russian Academy of Agricultural Sciences, 1994. 48 p.

[93] At a bulk density of peat with a low decomposition level of 150 kg/m^3 (GOST R 51213-98) and its even distribution throughout the area with 10 cm thick layer, the applied weight shall approximately amount to 150 t/ha. The indicators of peat with increased water content, after excavation, compaction and storage in dumps, are expected to increase: from 400 (milled peat) to 800 kg/m^3 (raw sphagnum peat). The mass fraction of organic matter in the peat-sand mixture will be determined not only by water content, but also by the substrate mineral and organic components ratio.

[94] A.N. Tikhanovsky Problems and Methods of Biological Reclamation of Technologically Disturbed Lands of the Far North // The Success of Modern Natural Science. 2017. No. 2. pp. 43-47.

[95] Engineering and Biological Reclamation of disturbed land of Yamburgsk GCF / I.L. Khabibullin, A. Lobastova, I.M. Gabbasova, A.R. Margulov, R.Kh. Suleymanov // M.: VNIIE Gazprom, 1991.29 p.

[96] A.S. Motorin, A.V. Iglovikov Development of Phytocenosis Artificially Created at the Biological Stage of Reclamation in the Far North Conditions // Siberian Herald of Agricultural Sciences. 2015. No. 6. pp. 50-56.

A.I. Popov Experimental Biological Reclamation in the Tundra Belt of the Nenets Autonomous Okrug. - Arkhangelsk, 2015.

A.A. Galyamov, E.V. Gaevaya, E.V. Zakharova Biological Reclamation of Agricultural Land (Reindeer Pastures) on the Yamal Peninsula // Herald KrasGAU. 2015. No. 10. pp. 17-22.

peat[97]. Another well-proven option is application of liquid sodium humate and auxin that enhance the growth of root systems and land-based plants biomass, noticeably increase the viability of planting[98].

Grassing-down. Agricultural and environmental aspects of biological reclamation provide for creation of a vegetation cover from perennial grasses having the highest biomass and extensive root system. Much experience in application of different grass mixtures has been accumulated over the past decades in the territory of YNAO, their efficiency for consolidation of soil surface, soil conditioning, enhancing further progressive succession that promote assimilation of reclaimed areas with the landscapes of their surrounding territory has been estimated.

Certain requirements and recommendations for the content of grass mixtures used for grassing down may differ:

- in the territory of Purovskiy District of YNAO that is adjacent to Tazovskiy District[99], rated grass mixture composition shall include annual (with the quantity of up to 30 %) and perennial plants able to grow up to the generative stage in the Far North conditions;
- Territorial Construction Standards TSN 30-311-2004[100] recommend application of red fescue, meadow foxtail, Kentucky bluegrass, Lapland reedgrass, tufted hairgrass, sheep fescue for the purposes of biological reclamation;
- experience of biological reclamation at the facilities of Yamburgsk GCF proved efficiency of applying local wild plants - Lapland reedgrass and purple reedgrass, sheep fescue, Deschampsia sukatschewii;
- forest plan of YNAO[101] recommends application of the following composition of the grass seeds with obligatory preseeding treatment with biological stimulant: fireweed (10 kg); wheat grass(35 kg); meadow-grass (10 kg); white clover (30 kg); bentgrass (25 kg); melilot (10 kg); total for 1 ha of reclaimed area - 120 kg of seeds;
- it is recommended to perform biological reclamation of sand quarries with application of multicomponent grass mixture including the following plants: red fescue, awnless brome, meadow fescue, Timothy-grass, couch grass, Kentucky bluegrass, sloughgrass in ratio of 40:35:10:5:5:3:2 % at a seeding rate of 120 kg/ha[102].

The following recommendations are considered as general:

- application of local plants;
- multicomponent grass mixtures;
- seeding in the period from June to early September;
- a shift away from pea family plants due to their frost-killing in the first year after seeding;
- check of seeds germinating ability and their pretreatment with growth substances (stimulators).

Certain timeframes for implementation of biological reclamation activities shall be determined based on the selected technical means. For the tundra belt of the Nenets Autonomous Okrug, it has been confirmed that seeding in autumn is preferred due to extended plant growth in the first year of life[103]. Based on the example of reclamation areas within the Bovanenkovskoye field (Yamal Municipal District of YNAO), grassing down in mid and late June has been proved effective with subsequent handling of plants until seasonal snow cover develops[104].

Plant species recommended for inclusion in the grass mixtures are given in Table A9.2. They mostly include perennial grasses able to create firm turf and good herbage, that are seed and vegetatively propagated,

[97] A.K. Arabisky, V.N Bashkin., R.V. Galiulin Innovative Technology for Soils Reclamation Implemented on the Tazovskiy Peninsula (Yamal-Nenets Autonomous Okrug) // Industrial Safety. 2018. No. 3

[98] N.B. Pystina et al. Technological Advancements in Reclamation of Disturbed and Polluted Lands in the Hydrocarbon Fields of the Far North // Scientific Newsletter of YNAO. 2016. No. 2 (91). pp. 4-8.

[99] Resolution of the Head of Purovskiy District Municipality of 02.02.2016 No. 17-PA "On procedure for consideration and approval of the projects of reclamation of the land plots located on the reserve, industrial and agricultural lands in the territory of the Purovskiy District"

[100] TSN 30-311-2004. Urban Development. Rural and Urban Planning and Development in the Yamal-Nenets Autonomous Okrug. Territorial Construction Standards. Accepted and entered into force based on the Resolution of the Governor of Yamal-Nenets Autonomous Okrug of 18.05.2002 No. 134

[101] As amended by YNAO Governor Resolution of 18.12.2008 No. 135-PG

[102] A.V. Iglovikov Biological Reclamation of Quarries in the Far North Conditions. - Thesis (M. Agr. Sc.) Barnaul, 2012. 196 p.

[103] A.I. Popov Experimental Biological Reclamation in the Tundra Belt of the Nenets Autonomous Okrug. - Arkhangelsk, 2015

[104] N.B. Pystina et al. Technological Advancements in Reclamation of Disturbed and Polluted Lands in the Hydrocarbon Fields of the Far North // Scientific Newsletter of YNAO. 2016. No. 2 (91). P. 4-8

winter hardy, growing on poor substrates with high acidity. In the column "Consultant Note" suitability of species for biological reclamation of disturbed land within Salmanovskiy (Utrenniy) license area is assessed.

Table A9.2: Plant species suitable for grassing down in the territory of YNAO

Species name		Species characteristics[105]	Consultant Note
Pendant grass	Arctophila fulva	Rhizomatous perennial grass growing up to 100 cm in height. Seed and vegetatively propagated. Used as pasture plant and partly as hay plant. Grows in the territory of YNAO in the forest-tundra and tundra. Goes to seed the second year after seeding. Winter hardy and water-intensive species forming thicket in river flood valleys and being a highly nutritious food for the reindeer. Tolerates seeding in wet peated areas both separately and as a part of grass mixture, with the content of 50 %. Seeding rate - 16 kg/ha, seeding depth - 2 cm	**Species are suitable for inclusion in the grass mixtures at the stage of biological reclamation design within Salmanovskiy (Utrenniy) LA**
Arctagrostis latifolia			
Slough grass	Beckmannia eruciformis	Tall rhizomatous perennial grass growing up to 120 cm in height. Water-intensive, winter hardy grass that tolerates flooding, re-grows again in spring. Grows in the territory of YNAO in the forest-tundra and tundra. Can be preserved in grass mixtures up to 10 years; can be used as both pasture plant and hay plant. Consumed by all animal species. An optimal option for seeding in peated areas both separately and as a part of grass mixture, with the content of 40 %. Goes to seed the second year. Seeding rate - 16 kg/ha, seeding depth - 2 cm	
Small reed	Calamagrostis Langsdorffii	Perennial grass with creeping rhizomes, growing up to 120 cm in height. Grows in the forest-tundra. The seeds ripen the second year after seeding. Sometimes pure thicket can be found, well-consumed by reindeer in spring, in autumn - not so well. Winter hardy, water-intensive. Seed and vegetatively propagated. Seeding is preferred on well watered peated areas. Seeding rate - 14 kg/ha, seeding depth - 2 cm	Since the species natural area doesn't extend to tundra, the species content in reclamation grass mixtures doesn't appear reasonable
Narrow small-reed	Calamagrostis neglecta	Rhizomatous perennial grass growing up to 80 cm in height. Seed and vegetatively propagated. Widespread in tundra and forest tundra in YNAO. Consumed by reindeer mainly in early spring. Winter hardy, water-intensive. Suitable for seeding in peated areas with seeding rate - 15 kg/ha and seeding depth - 2 cm	**Species are suitable for inclusion in the grass mixtures at the stage of biological reclamation design within Salmanovskiy (Utrenniy) LA**
Siberian wild rye	Elymus sibiricus	Tall perennial loose-bunch grass growing up to 130 cm in height, folious, frost-hardly, drought-tolerant. Common for forest tundra, but seeds ripen in tundra as well. Seed and vegetatively propagated. Consumed by all animal species; pasture plant and hay plant. Reinforces the sands well. Can be preserved in grass mixtures up to 6 years. Seeding rate - 16 kg/ha, content in grass mixtures - 40 %, seeding depth - 3-4 cm	
Cocksfoot	Dactylis glomerata	Tall perennial loose-bunch grass growing up to 130 cm in height, with high sprout formation capacity (up to 20 sprouts) and extensive root system. Re-grows again quickly in spring, in the year of seeding grows slowly. Frost-hardly, not tolerant to flooding. Seed and vegetatively propagated. Can be preserved in grass mixtures up to 10 years. Was introduced to YNAO from the areas with harsh climatic conditions. Well-consumed by all types of livestock. Satisfactory tolerates trampling. Suitable for grassing down	It is not suitable for the biological reclamation of the Gydan Peninsula soils due to adverse climatic and edaphic conditions and the invasiveness of the species

[105] According to the recommendations of Yamal Agricultural Experimental Station with Consultant comments added

Species name		Species characteristics[105]	Consultant Note
		of sand quarries at seeding rate 14-15 kg/ha, seeding depth - 2-3 cm	
Awnless brome	Bromus inermis)	Tall rhizomatous perennial grass. Folious, has many vegetative sprouts, well developed root system, grows up to 150 cm in height. Has a high drought tolerance and frost resistance, capable of withstanding flooding. Well-consumed by all types of animals. Can be preserved in plant formations up to 15 years. Was introduced to YNAO from the areas with harsh climatic conditions. Seeding rate for grassing down - 18 kg/ha, seeding depth - 3-4 cm	It is not suitable for the biological reclamation of the Gydan Peninsula soils due to the invasiveness of the species and disappearance from the grass mixtures in 2-3 years after seeding
Lady's-laces or reed canary grass	Digraphis arundinacea	Tall rhizomatous perennial grass growing up to 140 cm in height. Seed and vegetatively propagated: by fresh sprouts, stem cuttings, pieces of turf. Frost-hardly, water-intensive. In the territory of YNAO, it can be found in forest tundra. Has a large number of well-leafed stems, goes to seed the second year, manifest perennial characteristics in plant formations, well-consumed by the animals. Seeding rate for grassing down - 15 kg/ha. Seeding as a part of grass mixture is recommended with the content of up to 40 %. Seeding depth - 2 cm	It is not suitable for the biological reclamation of the Gydan Peninsula soils due to adverse climatic and edaphic conditions
Meadow foxtail	Alopecurus pratensis	Tall short-rhizomatous and loose-bunch grass growing up to 120 cm in height. Has a high tilling capacity; seed and vegetatively propagated. Wildlife species can be found in tundra and forest tundra. Water-intensive, tolerate long-term flooding, high acidity and salinity. Winter hardy, re-grows again in spring; well-consumed by the animals. The seeds ripen in tundra and forest tundra. Seeding rate for grassing down - 14-15 kg/ha, seeding depth - 2 cm	**Species are suitable for inclusion in the grass mixtures at the stage of biological reclamation design within Salmanovskiy (Utrenniy) LA**
Kentucky bluegrass	Poa pratensis	Perennial rhizomatous and loose-bunch grass growing up to 120 cm in height. Seed and vegetatively propagated. Frost-hardly, moderately drought resistant, tolerate temporary flooding. Creates firm turf. Wildlife species can be found in tundra and forest tundra in YNAO. Can be preserved in plant formations more than 10 years, consumed by all animal species. It grows on peat lands and sands. The seeds ripen in tundra and forest tundra. Can be included in grass mixtures and make up to 40 % at seeding rate of 15 kg/ha and seeding depth of 2 cm	
Meadow fescue	Festuca pratensis	Semi-tall perennial loose-bunch grass that forms a bush with a large number of stems, grows up to 120 cm in height. It is used as pasture and hay plant. Can be preserved in grass mixtures up to 8 years. Re-grows again in early spring. Water-intensive, tolerate long-term flooding. Resistant to soil pollution with oil products. Seeding rate for grassing down - 16 kg/ha, seeding depth - 2-3 cm. The recommended content in grass mixtures shall not exceed 40 %	It is noted that the species is unsuitable for sodding of sandy soils; in the Gyda tundra, there is a high probability of its frost-killing, therefore, the species is considered unsuitable for biological reclamation
Red fescue	Festuca rubra.	Low perennial grass growing up to 90 cm in height. Bunch, rhizomatous and rhizomatous and loose-bunch forms are common. It is not fastidious to soil and climatic requirements. Valuable pasture and hay plant, good turf builder. Wildlife species can be found in tundra and forest tundra in YNAO. Can be included in grass mixtures and make up to 40 % at seeding rate of 15 kg/ha and seeding depth of 2 cm	**Species are suitable for inclusion in the grass mixtures at the stage of biological reclamation design within Salmanovskiy (Utrenniy) LA**

Species name		Species characteristics[105]	Consultant Note
Creeping bentgrass	Agrostis alba	Rhizomatous perennial grass. Winter hardy, water-intensive, tolerate long-term flooding. Can be preserved in grass mixtures for decades. Valuable pasture plant creating firm turf. Wildlife species can be found in tundra and forest tundra in YNAO. An optimal option for grassing of waterlogged peated areas. Seeding rate - 12 kg/ha, seeding depth - 2 cm	
Timothy-grass	Phleum pratense	Tall loose-bunch grass, folious, grows slowly. It has a fibrous root system made up of a large number of thin roots. Consumed by all animal species. Winter hardy, water-intensive, tolerates waterlogging. Grows in grass mixtures up to 6 years. The seeds ripen in forest tundra. Seeding rate for grassing down - 8 kg/ha, seeding depth - 1 cm. Seed material is introduced from the areas with harsh climatic conditions	In the Gyda tundra, there is a high probability of its frost-killing, therefore, the species is considered unsuitable for biological reclamation
Tufted hairgrass or tussock grass	Deschampsia caespitosa	Semi-tall perennial tufted grass with spreading panicle, forms thick hummocky turf, is consumed by the animals in early vegetative stage, grows up to 80 cm in height. Seed and vegetatively propagated. Wildlife species can be found in tundra and forest tundra in YNAO. Winter hardy, water-intensive. Seeding rate for grassing down - 8 kg/ha, seeding depth - 1.5-2 cm	**Species are suitable for inclusion in the grass mixtures at the stage of biological reclamation design within Salmanovskiy (Utrenniy) LA**

When selecting grass mixtures for reclamation of certain land plots, the grass growth conditions given in Table A9.2 shall be taken into account. Recommended species serve as food resources for reindeer and other terrestrial vertebrates, which makes their usage during reclamation favourable for the fauna as well.

Considering availability of seed material, species that tolerate flooding well (slough grass, foxtail, hairgrass, meadow-grass) shall be selected for wetland, species creating firm turf (wheat grass, meadow-grass, red fescue) shall be selected for loose sand substrate, species resistant to lean acid substrate (pendant grass, arctagrostis, reed, slough grass, meadow-grass) shall be selected for peaty areas. The recommended minimum dry weight of planted seeds - 150 kg/ha for the areas with slopes of up to 5 degrees, 200 kg/ha - for greater slopes.

Methods of sowing seeds contained in the selected grass mixture may also differ. Mechanised dry seeding is a traditional method which implies using tractor mounted seed sowers with subsequent rolling down. Optimal seeding depth in the Gyda Tundra - 2 cm.

Mineral and organic fertilizer quantity optimization option suitable for the tundra conditions is seeds pelleting, i.e. covering seeds with a shell of organomineral materials. The resulting pellets can be applied to soil manually or using a mechanised method; pelleted seeds have higher resistance to external impacts and after germination have access to concentrated stock of nutrients.

In case of inability to use peat or in case of limited ameliorant, it is possible to use the so-called demutation method of restoring vegetation cover developed by the Department of Ecology of Tyumen Agricultural Academy for YNAO conditions and allowing to create a vegetation cover without using peat, agricultural lime and high quantities of mineral fertilizers by way of direct seeding in a given ratio without pre-building of soil fertility. In this case, the technology of biological stage includes 5 successive stages:

- tandem disk harrowing;
- seeding of universal grass mixture using a dedicated seed sower (120 kg/ha);
- single-cut disk harrowing;
- post-seeding rolling using dedicated rollers;
- fertilizing seedling with NPK in a recommended value of 40 kg/ha after the emergence.

Hydroseeding may be a local alternative, in this case a suspension consisting of seeds, nutrients and soil stabilizers is distributed over the surface of soils or technogenic substrates. Thus, hydroseeding combines chemical reclamation, seeding and consolidation of soil surface, but it can be applied on a limited area and mainly in the beginning of warm season. Traditionally, this method is used for prompt grassing of embankment slopes, which steepness doesn't allow application of the fertile layer.

Another local alternative developed in recent decades is the use of biotextile materials (geotextiles) - biodegradable layer made of vegetable fibres (straw, coconut fibre or their mixture) reinforced by

polypropylene or jute thread. Geotextile base is usually double layer, and reclamation mixture is put between the layers, it includes seeds of perennial grasses, nutrients (mineral and organic fertilizers, plant growth stimulants, soil-forming bacteria) and moisture retaining components (in a form of synthetic polymers) that increase soil water retention capacity.

Geotextile can be used without restoring soil fertility and on any sloped surfaces. First of all, this refers to the peat having a dissected pressed peat placed between the layers.

The experience of applying this technology shows that in the first 2-3 years, by the moment of a uniform plant formation establishment with extensive root system penetrating deeply into the ground, the geotextile reliably binds the ground creating a turf that has high mechanical strength[106]. Special types of geotextile are intended for reclamation of wetland and sandy soil.

The geotextile is laid on a pre-planned and levelled ground surface having no large inclusions, at an air temperature of +5 °C and higher. The most favourable time for laying geotextile is the beginning of spring/summer season (after snow cover melting and defrosting of the frost zone to a depth of 40-60 cm). Adjacent geotextile rolls are fixed with an overlap of 10-15 cm using T- or L-shaped brackets (anchors) or wooden pegs.

On the Consultant's opinion, usage of geotextile is the best method of reclamation for relatively small areas with complex relief, which doesn't allow to perform mechanised works, and with high activity of exogenous processes. An inventory of geotextile shall also be provided for prompt (emergency) use in the areas of hazardous endogenous and exogenous processes and phenomena.

After seeding and rolling, there is a common practice of applying a preventive anti-erosion compounds on erosion prone areas, and one of these common compounds contains 4-5 wt% of dust-binding substance Universin (or similar soil stabilizer) in addition to fine-sand filler. The composition can be sprayed onto the reclaimed surface or used to treat the sand before preparing peat-sand mixture. As it has been mentioned above, soil stabilizers based on oil products and synthetic organic substances shall be used in cases when it is necessary to promptly prevent activation of exogenous processes that jeopardise the safety of buildings and structures. Xanthan, a natural polysaccharide approved for use in the oil fields of the Russian Federation, shall be considered the least environmentally dangerous[107].

Planting willows. Cuttings and willow planting on disturbed soils, which can be combined with fascine works, have an additional and environmentally safe anti-erosion effect. In each of these cases, cuttings or branches of willows, a genus of water-intensive fast growing shrubs relatively widespread in the tundra belt of YNAO, are used. Willows tolerate long-term flooding quite well. Its bark, leaves and branches serve as food for the animals, buds and aglets - for the birds.

Characteristics of willow species suitable for biological reclamation in YNAO conditions are given in Table A9.3, according to the data of Yamal Agricultural Experimental Station with Consultant comments added.

Table A9.3: Plant species suitable for willow planting in the territory of YNAO

Species name		Species characteristics[108]	Consultant Note
Woolly willow	Salix lanata	Bush growing up to 30 - 100 cm in height. Grows on the slopes, on dry and wet tundra soils, forming thicket	Four more species that are common for the future Yuribeyskiy reserve[109] should be added to the listed species of willow, their usage for biological reclamation appears to be most reasonable, subject to availability of planting material: swamp willow (*Salix myrtilloides*): low upright bush growing up to 30-80 cm in height, rarely - up to 2 m; its natural habitat is marsh with sedge-sphagnum vegetation; creeping willow (*Salix reptans*): creeping shrub growing up to 5-15 cm in height with underground stem and whip-like branches, its flowers and leaves are the food for reindeer;
Long-leaved violet willow	Salix acutifolia	Bush growing up to 4 m in height. Grows on sand, on river banks	
Gray willow	Salix glauca	Arctic and highland shrub	

[106] I.P. Aistov, A.E. Gagloeva Prospects for the Use of Geotextile during Reclamation of Disturbed Land in the Far North // Systems. Methods. Technologies. 2013 No. 4 (20). pp. 188-191.

A.V. Iglovikov Biological Reclamation of Quarries in the Far North Conditions. - Thesis (M. Agr. Sc.) Barnaul, 2012. 196 p.

[107] N.B. Pystina et al. Technological Advancements in Reclamation of Disturbed and Polluted Lands in the Hydrocarbon Fields of the Far North // Scientific Newsletter of YNAO. 2016. No. 2 (91). pp. 4-8.

[108] According to the recommendations of Yamal Agricultural Experimental Station with Consultant comments added

[109] Yu.V. Gudovskikh, T.L. Egoshina, L.S. Savintseva Study of Biota of Designed Yuribeyskiy DCA (Gydan Peninsula) // Bulletin of Udmurt University. 2016. Vol. 26. Issue 1. P. 15-27

Species name		Species characteristics[108]	Consultant Note
Dwarf willow	Salix herbacea	Small shrub with branches close to the ground with the total length of 5 - 35 cm. It grows on the slopes of banks, ravines, often on sandy soils.	wrinkled-leaf willow (*Salix reticulata*): dwarf, prostrate shrub with creeping and partly underground and rooting branches up to 50-75 cm long; it is common for stony, gravelly and lichen arctic and alpine tundra; its leaves and ends of branches are consumed by reindeer, including in winter period; downy willow (*Salix lapponum*): bush growing up to 1.5 m in height, widespread in tundra and forest tundra, stems and leaves are the basal feed for the partridge

Willow cuttings are harvested 30-40 days before their intended planting in the areas of natural stand (for example, during cleaning). The resulting material is laid in a storage pit in the snow, then it is covered with sawdust, plastic sheet, and finally – with snow. Before planting, cuttings of the selected length are made from the withy (by the time of planting, roots appear on them).

They are planted in a 6 m wide strip along contours, to the pre-arranged holes, around the perimeter of erosion area or other potentially dangerous area with loose soil or vulnerable to scouring. Inside the willow planting strip, the cuttings are arranged in staggered rows at a distance of up to 70 cm from each other. After planting, the soil is rammed down, and the seeds of grasses are sown between the cuttings.

The optimal time for planting is the end of August or September, the normal quantity is from 2 to 4.5 thous. cuttings per 1 ha of reclaimed area.

Fascine works can serve as an alternative to planting – making withy fascines, and putting fascines into the grooves across erosion-prone slopes.

6. Assessment of reclamation effectiveness. Transfer of land plots to the landlord

Compliance with the recommendations of the Consultant set out in sub-section 9.4.8 will ensure effective reclamation of soil and vegetation cover of disturbed land plots and will minimize the activity of exogenous geological processes within their boundaries. Further assimilation of these areas with the surrounding landscape will be accompanied by long-term succession of the plant communities. Restoration of fruticose lichen – one of the main components of reindeer pastures - will be the longest. At present, the possibility of artificial stimulation of lichen growth is being studied, but this issue hasn't reached the technical stage yet.

Control over implementation and effectiveness of technical solutions for land reclamation shall be included in the operational environmental monitoring of the Project facilities construction and operation, and shall be performed by the designer representatives as part of a supervision procedure, and representatives of the landlord as part of a municipal land control.

The reclaimed lands shall be accepted and handed over by the Working Committee, which includes the representatives of the Permanent Committee of the Municipality on Land Reclamation, as well as the representatives of the construction project owner and the contractor, which shall be documented by a certificate in the appropriate form. The developing organization of reclamation project, OEMC contractor, territorial agrochemical service, territorial body of Rosprirodnadzor may be involved in the Committee's work.

In practice, the most common criteria of successful biological reclamation include the absence of visible area pollution with domestic and industrial wastes, density of sward, and the absence of observed hazardous endogenous and exogenous processes and phenomena (first of all, erosion, blowout and flooding), including in the adjacent territory.

ANNEX 10

DISTURBED LAND RECLAMATION ACTIVITIES INCLUDED IN THE DESIGN DOCUMENTATION FOR THE FIELD, PLANT AND PORT FACILITIES (ARCTIC LNG 2 PROJECT) AND THE UTRENNIY AIRPORT

Permanent facilities	Category of land	Reclamation objective	Land area subject to reclamation	Technical reclamation	Biological reclamation	Instruction as to selection of fertilisers and recultivant plants	Referenced sources
Salmanovskoye (Utrenneye) OGCF Facilities Setup: Early development facilities	Agricultural-purpose (farming) land	Farming (reinstatement of disturbed land for pastures). The concerned land does not belong to forest fund	Total land area is 434.3298 ha Technical reclamation 434.3298 Biological reclamation 343.7285 ha – grass sowing 324.9177 – application of fertilisers	Scope of the work: • Area clearing of temporary facilities, production equipment, installations and other structures; • Area clearing of remaining metal scrap, debris and domestic wastes; • Removal of all industrial wastes for disposal in compliance with applicable regulations; • Removal of fuel and lubricants stock from the territory; • Removal of temporary fills, banks, dump wells, machinery and vehicles parks; • Arrangement of slopes in the earth-works areas; • Surface grading; • Restoration of the natural drainage system; • Area arrangement to meet the fire safety requirements.	Stage 1 (intensive) - restoration of productive soils layer, prevention of erosion processes: • sowing perennial grasses; • application of fertilisers. Stage 2 (assimilation) - restoration of the natural ecosystem through gradual substitution of cultivated coenosis: • Protection against repeated technogenic disturbance; • Monitoring of self-restoration process. Activities: • Presowing disk plowing; • Application of mineral fertilisers; • Grass mix sowing; Seed rolling, plant care.	Fertilisers: • Compound NPK fertilizer; • Nitrophoska; • Nitroammophos. Plant species: • Siberian wildrye (*Elymus sibiricus*) • Meadow fescue (*Festuca pratensis*) • Red clover (*Trifolium pratense*) • Blue grass (*Poa pratensis*) • Rough bluegrass (*Póa triviális*) • Timothy grass (*Phleum pratense*)	Early development facilities at the Salmanovskoye (Utrenneye) OGCF EnergoGasEngineering JSC 143.01.00-02-196-OOC.6 Section 8 Part 6
Salmanovskoye (Utrenneye) OGCF Facilities Setup: gas supply for the power supply facilities to support construction, hydraulic filling and drilling operations (PIR)	Agricultural-purpose, industrial-purpose land	Farming Construction	Total land area is 209.9926 ha Technical reclamation 209.9926 ha Biological reclamation 127.4469 ha	Scope of the work: • Area clearing of temporary facilities, production equipment, installations and other structures; • Area clearing of remaining metal scrap, debris and domestic wastes; • Removal of all industrial wastes for disposal in compliance with applicable regulations; • Removal of fuel and lubricants stock from the territory; • Removal of temporary fills, banks, dump wells, machinery and vehicles parks; • Arrangement of slopes in the earth-works areas; • Surface grading; • Restoration of the natural drainage system; • Area arrangement to meet the fire safety requirements. Grading activity shall be carried out using bulldozers, during warm, no-frost period. The resulting surface shall be free from visible sinkholes and pits. To prevent erosion, slopes may not be steeper than 3° (for permafrost) and 5° (for other soils).	Stage 1 (intensive) - restoration of productive soils layer, prevention of erosion processes: • sowing perennial grasses; • application of fertilisers. Stage 2 (assimilation) - restoration of the natural ecosystem through gradual substitution of cultivated coenosis: • Protection against repeated technogenic disturbance; • Monitoring of self-restoration process. Activities: • Presowing disk plowing; • Application of mineral fertilisers; • Grass mix sowing; • Seed rolling, plant care.	Fertilisers: • Compound NPK fertilizer; Plant species: • Siberian wildrye (*Elymus sibiricus*) • Meadow fescue (*Festuca pratensis*) • Red clover (*Trifolium pratense*) • Blue grass (*Poa pratensis*) • Rough bluegrass (*Póa triviális*) • Timothy grass (*Phleum pratense*)	Salmanovskoye (Utrenneye) OGCF Facilities Setup. gas supply for the power supply facilities to support construction, hydraulic filling and drilling operations 120.ЮР.2017-2010-02-ООС5 2010-P-NG-PDO-08.00.05.00.00-00 Vol. 8.5.
Salmanovskoye (Utrenneye) OGCF Facilities Setup: completion of well pads No. 2 and No.16	Agricultural-purpose (farming) land	At the end of drilling - environmental, after the facilities' decommissioning - farming	15.6865 ha – well pad No. 16; 0.7484 ha – water main corridor to well pad No. 16; 16.7856 ha – well pad No. 2. Phase 1 - land released at the end of drilling activity (15.7024 ha). Phase 2 - after the facilities decommissioning (17.5181 ha).	Scope of the work: • Site clearing of construction debris to be removed to the nearest MSW disposal site; • Dismantling and removal of site buildings, installations, temporary structures; • Dismantling and removal of domestic sewerage system, power supply system of the temporary site facilities; • Removal of filled platform for the drilling works; • Final grading; Treatment of soil contaminated with fuel and petroleum products with Putidoil bacterial preparation.	Stage 1 (intensive) - restoration of productive soils layer, prevention of erosion processes: • sowing perennial grasses; • application of fertilisers. Stage 2 (assimilation) - restoration of the natural ecosystem through gradual substitution of cultivated coenosis: • Protection against repeated technogenic disturbance; • Monitoring of self-restoration process. Activities: • Presowing disk plowing; • Application of mineral fertilisers; • Grass mix sowing; • Seed rolling, plant care.	Not covered in the DD	Construction of well pads No.2 and No.16 at the Salmanovskoye (Utrenneye) OGCF, drilling and testing period. DESIGN DOCUMENTATION. SECTION 8 - LIST OF ENVIRONMENTAL PROTECTION MEASURES. 346-1-319/18/П-346-ООС
Development of sand jetting quarries		Farming/ Environmental/ water management		Scope of the work: • Site clearing of construction debris and domestic wastes to be removed to the nearest MSW disposal site; • Removal of anthropogenic terrain features with sopos steeper than 3º (artificial features, e.g. filled banks, heaps, rough grading); • Grading of horizontal surfaces; • Final grading. Grading activity shall be carried out using bulldozers, during warm, no-frost period. The resulting surface shall be free from visible sinkholes and pits. To prevent erosion, slopes may not be steeper than 3° (for permafrost) and 5° (for other soils).	Stage 1 (intensive) - restoration of productive soils layer, prevention of erosion processes: • sowing perennial grasses; • application of fertilisers. Stage 2 (assimilation) - restoration of the natural ecosystem through gradual substitution of cultivated coenosis: • Protection against repeated technogenic disturbance; • Monitoring of self-restoration process. Activities: • Presowing disk plowing; • Application of mineral fertilisers; • Grass mix sowing; • Seed rolling, plant care; • Planting of willow cuttings.	Fertilisers: • Compound NPK fertilizer; Plant species: • Siberian wildrye; • Meadow fescue; • Red clover; • Blue grass; • Rough bluegrass; • Timothy grass. Sometimes recommended: • Annual ryegrass; • Couch grass; • Common oat (*Avéna satíva*); • Awnless brome.	Jetting quarries design note. MTA Company, 2018
Development of dry-excavation quarries		Farming		Scope of the work: • Dismantling all equipment, temporary buildings and installations, temporary and permanent structures, filling of ditches, pits, dismantling of communication lines and utility infrastructure; • Site clearing of construction debris and removal to MSW disposal site by dump tracks;	Stage 1 (intensive) - restoration of productive soils layer, prevention of erosion processes: • sowing perennial grasses; • application of fertilisers. Stage 2 (assimilation) - restoration of the natural ecosystem through gradual substitution of cultivated coenosis:	Fertilisers: • Nitrophoska; • Compound NPK fertilizer; Plant species: • Common oat (*Avéna satíva*); • Blue grass (*Poa pratensis*); • Red fescue (*Festuca rubra*); • Timothy grass (*Phleum pratense*); • Slough grass (*Beckmannia eruciformis*);	PurGeoCom LLC. 2019

Permanent facilities	Category of land	Reclamation objective	Land area subject to reclamation	Technical reclamation	Biological reclamation	Instruction as to selection of fertilisers and recultivant plants	Referenced sources
				• Removal of anthropogenic positive landforms (artificial terrain features including filled banks, dumps, filling for linear and areal facilities with imported ground); • Excavation of amenity facilities sites by track-mounted excavator with a 1.8 m^3 bucket, loading on dump trucks, group 1 ground; • Distribution of group 1 ground from banks by bulldozer moving within 50m in the quarry site; • Final grading. Grading activity shall be carried out using bulldozers, during warm, no-frost period. The resulting surface shall be free from visible sinkholes and pits. To prevent erosion, slopes may not be steeper than 3° (for permafrost) and 5° (for other soils).	• Protection against repeated technogenic disturbance; • Monitoring of self-restoration process. Activities: • Presowing disk plowing; • Application of mineral fertilisers; • Grass mix sowing; • Seed rolling, plant care;	• Meadow fescue (*Festuca pratensis*); • Couch grass (*Elytrígia répens*)	
Salmanovskoye (Utrenneye) OGCF Facilities Setup: completion of well pads Nos. 1, 3-15, 17-19		Environmental (sanitary-hygienic)	**237.725 ha:** **WP No.1**: 22.4866 ha **WP No.3**: 22.5867 ha **WP No.4**: 16.537 ha **WP No.5**: 11.2916 ha **WP No.6**: 12.5281 ha **WP No.7**: 11.7038 ha **WP No.8**: 11.7297 ha **WP No.9**: 16.2287 ha **WP No.10**: 12.9464 ha **WP No.11**: 16.1311 ha **WP No.12**: 14.7704 ha **WP No.13**: 13.1409 ha **WP No.14**: 10.8712 ha **WP No.15**: 11.7127 ha **WP No.17**: 12.1351 ha **WP No.18**: 10.8666 ha **WP No.19**: 10.0581 ha	Scope of the work: • Site clearing of construction debris to be removed to the nearest MSW disposal site; • Dismantling and removal of site buildings, installations, temporary structures; • Dismantling and removal of domestic sewerage system, power supply system of the temporary site facilities; • Removal of filled platform for the drilling works; • Final grading; Treatment of soil contaminated with fuel and petroleum products with Putidoil bacterial preparation.	Not covered in the DD	Not covered in the DD	Construction of 18 well pads at Salmanovskoye (Utrenneye) OGCF, drilling and testing period. Materials for public discussion. Environmental Impact Assessment (EIA) – Code 2018-560-НТЦ-ОВОС – Moscow: NOVATEK STC, 2019. 332 p.
Salmanovskoye OGCF Facilities Setup (PIR-5) GBS LNG & SGC Plant Utrenniy Terminal (including general-purpose berth)	Industrial land	Environmental	Reclamation design covers the areas disturbed by construction of drainage channel within the land acquisition area. According to the design, total land acquisition for construction of the designed drainage channel is 56533 m^2, including: • 27488 m^2 permanent acquisition; • 29045 m^2 temporary acquisition. Area subject to technical reclamation at the Salmanovskoye (Utrenneye) OGCF Facilities Setup is 482.0627 ha. Area subject to biological reclamation is 482.0627 ha.	Scope of the work: • Dismantling and removal of temporary structures; • Area clearing of debris, felling residues, materials and structures; • Removal of anthropogenic positive landforms (artificial terrain features including filled banks, filling for linear facilities with imported ground); • Final grading of disturbed surfaces. Agrochemical reclamation is provided in case of potential contamination of ground with hydrocarbons - treatment of contaminated areas with Putidoil bacterial preparation.	Reclamation Stage 1 - Intensive (1st year of reclamation): • Disk plowing to 0.1 m; • Surface dragging; • Sowing with frost-resistant perennial grasses; • Seed rolling. Reclamation Stage 2 - Assimilative (2nd and 3rd year of reclamation): • Dragging in areas with poor germinating power; • Complementary seeding on surfaces with lack of vegetation; • Seed rolling.	Grass mix for biological reclamation in Arctic and Sub-Arctic areas must include three groups of species: I – apophyte-anthropophyte with a short development cycle (1-2 years) – northern swamp groundsel, blue grass; II – apophyte-climax with a medium duration of development cycle (3 to 5 years) - red fescue, Siberian wildrye, slough grass; III – climax with a long development cycle (10-50-100 years) – meadow foxtail, cough grass. Annual plants: • northern swamp groundsel (*Senecio congestus*); Perennial plants: • Blue grass (*Poa pratensis*); • Red fescue (*Festuca rubra*); • Siberian wildrye (*Elymus sibiricus*); • Couch grass (*Elytrígia répens*); • Meadow foxtail (*Alopecúrus praténsis*); • Slough grass (*Beckmannia eruciformis*).	GBS Plant for production, storage and offloading of liquefied natural gas and stabilized gas condensate. Design documentation. Section 8. List of Environmental Protection Measures. Book 5. Reclamation of disturbed land – Document code 2017-423-M-02-OOC5 (3000-P-NE-PDO-08.05.00.00.00-00) – Moscow: NIPIGAZ JSC, 2019. 152 p. Salmanovskoye (Utrenneye) oil, gas, and condensate field facilities setup. Vol. 8.8 Part 8. Document code 120.ЮР.2017-2020-02-OOC8_03D. Sanitary Protection Zone Design Document for the GBS Plant for production, storage and offloading of liquefied natural gas and stabilized gas condensate. Vol. 1 - LLC “Environmental project support company “Geoecologia Consulting”, 2019. 275 p.
Fuel gas pipeline to the Utrenniy Airport Vent stacks on shells Road to the Utrenniy Airport OPL 10 kV to the Utrenniy Airport Purpose 1. Purpose 2. FOCL Cable rack to the Utrenniy Airport TSF site No.13 Temporary access road No.1 to TSF No.13 Temporary access road No.1 to TSF No.13	Industrial and other special purpose land	Environmental	91.0851 ha 0.0018 ha 7.9044 ha 81.9044 ha 5.4138 ha 14.2245 ha 0.7517 ha 0.4273 ha	Total area subject to technical reclamation is 201.7930 ha. Scope of the work: • Removal of industrial structures and construction debris • from the area subject to reclamation; • Surface grading with bulldozer in the area subject to reclamation; • Erosion prevention measures. Construction period: • Area clearing of temporary facilities, production equipment, installations and other structures; • Removal of domestic wastes and construction debris (in the whole site area); • Surface grading and filling of pits and sinkholes, flattening of anthropogenic positive landforms; • Surface reinforcement with biomaterial (erosion-preventive cover Ecotrassa). Operation period: • Area improvement (removal of debris, fencing).	Total area subject to biological reclamation is 189.9333 ha. Phase 1 (Intensive) • sowing perennial grasses; • application of fertilisers. Phase 2 (assimilative): • Protection against repeated technogenic disturbance; • Monitoring of self-restoration process. Activities: • Presowing disk plowing; • Application of mineral fertilisers (compound NPK fertilizer); • Grass mix sowing; • Seed rolling, plant care. To prevent chemical contamination of water horizons during the biological reclamation, application of mineral fertilizers is prohibited in the water protection zones, CPB and flood plains. Mineral fertilisers will not be applied in the total area of 4.1978 ha.	Fertilisers: • Compound NPK fertilizer; Plant species: • Siberian wildrye (*Elymus sibiricus*); • Meadow fescue (*Festuca pratensis*); • Red clover (*Trifolium rubens*); • Blue grass (*Poa pratensis*); • Rough bluegrass (*Póa triviális*) • Timothy grass (*Phleum pratense*);	Utrenniy Airport. Design documentation. Section 8. List of Environmental Protection Measures. Part 5. Offsite utilities. Reclamation of disturbed land – Document code 375-юр/2018-ООС5 (6200-P-KR-PDO-08.05.00.00.00-00_04) – YUZNIIGIPROGAS INSTITUTE LLC, 2019. 105 p. Utrenniy Airport. Design documentation. Section 8. List of Environmental Protection Measures. Part 2. Construction period. Book 1. Narrative. Appendixes А-Ж (A-Zh) – Document code 375-юр/2018-ООС2.1 (6200-P-KR-PDO-08.02.01.00.00-00_02) – StPb: TsEI-Energo LLC, 2019. 338 p.

ANNEX 11

LAND PLOTS IN THE TAZOVSKIY MUNICIPAL DISTRICT OF YNAO OCCUPIED BY THE SALMANOVSKOYE (UTRENNEYE) OGCF FACILITIES SETUP (ARCTIC LNG 2 PROJECT)

Index	Project facilities	Area, ha			Referenced sources	Notes
		Permanent acquisition	Temporary acquisition	Total land acquisition		
Early development facilities						
F1	**Total for the early development facilities**	**434.3298**	**88.2312**	**522.561**	PDD	
F1.1	Areal facilities, including:	48.8385	0	48.8385	PDD	Sites leased for the period expiring in 2020-2031, with an option to renew the lease. Actual purpose of the sites use has been corrected at subsequent stages of design development for the Field facilities.
F1.1.1	*Single well No.P-304 site*	2.1473	0	2.1473	PDD	
F1.1.2	*PGTPP No.1 site*	3.7192	0	3.7192	PDD	
F1.1.3	*Single well No.P-270 site*	1.3432	0	1.3432	PDD	
F1.1.4	*PGTPP No.2 site*	3.609	0	3.609	PDD	
F1.1.5	*TAC*	5.6783	0	5.6783	PDD	
F1.1.6	*Fuel and methanol tank farm*	10.9178	0	10.9178	PDD	The facility has been moved to a different location at subsequent stages of design development for the Field facilities
F1.1.7	*Materials and equipment storage site at the berth*	10.8063	0	10.8063	PDD	Dimensions and function of the site have been changed at subsequent stages of design development for the Field facilities
F1.1.8	*HP No.2*	1.5122	0	1.5122	PDD	Location and reference number of facility have been changed at subsequent stages of design development for the Field facilities
F1.1.9	*HP No.3*	0.6547	0	0.6547	PDD	Reference number of the facility has been Revised by at subsequent stages of design development for the Field facilities
F1.1.10	*Water filters site*	0.6916	0	0.6916	PDD	Dimensions and function of the site have been changed at subsequent stages of design development for the Field facilities
F1.1.11	*STF site*	1.8743	0	1.8743	PDD	
F1.1.12	*Construction support facilities site (CSS)*	5.8846	0	5.8846	PDD	
F1.2	Linear facilities, including:	385.4913	88.2312	473.7225	PDD	
F1.2.1	*Utility corridor along road MR No.1 from the berth structures to PGTPP No.2, sites of PTS, DPP, PCPSU, HP No.2 and SOVS No.6*	80.4894	0	80.4894	PDD	
F1.2.2	*Utility corridor along road MR No.1 from the berth structures to PGTPP No.2, sites of PTS, DPP, PCPSU, HP No.2 and SOVS No.6*	100.3549	0	100.3549	PDD	
F1.2.3	*Utility corridor comprising a section of MR No.1 and OPL No.2 10 kV from PGTPP No.2 to SMCIW DS*	44.4228	0	44.4228	PDD	
F1.2.4	*Utility corridor comprising access road of SMICW DS and OPL 10 kV*	5.2985	0	5.2985	PDD	
F1.2.5	*MR No.1 section from the access road of SMICW DS to the access road of HP No.3 site*	64.5491	0	64.5491	PDD	

Index	Project facilities	Area, ha			Referenced sources	Notes
		Permanent acquisition	Temporary acquisition	Total land acquisition		
F1.2.6	*Access road of single well No.P-304 site*	1.8922	0	1.8922	PDD	
F1.2.7	*Utility corridor of single well No.P-304 site*	0.0466	0	0.0466	PDD	
F1.2.8	*Seasonal (winter) road to quarry SQ No.10*	0	23.3835	23.3835	PDD	
F1.2.9	*Seasonal (winter) road from HP No.3 to quarry SQ No.2*	0	55.728	55.728	PDD	
F1.2.10	*Branch road from the seasonal (winter) road to quarry SQ No.2*	0	1.8705	1.8705	PDD	
F1.2.11	*Seasonal (winter) road to quarry SQ No.5*	0	7.2492	7.2492	PDD	
F1.2.12	*Connecting assembly (utility corridor connection to the berth structures)*	0.2066	0	0.2066	PDD	
Gas supply for the power supply facilities to support construction, hydraulic filling and drilling operations (PIR-1)						
F2	**Total for the gas and power supply facilities (PIR-1)**	**65.3258**	**144.7384**	**210.0642**	PDD	
F2.1	GWP No.16	12.7963	0	12.7963	PDD	
F2.2	Power supply complex No.2	12.159	0	12.159	PDD	
F2.3	Utility corridor between GWP No.16 and Power Supply Complex No.2 (racks of the gas flow line, methanol pipeline, FOCL)	7.4643	29.761	37.2253	PDD	
F2.4	OPL 10 kV from Power supply complex No.2 to GWP No.16	0.2397	21.3608	21.6005	PDD	
F2.5	Two-line OPL 10 kV from Power supply complex No.2 to TAC	0.1094	13.0759	13.1853	PDD	
F2.6	Two-line OPL 10 kV from Power supply complex No.2 to FC	0.672	38.1034	38.7754	PDD	
F2.7	Two-line OPL 10 kV from Power supply complex No.2 to WTP-3	0.0244	2.7183	2.7427	PDD	
F2.8	MR No.2 from TAC to GWP No.16 including a bridge over the Khaltsyney-Yakha River	25.5282	0	25.5282	PDD	
F2.9	MR No.3 to WTP-3	1.9075	0	1.9075	PDD	
F2.10	MR No.7. Section No.1 from the MR to Power Supply Complex No.2	4.425	0	4.425	PDD	
F2.11	TSF No.1 site	0	5.2049	5.2049	PDD	
F2.12	Temporary access road to TSF No.1 site	0	21.0105	21.0105	PDD	
F2.13	TSF No.2 site	0	7.7795	7.7795	PDD	
F2.14	Temporary access road No.1 to TSF No.2 site	0	0.1294	0.1294	PDD	
F2.15	Temporary access road No.2 to TSF No.2 site	0	0.3667	0.3667	PDD	
F2.16	Temporary access road No.3 to TSF No.2 site	0	0.6067	0.6067	PDD	
F2.17	TSF No.5 site	0	4.556	4.556	PDD	
F2.18	Temporary access road to TSF No.5	0	0.0653	0.0653	PDD	

Index	Project facilities	Area, ha			Referenced sources	Notes
		Permanent acquisition	Temporary acquisition	Total land acquisition		
Main Field Facilities (PIR-5)						
F3	**Total for the Fild facilities (PIR-5)**	**1113.5704**	**1655.0912**	**2769.0181**	PDD	The difference in area size values in PIR-5 PDD (**1128.3117 ha** for permanent acquisition and **2700.9176 ha** for the total acquisition, NIPIGAZ JSC, 2019) is due to the updated area sizes of the well pads based on respective GWP designs prepared by NOVATEK SCIENTIFIC AND TECHNICAL CENTER LLC and SERVISPROEKTNEFTEGAZ LLC)
F3.1	**Well pads (gas well pads, GWP)**	**271.2680**	**82.8418**	**354.1098**	PDD	
F3.1.1	*GWP No.1*	22.4866	8.0961	30.5827	PDD	The PIR-5 PDD (NIPIGAZ JSC, 2019) and PDD for gas well pads GWP No.2 and GWP No.16 (SERVISPROEKTNEFTEGAZ LLC, 2018) and GWPs Nos. 1, 3-15, 17-19 (NOVATEK SCIENTIFIC AND TECHNICAL CENTER LLC, 2019), differ in specification of the size of land acquisition. Maximum designed size of land acquisition is adopted in this table. Land plot for GWP No.6 includes the land plot establishearlied at the stage of PIR-1 (item F2.1).
F3.1.2	*GWP No.2*	17.8568	0	17.8568	PDD	
F3.1.3	*GWP No.3*	22.5867	7.4520	30.0387	PDD	
F3.1.4	*GWP No.4*	16.5370	3.4263	19.9633	PDD	
F3.1.5	*GWP No.5*	11.2916	3.2505	14.5421	PDD	
F3.1.6	*GWP No.6*	12.5281	7.8926	20.4207	PDD	
F3.1.7	*GWP No.7*	11.7038	1.0422	12.7460	PDD	
F3.1.8	*GWP No.8*	11.7297	5.0689	16.7986	PDD	
F3.1.9	*GWP No.9*	16.2287	7.0640	23.2927	PDD	
F3.1.10	*GWP No.10*	12.9464	7.1651	20.1115	PDD	
F3.1.11	*GWP No.11*	16.1311	8.2866	24.4177	PDD	
F3.1.12	*GWP No.12*	14.7704	6.7458	21.5162	PDD	
F3.1.13	*GWP No.13*	13.1409	5.6563	18.7972	PDD	
F3.1.14	*GWP No.14*	10.8712	0.7279	11.5991	PDD	
F3.1.15	*GWP No.15*	11.7127	1.0433	12.7560	PDD	
F3.1.16	*GWP No.16*	15.6865	0	15.6865	PDD	
F3.1.17	*GWP No.17*	12.1351	2.0615	14.1966	PDD	
F3.1.18	*GWP No.18*	10.8666	7.3268	18.1934	PDD	
F3.1.19	*GWP No.19*	10.0581	0.5359	10.5940	PDD	
F3.2	**Gas treatment facilities**	**67.6435**	**0**	**67.6435**	PDD	
F3.2.1	*Site of CGTP1 (Central dome)*	27.5444	0	27.5444	PDD	
F3.2.2	*Site of CGTP2 (Southern dome)*	25.4364	0	25.4364	PDD	
F3.2.3	*Site of PGTP3 (Northern dome)*	14.6627	0	14.6627	PDD	
F3.3	**Effluent re-injection sites (ERIS)**	**21.7712**	**0**	**21.7712**	PDD	
F3.3.1	*ERIS-1 (Central dome)*	6.3519	0	6.3519	PDD	
F3.3.2	*ERIS-2 (Southern dome)*	6.4626	0	6.4626	PDD	
F3.3.3	*ERIS-3 (Northern dome)*	8.9567	0	8.9567	PDD	
F3.4	**Helicopter pads**	**0.8569**	**0**	**0.8569**		
F3.4.1	*HP-1 (Central dome)*	0.4397	0	0.4397	PDD	
F3.4.2	*HP-2 (Southern dome)*	0.4172	0	0.4172	PDD	

Index	Project facilities	Area, ha			Referenced sources	Notes
		Permanent acquisition	Temporary acquisition	Total land acquisition		
F3.5	**Permanent water intake facilities**	**1.1855**	**0**	**1.1855**	PDD	
F3.3.1	*Water intake facilities WIF No.3.2 (Northern dome)*	0.6218	0	0.6218	PDD	
F3.3.2	*Water intake facilities WIF No.2 (Southern dome)*	0.2694	0	0.2694	PDD	
F3.3.3	*Water intake facilities WIF No.1 (Central dome)*	0.2943	0	0.2943	PDD	
F3.6	**Other areal facilities of the Field**	**101.1712**	**0.0000**	**101.1712**	PDD	
F3.6.1	*Gas turbine power plant (GTPP)*	7.3573	0	7.3573	PDD	
F3.6.2	*Fire station adjacent to the PGTP-3 site*	1.5441	0	1.5441	PDD	
F3.6.3	*Sewerage treatment facility STF-3*	4.2919	0	4.2919	PDD	
F3.6.1	*Temporary accommodation camp (TAC)*	13.4096	0	13.4096	PDD	
F3.6.5	*Emergency Rescue Centre (ERC)*	3.1225	0	3.1225	PDD	
F3.6.6	*Administrative area*	3.5289	0	3.5289	PDD	
F3.6.7	*Field camp (FC)*	34.6440	0	34.6440	PDD	
F3.6.8	*Methanol storage*	3.0537	0	3.0537	PDD	
F3.6.9	*Fuel depot*	5.3264	0	5.3264	PDD	
F3.6.10	*Data processing / telecommunication center (DP/TC) site*	1.3363	0	1.3363	PDD	
F3.6.11	*Solid municipal, construction and industrial waste disposal site (SMCIW DS)*	20.9678	0	20.9678	PDD	
F3.6.12	*Water treatment plant WTP-3 (Northern dome)*	2.5887	0	2.5887	PDD	
F3.7	**Utility corridors between GWP and gas treatment facilities**	**198.5761**	**428.2333**	**626.8094**	PDD	
F3.7.1	**Northern dome**	**67.0407**	**103.1302**	**170.1709**	PDD	
	Utility corridors between GWPs Nos. 15-19, PGTP-3, PTS sites of GWPs Nos. 15, 17 and 18, 19 (gas flow lines, methanol pipelines, FOCL)	67.0407	103.1302	170.1709	PDD	
F3.7.2	**Central dome**	**65.7256**	**193.1706**	**258.8962**		
	Utility corridor to GWP No.1 (gas flow line, methanol pipeline, FOCL)	0.1643	0	0.1643	PDD	
	Utility corridor to GWP No.2 (gas flow line, methanol pipeline, FOCL)	4.6747	12.8242	17.4989	PDD	
	Utility corridor to GWP No.3 (gas flow line, methanol pipeline, FOCL)	6.8956	21.2304	28.1260	PDD	
	Utility corridor to GWP No.4 (gas flow line, methanol pipeline, FOCL)	10.1327	35.6196	45.7523	PDD	
	Utility corridor to GWP No.5 (gas flow line, methanol pipeline, FOCL)	2.7941	11.4046	14.1987	PDD	
	Utility corridor to GWP No.6 (gas flow line, methanol pipeline, FOCL)	11.5640	28.5879	40.1519	PDD	
	Utility corridor to GWP No.7 (gas flow line, methanol pipeline, FOCL)	18.7499	58.4195	77.1694	PDD	
	Other utility corridors associated with GWPs Nos. 1-7	10.7503	25.0844	35.8347	PDD	

Index	Project facilities	Area, ha			Referenced sources	Notes
		Permanent acquisition	Temporary acquisition	Total land acquisition		
F3.7.3	**Southern dome**	**65.8098**	**131.9325**	**197.7423**		
	Utility corridor between GWP No.12 and CGTP-2 (gas flow line, methanol pipeline, FOCL)	2.6868	6.1706	8.8574	PDD	
	Utility corridor between GWP No.10 and CGTP-2 (gas flow line, methanol pipeline, FOCL)	21.8082	35.8991	57.7073	PDD	
	Utility corridor between GWP No.8 and CGTP-2 (gas flow line, methanol pipeline, FOCL)	3.7358	14.5128	18.2486	PDD	
	Utility corridor between GWP No.9 and CGTP-2 (gas flow line, methanol pipeline, FOCL)	4.3505	8.2894	12.6399	PDD	
	Utility corridor between GWP No.11 and CGTP-2 (gas flow line, methanol pipeline, FOCL)	14.6920	23.9262	38.6182	PDD	
	Utility corridor between GWP No.13 and CGTP-2 (gas flow line, methanol pipeline, FOCL)	4.6926	10.9517	15.6443	PDD	
	Utility corridor between GWP No.14 and CGTP-2 (gas flow line, methanol pipeline, FOCL)	13.8439	32.1827	46.0266	PDD	
F3.8	**Utility corridors between has treatment facilities, Plant, Power Supply Complex No.2 and methanol storage (infield)**	**0**	***328.9903***	***328.9903***	PDD	
F3.8.1	*Utility corridor "CGTP No.1 - Plant" (gas line, condensate line, methanol line)*	0	148.7153	148.7153	PDD	The pipelines are fully installed underground. Temporary land acquisition is specified (for the period of construction). Data on the areal pipeline facilities are provided separately
F3.8.2	*Utility corridor "CGTP No.21 - Plant" (gas line, condensate line, methanol line)*	0	37.4362	37.4362	PDD	
F3.8.3	*Utility corridor "PGTP No.3 – Infield pipelines" (gas line, condensate line, methanol line)*	0	2.5893	2.5893	PDD	
F3.8.4	*Gas pipelines to GTPP*	0	3.2275	3.2275	PDD	
F3.8.5	*Fuel gas pipelines connecting Power Supply Complex No.2 with TAC, SMCIW DS, ERC and Plant*	0	18.3107	18.3107	PDD	
F3.8.6	*Utility corridor between Power Supply Complex No.2 and PGTP No.3 (fuel gas pipeline, nitrogen pipeline)*	0	1.9319	1.9319	PDD	
F3.8.7	*Utility corridor between CGTP No.2 and the Plant (gas line, condensate line, methanol line)*	0	116.7794	116.7794	PDD	
F3.9	**Areal pipeline facilities of the utility corridors**	**10.6173**	**1.0253**	**11.9991**	PDD	
F3.9.1	***Northern dome***	***7.7192***	***0***	***7.7192***	PDD	
	Site of pipeline wastewater pump stations (WWPS)	1.1334	0	1.1334	PDD	
	Pig trap station (PTS) for pipelines cleanup and diagnostic	3.1627	0	3.1627	PDD	
	Pipeline vent stack site	0.0009	0	0.0009	PDD	
	PTS site of GWPs Nos. 18, 19	0.4744	0	0.4744	PDD	
	PTS site of GWPs Nos. 15, 17	0.5076	0	0.5076	PDD	
	Pipeline shell vent stack site	0.0054	0	0.0054	PDD	
	Pipeline shell vent stack site	0.0039	0	0.0039	PDD	
	Pipeline shell vent stack site	0.0009	0	0.0009	PDD	
	Pipeline shell vent stack site	0.0021	0	0.0021	PDD	

Index	Project facilities	Area, ha			Referenced sources	Notes
		Permanent acquisition	Temporary acquisition	Total land acquisition		
	Inter-site gas pipeline valve station site ISGV-1, ISGV-2	0.6000	0	0.6000	PDD	
	Pipeline vent stack site	0.0009	0	0.0009	PDD	
	Pipeline vent stack site	0.0009	0	0.0009	PDD	
	Gas valve station site MV1, CV1, MV2, CV2, CV3 No.1, CV3 No.2	0.6144	0	0.6144	PDD	
	Gas valve station site GV GTPP No.1, GV GTPP No.2	0.1586	0	0.1586	PDD	
	Pipeline shell vent stack site	0.0009	0	0.0009	PDD	
	Safety valve site of the GTPP gas pipeline	0.1129	0	0.1129	PDD	
	Safety valves site of the methanol and condensate pipelines MSV-3, CSV3	0.1981	0	0.1981	PDD	
	Safety valves site of gas pipelines GSV-1, GSV-2	0.3903	0	0.3903	PDD	
	Valve stations site CV1 and MV1	0.1755	0	0.1755	PDD	
	Valve stations site CV1 and MV1	0.1754	0	0.1754	PDD	
F3.9.2	***Central dome***	***1.2794***	***1.0253***	***2.3047***	PDD	
	Pipeline shell vent stacks site (6 units)	0.0054	0	0.0054	PDD	
	Valve stations site CV1, MV1 "Salpadayakha Right"	0.1015	0	0.1015	PDD	
	Valve stations site CV1, MV1 "Salpadayakha Left"	0.1015	0	0.1015	PDD	
	Safety valve site SV MPG1	0.1024	0	0.1024	PDD	
	Pipeline vent stack site	0.0009	1.0253	1.0262	PDD	
	Pipeline vent stack site	0.0009	0	0.0009	PDD	
	Safety valve site SV M1, SV MPG1	0.1015	0	0.1015	PDD	
	PTS site of GWPs Nos. 1, 6	0.2176	0	0.2176	PDD	
	PTS site of GWPs Nos. 5, 7	0.2461	0	0.2461	PDD	
	PTS site of GWPs Nos. K5, 7, 2	0.4016	0	0.4016	PDD	
F3.9.3	***Southern dome***	***1.6187***	***0***	***1.9752***	PDD	
	Valve stations site of condensate and methanol pipelines CV2, MV2	0.1015	0	0.1015	PDD	
	Valve stations site of condensate and methanol pipelines CV2, MV2	0.1015	0	0.1015	PDD	
	Safety valve site SV MPG2	0.1238	0	0.1238	PDD	
	Vent stack	0.0009	0	0.3574	PDD	
	Safety valve site MSV2, MPK SV2	0.1030	0	0.1030	PDD	
	Pipeline shell vent stack site	0.0060	0	0.0060	PDD	
	PTS site of GWPs Nos. 13, 14	0.3934	0	0.3934	PDD	
	Pipeline vent stack site	0.0009	0	0.0009	PDD	
	PTS site of GWPs Nos. 9, 11	0.3004	0	0.3004	PDD	
	PTS site of GWPs Nos. 8, 12	0.4873	0	0.4873	PDD	
F3.10	**Motor roads (MR) including access roads (AMR)**	**385.3961**	**1.4532**	**386.8493**	PDD	
F3.10.1	***Northern dome***	***229.7462***	***0.6063***	***230.3525***	PDD	
	MR No.1. Section No.2 from TAC to the Utrenniy Airport	29.6129	0	29.6129	PDD	
	MR No.1. Section No.3 from the Utrenniy Airport to the Salpada-Yakha River crossing	46.7875	0	46.7875	PDD	

Index	Project facilities	Area, ha			Referenced sources	Notes
		Permanent acquisition	Temporary acquisition	Total land acquisition		
	AMR of the Utrenniy Terminal	3.528	0	3.528	PDD	
	MR No.4 from ERC site to the Plant	7.1475	0	7.1475	PDD	
	MR No.7. Section No.2 from Power Supply Complex No.2 to the Plant	3.5166	0	3.5166	PDD	
	MR No.7.2 to the pig trap station	0.9605	0	0.9605	PDD	
	MR No.8 to GWP No.15 site	16.3281	0	16.3281	PDD	
	MR No.9 to GWP No.17 site	4.3158	0	4.3158	PDD	
	MR No.10 to GWP No.18 site	24.3844	0.1853	24.5697	PDD	
	MR No.11 to GWP No.19 site	9.8875	0	9.8875	PDD	
	MR No.13 to SMCIW DS	8.9656	0	8.9656	PDD	
	MR No.16 to CGTP-2 site	58.1575	0.421	58.5785	PDD	
	AMR of the Plant fire entrance	0.5712	0	0.5712	PDD	
	AMR of water intake site No.3.2	2.1861	0	2.1861	PDD	
	AMR of DP/TC site	0.9104	0	0.9104	PDD	
	AMR of STF-3 site	0.2279	0	0.2279	PDD	
	AMR of USZP-3 site	0.2409	0	0.2409	PDD	
	AMR of FC site	5.8506	0	5.8506	PDD	
	AMR of the fuel depot	0.5718	0	0.5718	PDD	
	AMR of the methanol storage	0.6518	0	0.6518	PDD	
	AMR of CGTP-1, CGTP-2	2.645	0	2.645	PDD	
	AMR of the MV1, CV1, MV2, CV2, CV3 No.1, CV3 No.2 site	0.237	0	0.237	PDD	
	AMR of GSV-1, GSV-2 site	0.653	0	0.653	PDD	
	AMR of the site of KI GWP No.16, KI GWP Nos. 15-17, KI GWP Nos. 18-19 (right-hand)	0.4954	0	0.4954	PDD	
	AMR of the site of KI GWP No.16, KI GWP Nos. 15-17, KI GWP Nos. 18-19 (left-hand)	0.5889	0	0.5889	PDD	
	AMR to CV1 and MV1 site	0.1674	0	0.1674	PDD	
	AMR to CV1 and MV1 site	0.1569	0	0.1569	PDD	
F3.10.2	***Central dome***	***87.7669***	***0.1602***	***87.9271***	PDD	
	MR No.1. Section No.4 from the Salpada-Yakha River crossing to CGTP-1 site	8.2869	0	8.2869	PDD	
	MR No.22 to GWP No.5 site	3.0524	0	3.0524	PDD	
	MR No.23 to GWP No.2 site	7.6393	0	7.6393	PDD	
	MR No.24 to GWP No.3 site	8.4178	0.1602	8.5780	PDD	
	MR No.25 to GWP No.6 site	13.8837	0	13.8837	PDD	
	MR No.26 to GWP No.4 site	17.7753	0	17.7753	PDD	
	MR No.27 to GWP No.7 site	20.5552	0	20.5552	PDD	
	MR No.28 to HP-1 site	1.8512	0	1.8512	PDD	
	MR No.29 to GWP No. 1 site	1.1400	0	1.1400	PDD	
	MR No.32 to water intake site No.1	1.1557	0	1.1557	PDD	
	AMR to site CV1, MV1 "Salpadayakha Right"	0.4966	0	0.4966	PDD	

Index	Project facilities	Area, ha			Referenced sources	Notes
		Permanent acquisition	Temporary acquisition	Total land acquisition		
	AMR to site CV1, MV1 "Salpadayakha Left" and SV MPG1	3.1619	0	3.1619	PDD	
	AMR to site SV M1, SV MPG1	0.3509	0	0.3509	PDD	
F3.10.3	***Southern dome***	***67.8830***	***0.6867***	***68.5697***	PDD	
	MR No.15 to GWP No.10 site	8.6314	0	8.6314	PDD	
	MR No.17 to GWP No.8 site	4.8227	0	4.8227	PDD	
	MR No.12 to HP-2, CGTP-2 site	4.8120	0	4.8120	PDD	
	MR No.18 to GWP No.9 site	11.2770	0.2388	11.5158	PDD	
	MR No.19 to GWP No.11 site	9.3060	0.2221	9.5281	PDD	
	MR No.20 to GWP No. 14 site	18.2462	0	18.2462	PDD	
	MR No.21 to GWP No. 13 site	6.0349	0.2258	6.2607	PDD	
	MR No.14 to GWP No.12 site	1.2735	0	1.2735	PDD	
	AMR of water intake site No.2	2.1534	0	2.1534	PDD	
	AMR of CV2, MV2 site	0.2274	0	0.2274	PDD	
	AMR of CV2, MV2 site	0.2144	0	0.2144	PDD	
	AMR of SV MPG2 site	0.1513	0	0.1513	PDD	
	AMR of MSV2, MPK SV2 site	0.4661	0	0.4661	PDD	
	AMR of SV2 site	0.2667	0	0.2667	PDD	
F3.11	**Water transport lines**	**47.3552**	**54.8976**	**102.2528**	PDD	
F3.11.1	***Northern dome***	***38.2199***	***36.0391***	***74.2590***	PDD	
	Pipe rack "WI No.3.2 - WTP-3"	2.0162	1.6825	3.6987	PDD	
	Pipe rack "WI No.3.1 - WTP-3"	0.2833	0.4700	0.7533	PDD	
	Pipe rack No.1 "WTP-3 - TAC"	22.5523	15.3501	37.9024	PDD	
	Pipe rack No.3 to ERC	0.2585	0.1630	0.4215	PDD	
	Pipe rack No.4 "ERC - FC"	1.0508	0.7892	1.8400	PDD	
	Pipe rack No.12 to methanol storage	0.1584	0.4974	0.6558	PDD	
	Pipe rack No.6 to fuel depot	0.0960	0.0000	0.0960	PDD	
	Pipe rack No.5 to DP/TC	0.5352	0.9729	1.5081	PDD	
	Pipe rack No.2 to the Utrenniy Terminal	1.9655	2.1417	4.1072	PDD	
	Pipe rack No.7 to the Plant	1.1415	0.2417	1.3832	PDD	
	Pipe rack No.10 to GTPP site	0.1563	0.0000	0.1563	PDD	
	Pipe rack No.1 to PGTP-3	0.1791	0.0000	0.1791	PDD	
	Pipe rack No.8 to STF-3 and SMCIW DS	3.0048	2.5083	5.5131	PDD	
	Pipe rack No.9 from SMCIW DS to the Nyaday-Pynche River	3.0080	5.6481	8.6561	PDD	
	Pipe rack from STF-3 to ERIS-3	0.0520	0.0000	0.0520	PDD	
	Pipe rack No.13 to the Utrenniy Terminal	1.0136	5.5742	6.5878	PDD	
	Water main to GWP No.16 site	0.7484	0.0000	0.7484	PDD	
F3.11.2	***Central dome***	**5.0624**	**9.6555**	**14.7179**		
	Utilities rack between CGTP-1 and ERIS-1	0.0753	0.3609	0.4362	PDD	
	Utilities rack between WI No.1 and WTP at CGTP-1	4.9871	9.2946	14.2817	PDD	
F3.11.3	***Southern dome***	**4.0729**	**9.2030**	**13.2759**		
	Rack WI2 - WTP at CGTP2	3.2272	6.5139	9.7411	PDD	

Index	Project facilities	Area, ha			Referenced sources	Notes
		Permanent acquisition	Temporary acquisition	Total land acquisition		
	Rack CGTP2 - ERIS2	0.8457	2.6891	3.5348	PDD	
F3.12	**Power supply and communications lines**	**7.7294**	**594.7901**	**602.5195**	PDD	
F3.12.1	***Northern dome***	***6.5549***	***396.2340***	***402.7889***	PDD	
	Cable rack 10 kV from Power Supply Complex No.2 to WTP-3	0.0463	0.2788	0.3251	PDD	
	Cable rack 10 kV to GTPP	0.0516	0	0.0516	PDD	
	Utility corridor to GWP No.15 (OPL 10 kV, FOCL)	0.1420	20.1250	20.2670	PDD	
	Utility corridor to GWP No.17 (OPL 10 kV, FOCL)	0.0316	5.0853	5.1169	PDD	
	Utility corridor to GWP No.18 (OPL 10 kV, FOCL)	0.1810	25.8601	26.0411	PDD	
	Utility corridor to GWP No.19 (OPL 10 kV, FOCL)	0.0566	9.9176	9.9742	PDD	
	Utility corridor between GTPP and CGTP-2 (OPL 35 kV, FOCL)	2.0282	140.2476	142.2758	PDD	
	Utility corridor between GTPP and CGTP-1 (OPL 35 kV, FOCL)	3.9808	192.2538	196.2346	PDD	
	OPL 10 kV to the fuel depot	0.0042	0.1239	0.1281	PDD	
	Two-line OPL 10 kV to WI No.3.2	0.0326	2.3419	2.3745	PDD	
F3.12.2	***Central dome***	***0.5221***	***96.5399***	***97.0620***	PDD	
	Utility corridor to GWP No.1 (OPL 10 kV, FOCL)	0.0235	2.3003	2.3238	PDD	
	Utility corridor to GWP No.2 (OPL 10 kV, FOCL)	0.0445	8.2719	8.3164	PDD	
	Utility corridor to GWP No.3 (OPL 10 kV, FOCL)	0.0592	11.6050	11.6642	PDD	
	Utility corridor to GWP No.4 (OPL 10 kV, FOCL)	0.0840	15.2038	15.2878	PDD	
	Utility corridor to GWP No.5 (OPL 10 kV, FOCL)	0.0274	5.5561	5.5835	PDD	
	Utility corridor to GWP No.6 (OPL 10 kV, FOCL)	0.0898	16.6751	16.7649	PDD	
	Utility corridor to GWP No.7 (OPL 10 kV, FOCL)	0.1842	35.2382	35.4224	PDD	
	OPL 10 kV to WI No.1	0.0095	1.6895	1.6990	PDD	
F3.12.3	***Southern dome***	***0.6524***	***102.0162***	***102.6686***	PDD	
	Utility corridor to GWP No.10 (OPL 10 kV, FOCL)	0.0404	9.9888	10.0292	PDD	
	Utility corridor to GWP No.12 (OPL 10 kV, FOCL)	0.1194	30.2124	30.3318	PDD	
	Utility corridor to GWP No.8 (OPL 10 kV, FOCL)	0.0356	6.0801	6.1157	PDD	
	Utility corridor to GWP No.9 (OPL 10 kV, FOCL)	0.0720	12.0691	12.1411	PDD	
	Utility corridor to GWP No.11 (OPL 10 kV, FOCL)	0.0456	11.0012	11.0468	PDD	
	Utility corridor to GWP No.14 (OPL 10 kV, FOCL)	0.1280	23.9885	24.1165	PDD	
	Utility corridor to GWP No.13 (OPL 10 kV, FOCL)	0.0348	5.2603	5.2951	PDD	
	OPL 10 kV to WI No.2	0.0166	2.3484	2.3650	PDD	
	Utility corridor to WTP-100 and WTP-3 site (OPL 10 kV, FOCL)	0.1600	1.0674	1.2274	PDD	
F3.13	**Temporary facilities for the construction phase**	**0**	**162.8596**	**162.8596**	PDD	
F3.13.1	***Northern dome***	0	***52.8583***	***52.8583***	PDD	
	Temporary OPL 10 kV to STF-100	0	1.9484	1.9484	PDD	
	Temporary fuel depot	0	2.5697	2.5697	PDD	
	Temporary fuel pipeline from the Utrenniy Terminal to the temporary fuel depot	0	0.7144	0.7144	PDD	

Index	Project facilities	Area, ha			Referenced sources	Notes
		Permanent acquisition	Temporary acquisition	Total land acquisition		
	Temporary water intake at Quarry No.9G	0	0.0528	0.0528	PDD	
	Temporary AMR of temporary water intake facilities at Quarry No.9G	0	0.0822	0.0822	PDD	
	TSF No.6 site	0	1.6667	1.6667	PDD	
	Temporary AMR of TSF No.6 site	0	0.0271	0.0271	PDD	
	TSF No.7 site	0	10.7945	10.7945	PDD	
	Temporary AMR No.1 of TSF No.7 site	0	0.0886	0.0886	PDD	
	Temporary AMR No.2 of TSF No.7 site	0	0.0453	0.0453	PDD	
	TSF No.5 site	0	4.5560	4.5560	PDD	
	Temporary AMR of TSF No.5 site	0	0.1220	0.1220	PDD	
	TSF No.3 site	0	4.5068	4.5068	PDD	
	TSF No.4 site	0	5.0277	5.0277	PDD	
	Temporary AMR of TSF No.4 site	0	1.1030	1.1030	PDD	
	Temporary AMR of TSF No.3 site	0	0.4854	0.4854	PDD	
	TSF No.1 site	0	5.0277	5.0277	PDD	
	Temporary AMR of TSF No.1 site	0	0.0610	0.0610	PDD	
	TSF No.1/1 site	0	4.3466	4.3466	PDD	
	TSF No.2 site	0	7.7795	7.7795	PDD	
	Temporary AMR No.1 of TSF No.2 site	0	0.1045	0.1045	PDD	
	Temporary AMR No.2 of TSF No.2 site	0	0.3389	0.3389	PDD	
	Temporary testing equipment sites (6 units)	0	1.4095	1.4095	PDD	
F3.13.2	***Central dome***	0	***53.1655***	***53.1655***	PDD	
	TSF No.10 site	0	18.3223	18.3223	PDD	
	Temporary AMR No.1 of TSF No.10 site	0	1.4670	1.4670	PDD	
	Temporary AMR No.2 of TSF No.10 site	0	0.4011	0.4011	PDD	
	TSF No.9 site	0	11.6768	11.6768	PDD	
	Temporary AMR No.1 of TSF No.9 site	0	0.0661	0.0661	PDD	
	Temporary AMR No.2 of TSF No.9 site	0	0.0966	0.0966	PDD	
	TSF No.8 site	0	14.4103	14.4103	PDD	
	Temporary AMR No.1 of TSF No.8 site	0	0.0961	0.0961	PDD	
	Temporary AMR No.2 of TSF No.8 site	0	0.0928	0.0928	PDD	
	Temporary WI site at Quarry No.31N	0	0.0528	0.0528	PDD	
	Temporary AMR of the temporary WI site at Quarry No.31N	0	0.1639	0.1639	PDD	
	Temporary testing equipment sites (6 units)	0	3.4452	3.4452	PDD	
	Temporary testing equipment sites (8 units)	0	2.8745	2.8745	PDD	
F3.13.3	***Southern dome***	0.0000	***56.8358***	***56.8358***	PDD	
	TSF No.12 site	0	11.6882	11.6882	PDD	
	Temporary AMR of TSF No.12 site	0	0.0774	0.0774	PDD	
	TSF No.11 site	0	22.9747	22.9747	PDD	
	Temporary AMR of TSF No.11 site	0	1.9261	1.9261	PDD	
	TSF No.14 site	0	18.1633	18.1633	PDD	

Index	Project facilities	Area, ha			Referenced sources	Notes
		Permanent acquisition	Temporary acquisition	Total land acquisition		
	Temporary AMR of TSF No.14 site	0	1.6865	1.6865	PDD	
	Temporary WI site at Quarry No.2G	0	0.0624	0.0624	PDD	
	Temporary AMR of the temporary WI site at Quarry No.2G	0	0.2572	0.2572	PDD	
Utrenniy Airport						
A	**Total Airport facilities**	**255.6817**	**189.9594**	**445.6411**	PDD	Lessee - LLC "Arctic LNG 2", sub-lessee - LLC "Nova"
A1	*Areal facilities*	243.8481	15.4035	259.2516	PDD	Temporary facilities of the constrution period including TSF site (14.2245 ha) and two access roads (0.8640 ha and 0.3150 ha).
A2	*Linear facilities*	11.8336	174.5559	186.3895	PDD	Building easement is included in the temporary acquisition area

Referenced sources:

PDD - design survey materials, design documentation, conclusions of expert review

ANNEX 12

LAND PLOTS IN THE TAZOVSKIY MUNICIPAL DISTRICT OF YNAO AND WATER AREAS WITHIN THE OB ESTUARY OCCUPIED BY THE PLANT AND PORT FACILITIES (ARCTIC LNG 2 PROJECT)

Index	Project facilities	Area, ha	Referenced sources*	Notes
General-purpose berth (in operation since 2016)				
T1	**Berth structures**	2.30578	PDD, CAD	
T1.1	*water area*	2.0004	PDD	Water area occupied by jetty
T1.2	*territory*	0.30538	PDD	Onshore area occupied by the jetty access road
T2	Area of **dredging** to minus 4.8 m (BSD)	6.46	PDD	
T3	Total affected water area (without the remote dumping site)	8.95	PDD	
T4	Area size of the **dumping** site	1300 (appr.)	GIS	
T5	**Temporary site facilities of the construction period** (TSF)	0	PDD	TSF are located on the onshore sites intended for development of the Field facilities (early development facilities, subsequently integrated into the land of the Salmanovskoye (Utrenneye) OGCF Facilities Setup)
Terminal: Reconstruction of the general-purpose berth and construction of new facilities				
T6	**Water area**, including:	6000 (appr.)	GIS	
T6.1	*internal basin*	400 (appr.)	GIS	Port water area within the barriers
T6.2	*anchoring berths in the outer area*	500 (appr.)	GIS	
T7	**Dredged port area** (slope top edge), including:	552.72	PDD	Table 13 in Vol. P31.1, Terminal OPF (document code - 018-ЮР/2018(4742); LENMORNIIPROEKT JSC, 2019
T7.1	*dredging contour to level minus 17.00 m (BSD) (for three GBSs)*	20.5036	PDD	Corresponds to contour R3.1. One-time dredging.
T7.2	*dredging contour to level minus 17.54 m (BSD) in the tankers and gas carriers mooring area along two GBSs*	6.308	GIS	Primary and regular (maintenance) dredging
T7.3	*dredging contour to level minus 15.00 m (BSD) (approach channel with plan view dimensions 5618x510 m, and turning/maneuvering area)*	479.4084	GIS, PIM, PDD	Calculated as difference: T7-(T7.1+T7.2+T7.4+T7.5). Primary and regular (maintenance) dredging
T7.4	*dredging contour to level minus 12.00 m (BSD) (internal basin adjoining the general-purpose berth)*	45 (appr.)	GIS	Contour T1.1 is integrated
T7.5	*dredging contour to level minus 7.00 m (BSD) (general-purpose berth adjoining the shore)*	1.5 (appr.)	GIS	Primary and regular (maintenance) dredging
T8	Future dredging for the Terminal extension (for 6 GBS units)	100 (appr.)	GIS	Primary and regular (maintenance) dredging
T9	**Dumping** sites area (2 units)	6000 (appr.)	GIS	Disposal of bottom soil from dredging areas T7
T.9.1	*including in the outer Port area*	1500 (appr.)	GIS	
T10	**Artificial land plots** (ALP), including:	24.1	PDD	Table 13 in Vol. P31.1, Terminal OPF (document code - 018-ЮР/2018(4742); LENMORNIIPROEKT JSC, 2019). ALP-1 also includes the Plant facilities (item P2)
T10.1	*ALP-1 (for configuration with 3 GBSs)*	13.6	PDD	
T10.2	*ALP-2 (extension to 6 GBSs)*	10.5	PDD	
T11	**Hydraulic structures**, including			
T11.1	*adjoining the ALP (quay, shore reinforcement)*	22.52	PDD	
T11.1.1	*adjoining the Project's three GBSs*	10.93 (appr.)	GIS	The sum of items T11.1.1, T11.1.2 and T1 is the total area of designed hydraulic structures of 24.52 ha (Table 13 Vol. P31.1 Document 018-ЮР/2018(4742) - LENMORNIIPROEKT JSC, 2019)
T11.1.2	*adjoining the three additional GBSs (future extension)*	11.28 (appr.)	GIS	
T11.2	*Ice barriers*	12.85 (appr.)	PDD, GIS	PDD - linear dimensions - 3117 (S) +1300 (N) = 4417 m; GIS - area size of the facilities
T12	**Territory**, including:			
T12.1	*cadastral land plots established and re-classified under the category of industry lands** (18 units, including 89:06:000000:1853 and :1854, 89:06:050303:78, :100, :101,*	87.6981	PDD, CAD	Partially used (item T12.2). Unoccupied part of the cadastral land plots with the total area of 58.3598 ha is designated in the PDD as reserve territory (in Table 13 Vol. P31.1, Terminal OPF

Index	Project facilities	Area, ha	Referenced sources*	Notes
	:123, :124, :125, :186, :187, :190, :191, :192, :193, :211, :338, :342, :470)			its size is erroneously specified as 58.32 ha). In aggregate with items T1, T10, T11.1. T12.3 it gives the area of 137.99 ha which is designated in the PDD as territory within conventional design boundaries of the Terminal (including onshore land, ALP and hydraulic structures). Three plots (:1853, :191, :470) are also occupied by the Plant facilities
T12.2	*parts of cadastral plots (T12) immediately occupied by the Terminal facilities*	29.3383	PDD	
T12.3	*designed facilities outside the boundaries of land plots allocated for the Terminal construction*	1.72	PDD	Outer slope of the rear-side territory
T12.4	*plot occupied by TSF during construction*	38.5085	PDD, CAD	Corresponds to cadastral plot 89:06:050303:188 (38.5085 h)
GBS LNG & SGC Plant				
P1	**Territory**, including			
P1.1	*cadastral land plots established and re-classified under the category of industry lands** (9 units including 89:06:000000:1853, 89:06:050301:201, 89:06:050303:191, :378, :456, :188, :342, :470, :471)*	2183.6133	PDD, CAD	Plots occupied by TSF during construction (P1.3) are not included in the list. Three plots (:1853, :191, :470) are also occupied by the Terminal facilities
P1.2	*cadastral plots (listed in item P1.1) immediately occupied by the Plant onshore facilities*	45.2856	PDD	Corresponds to cadastral plots 89:06:050303:378 (36.7456 ha) and 89:06:050301:201 (8.5400 ha)
P1.3	*Fenced onshore facilities of the Plant, including:*	41.93	PDD	A part of utility lines racks is outside this territory (the racks are routed across ALP, refer to item P2)
P1.3.1	*footprint area of buildings and installations*	1.0112	PDD	
P1.3.2	*footprint of process lines racks*	1.3026	PDD	
P1.3.3	*site roads*	2.60302	PDD	
P1.3.4	*paving unbuilt surfaces with crushed stone*	28.83458	PDD	Defined as difference (in the original table, the total of site areas does not match the total area size)
P1.3.5	*sand filling of unbuilt territory*	7.6605	PDD	
P1.3.6	*water drainage facilities*	0.5181	PDD	
P1.4	*plot occupied by TSF during construction*	13.8436	CAD, GIS	Located within cadastral plot 89:06:050303:379 (52.3250 ha). Two utility corridors associated with the land plot will be established in cadastral plots 89:06:050303:456 and :566 (the latter is not included in the list of land plots in item P1.1). Boundaries of land plot P1.4.1 correspond to the contour of TSF site in the design documentation. Additional land plot P1.4.2 follows the fill contour on the Rosreestr public cadastral map
P1.4.1	*TSF site provided for in the design documentation*	10.7100	PDD, GIS	
P1.4.2	*TSF extension*	2.5750	CAD, GIS	
P1.4.3	*access motor road (AMR) of TSF site*	0.5586	CAD, GIS	Axial length of the facility - appr. 410 m. The plot contours follow the countour lines of filled area. The road is routed across plots 89:06:050303:378 (start, territory of the Plant onshore facilities), :338 (designated for the Terminal) and :379 (end, TSF site)
P2	Facilities developed on the **artificial land plots** (ALP), including:	8.5356	PDD	
P2.1	*Plant process pipe racks within ALP-1 (T10.1)*	4.8093	PDD	
P2.2	*construction sites for crossway connections at the process trains within ALP-1 (T10.1)*	3.7263	PDD	Three sites 1.2421 ha each

Index	Project facilities	Area, ha	Referenced sources*	Notes
P3	**Hydraulic structures**, including:	2.6728	PDD, GIS	Designed channel length is 980 m. The channel includes 2 main sections and an exit section of 130 m. The channel design also includes a catchwater drain. The design boundaries refer to the general layout plan. The concerned cadastral plots are 89:06:050303:191, :470, :188, :456, :378, 89:06:000000:1853
P3.1	*drainage channel*	2.6380	PDD, GIS	
P3.2	*catchwater drain*	0.0348	PDD, GIS	
P4	Facilities within the **water area**, including:	20.8108	PDD	Total area of P3.1 and P3.2. Water area is permanently occupied
P4.1	*preparation of underwater bases for installation of the Plant Process Trains*	20.5036	PDD	Area occupied by one GBS - 331.74x153.74 m = 5.1002 ha
P4.2	*connections sites*	0.3072	PDD	

Referenced sources:

PDD – design survey materials, design documentation, conclusions of expert review

CAD – data of the Federal Service for State Registration, Cadastre and Cartography (Rosreestr)

GIS – map-based information derived from graphical materials in the survey reports and design documentation

PIM – Project Information Memorandum

****Full name of the category** is the "land designated for industry, energy, transport, communications, radiobroadcasting, television, information technology, support land for space activities, defence and security land, and other land of special designation".*

ANNEX 13
FUEL CONSUMPTION OF THE PROJECT FACILITIES

1. FUEL CONSUMPTION ON THE CONSTRUCTION STAGE

Table A13.1: GBS LNG & SGC Plant's fuel consumption

Facility/ type of activity	Diesel		Gasoline		Construction period		Source	
	Value	Units	Value	Units	Years	Months	Title	Page number
Construction & installation	11083	t	-	-	2020 - 2026	84	GBS Plant for production, storage and offloading of liquefied natural gas and stabilized gas condensate. Design documentation. Chapter 6. Project construction plan. Part 1. Main and auxiliary facilities located on ALP and shore side. Book 1. Text part – Pressmark 2017-423-M-02-ПОС1.1 – Moscow: JSC "NIPIGAZ", 2019. 269 p.	151
Freight transport	397	t	-	-	2020 - 2026	84		
Operations in Ob Bay water area	6000	t	-	-	2021 - 2025	60		

Table A13.2: GBS LNG & SGC Plant fuel consumption by years

Fuel consumption by years, t								Source
2020	2021	2022	2023	2024	2025	2026	Total	
1148	4818	4296	2922	1948	1774	574	**17480**	GBS Plant for production, storage and offloading of liquefied natural gas and stabilized gas condensate. Design documentation. Chapter 6. Project construction plan. Part 1. Main and auxiliary facilities located on ALP and shore side. Book 1. Text part – Pressmark 2017-423-M-02-ПОС1.1 – Moscow: JSC "NIPIGAZ", 2019. 269 p.

Table A13.3: Fuel consumption during the Terminal construction

Facility/ type of activity	Diesel		Gasoline		Construction period		Source	
	Value	Units	Value	Units	Years	Months	Title	Page number
Construction of the berth structures at Salmanovskoye (Utrenneye) OGCF Maintenance dredging in the water area of the berth structures of the Salmanovskoye (Utrenneye) OGCF	123.5	t	-	-	-	27	Construction of the berth structures at Salmanovskoye (Utrenneye) OGCF. Design documentation. Chapter 12. Project construction plan. – Pressmark 603-2013-00-ПОС. - «Morstroytekhnologiya», 2014.	46
Facilities of prepairing period (start-up package I, designation in the design documentation - PIR-1)	1700	m^3/year	-	-	2019-2021	36	LNG & SGC Terminal «Utrenniy». Design documentation. Chapter 6. Project construction plan – Saint-Petersburg: JSC «LENMORNIIPROEKT»	23

Table A13.4: Fuel consumption during the Field facilities construction

Facility/ type of activity	Diesel		Gasoline		Construction period		Source	
	Value	Units	Value	Units	Years	Months	Title	Page number
Early development facilities	55457	t	3.3	t	2017 - 2020	48	Salmanovskoye (Utrenneye) OGCF Early development facilities. Design documentation. Chapter 6. Project construction plan. Pressmark 143.01.00-02-196-ПОС.1, Volume 6.1. - CJSC "GK RusGazEngineering", 2017. 181 p.	66

Facility/ type of activity	Diesel		Gasoline		Construction period		Source	
	Value	Units	Value	Units	Years	Months	Title	Page number
Salmanovskoye (Utrenneye) OGCF Facilities Setup. Gas supply for the power supply facilities to support construction, hydraulic filling and drilling operations (start-up package I, - PIR-1)	283.01	t	0.8	T		16	Salmanovskoye (Utrenneye) OGCF Facilities Setup Gas supply for the power supply facilities to support construction, hydraulic filling and drilling operations . Chapter 6. Project construction plan. Pressmark 120.ЮР.2017-2010-02-ПОС1. LLC «INSTITUT YUZHNIIGIPROGAZ», 2019. 177 p.	78
Well pad No.16 (battery No.1)	174.79	t	-	-	2020 - 2026	3.7	Construction of well pads No.2 and No.16 at Salmanovskoye (Utrenneye) oil, gas, and condensate field, drilling and testing period. Environmental impact assessment. Pressmark 346-1-319/18/П-346-ООС. LLC «SERVISPROEKTNEFTEGAZ», 2018. 406 p.	Beginning from page 214
Well pad No.16 (battery No.2)	200.23	t	-	-		6.6		
Well pad No.2	390	t	-	-		28.5		
DPP for drilling of 18 GWP	961	t	-	-		Depends on GWP - from 8.9 till 39	Construction of 18 well pads at Salmanovskoye (Utrenneye) OGCF, drilling and testing period. Design documentation. Chapter 8. Environmental protection measurements. Part 1. Text part. Volume 8.1 - Pressmark 2018-560-НТЦ-ООС1. - LLC "NOVATEK Scientific-technical centre", 2019. 387 p.	25
UPNSh unit	524.52	t	-	-				29

Table A13.5: Fuel consumption during the Airport construction period

Facility/ type of activity	Diesel		Natural Gas		Construction period		Source	
	Value	Units	Value	Units	Years	Months	Title	Page number
Boiler house	-	-	1329	m^3/hour	I – III quarters 2022	9	Airport Utrenniy. Design documentation. Chapter 1. Explanatory note – Pressmark 375-юр/2018-ПЗ - Krasnoyarsk: LLC Project Institute "KRASAEROPROEKT", 2019	23
DPP – 1000 kWt /1250 kVA	30	t/year	-	-	-	45	Airport Utrenniy. Design documentation. Chapter 8. Environmental protection measurements. Part 2. Construction stage. - Pressmark 375-юр/2018-	160
DPP – 320 kWt /400 kVA	30	t/year	-	-	-	45		

Facility/ type of activity	Diesel		Natural Gas		Construction period		Source	
	Value	Units	Value	Units	Years	Months	Title	Page number
DPP – 280 kWt /350 kVA (×2)	60	t/year	-	-	-	34	ООС2.1 - Krasnoyarsk: LLC Project Institute "KRASAEROPROEKT", 2019	
DPP 80 kWt for the off-site networks	4.4	t	-	-	240 hours total		Airport Utrenniy. Design documentation. Chapter 8. Environmental protection measurements. Part 3. Off-site networks. - Pressmark 375-юр/2018-ООС3.2 - Krasnoyarsk: LLC Project Institute "KRASAEROPROEKT", 2019	102
Construction equipment	427	t	-	-	-	45		106

2. FUEL CONSUMPTION DURING OPERATIONS

Table A13.6: Fuel consumption during the Terminal operations

Facility/ type of activity	Diesel		Fuel gas		Date of commissioning	Source	
	Value	Units	Value	Units		Title	Page number
Utrenniy liquefied natural gas and stabilised gas condensate terminal: Operating phase facilities (OPF, PK 2)	1100	m^3/year	-	-	2023	LNG & SGC Terminal «Utrenniy». Improvements and extensions. Design documentation. Chapter 1. Explanatory note – Saint-Petersburg: JSC «LENMORNIIPROEKT»	36

Table A13.7: Fuel consumption during Field facilities operation

Facility/ type of activity		Diesel		Fuel gas		Date of commissioning	Source
		Value	Units	Value	Units		
Completion of well pads П304 and Р295 at the Salmanovskoye (Utrenneye) OGCF	GFU on the well П304	-	-	26.28	MCMPA	-	Salmanovskoye (Utrenneye) OGCF Early development facilities. Design documentation. Chapter 1. Explanatory note – JSC «EnergoGasEngineering», 2018
	FGTU (own consumption) on the MAPP1 site	-	-	0.59	MCMPA	-	

Facility/ type of activity		Diesel		Fuel gas		Date of commissioning	Source
		Value	Units	Value	Units		
	FGTU (own consumption) on the MAPP2 site	-	-	0.59	MCMPA	-	
Salmanovskoye (Utrenneye) OGCF Facilities Setup. Gas supply for the power supply facilities to support construction, hydraulic filling and drilling operations (PIR-1)	Power plant No.2: MAPP-2500Г (16 units = 4 units x 4 blocks) total output 40 MWt	-	-	166.6	MCMPA	2019 – under commissioning GTPP, staged input and output up to 2025, peak in 2022- after commissioning GTPP	Salmanovskoye (Utrenneye) OGCF Facilities Setup Gas supply for the power supply facilities to support construction, hydraulic filling and drilling operations . Chapter 1. Explanatory note. Pressmark 120.ЮР.2017-2010-02-П31.ТЧ. JSC «NIPIGAZ», 2018. 63 p. Sanitary protected zone project. Salmanovskoye (Utrenneye) OGCF Facilities Setup. Gas supply for the power supply facilities to support construction, hydraulic filling and drilling operations – Yekaterinburg: LLC «KSEP Geoecologia Consulting», 2019. 58 p.
Salmanovskoye (Utrenneye) OGCF Facilities Setup (start-up packages PIR-2…5)	Boiler house on TAC	-	-	8.38	MCMPA	2021	Salmanovskoye (Utrenneye) OGCF Facilities Setup . Design documentation. Chapter 1. Explanatory note. 120.ЮР.2017-2020-02-П31.ТЧ – JSC «NIPIGAZ», 2019 - P.96-97
	Boiler house on ERC	-	-	7.47	MCMPA	2021	
	Boiler house on CGTP-1	-	-	3.62	MCMPA	IV quarter 2022	
	Boiler house on CGTP-2	-	-	3.63	MCMPA	IV quarter 2023	
	GFU on WWTP	-	-	26.28	MCMPA	-	Salmanovskoye (Utrenneye) OGCF Early development facilities. Design documentation. Chapter 1. Explanatory note – JSC «EnergoGasEngineering», 2018

Facility/ type of activity		Diesel		Fuel gas		Date of commissioning	Source
		Value	Units	Value	Units		
	All power generating units of GTPP (5 in operation, 1 in reserve)	-	-	113.83	MCMPA	2022 – first power generating units 2025 – full power	Salmanovskoye (Utrenneye) OGCF Facilities Setup . Design documentation. Chapter 8. Environmental protection measurements. Part 3. Air quality impact assessment . 120.ЮР.2017-2020-02-ООС3.2 – JSC «NIPIGAZ», 2019 – P. 566

MCMPA – million cubic meters per annum

Table A13.8: Fuel consumption during the Airport operation

Facility/ type of activity	Diesel		Natural gas		Date of commissioning	Operation period, h/year	Source	
	Value	Units	Value	Units			Title	Page number
Boiler house	-	-	5700	thous. m^3/year	IV quarter 2022	8760	Airport Utrenniy. Design documentation. Chapter 8. Environmental protection measurements – Pressmark 375-юр/2018-ООС1.1 - Krasnoyarsk: LLC Project Institute "KRASAEROPROEKT", 2019	256
DPP (engine CUMMINS 4B3.9G-1), 20 kWt	2.5	t/year	-	-		500		260 - 275
DPP (engine CUMMINS 4B3.9G-1), 20 kWt	2.5	t/year	-	-		500		
DPP (engine CUMMINS 6BTAA5.9-G12), 120 kWt	16.5	t/year	-	-		500		
DPP (engine CUMMINS NTA855G2), 240 kWt	25	t/year	-	-		500		
DPP (engine CUMMINS 6BTAA5.9-G12), 120 kWt	16.5	t/year	-	-		500		
DPP (engine CUMMINS 6BTAA5.9-G12), 120 kWt	16.5	t/year	-	-		500		
DPP (engine CUMMINS NT855GA), 200 kWt	20.65	t/year	-	-		500		

ANNEX 14

LIST OF HYDRAULIC-JETTING AND DRY-EXCAVATION QUARRIES PLANNED, BEING DEVELOPED OR EXISTING WITHIN THE SALMANOVSKIY (UTRENNIY) LA

Quarry index	Location	Status of development	CMR type	CMR reserves, m^3	"Commercial" sand reserves, m^3	Demand for PIR-1 facilities, m^3	Demand for PIR-5 facilities, m^3	Remaining volume, m^3	CMR consumer facilities	Notes	Land area subject to reclamation at the end of activity, ha	Lake water area (for hydraulic-jetting quarries), ha
GYDRAULIC-JETTING QUARRIES												
2г	Southern dome	Land plot established	Sand	809881	715044	0	706424	8620	GWPs No.11 and No.13 Gas flow-line (Southern dome) Water intake No.2 Effluents re-injection site No.2 Motor roads (Southern dome) Bridge crossings (Southern dome) Temporary water intake site (Southern dome) Temporary access road (Southern dome) Helicopter pad No.2	Development in 2020 (design) Arrangement of temporary water intake for domestic and technical water supply for several facilities including CGTP-2	19.9900	55.31
2н	Northern dome	Development is completed	Sand	2212759	1939795	0	1878869	60837	PGTP-3 (Northern dome) Gas turbine power plant (Northern dome) Emergency Rescue Centre (Northern dome) Motor roads including temporary access roads (Northern dome) Infield gas pipeline from CGTP-1, CGTP-2 to the LNG Plant (Central dome) Pig trap station (Central dome) Infield gas pipeline from PGTP-3 to connecting assembly (Northern dome) Solid municipal, construction and industrial waste disposal site (Northern dome) Temporary fuel depot (Northern dome) Sewage treatment facility No.3 (Northern dome) Field camp (Northern dome) Administrative area (Northern dome) Emergency Rescue Centre (Northern dome)	Development during 2018-2019 (design)	37.1913	180.781
4н	Northern dome	Development is completed	Sand	1535359	1409920	0	0	1409920	N/A	Development during 2018-2020 (design)	29.5944	13.1452
5г	Central dome	Operational	Sand	N/A	8310319	0	6920495	1389824	GWP Nos.1-7 (Central dome), 9, 14 (Southern dome) CGTP-1 (Central dome) CGTP-2 (Southern dome) Gas flow-lines (Central and Southern domes) Infield gas pipelines (Central and Southern domes) TSF Nos.8-10 (Central dome), 11-12, 14 (Southern dome), including related temporary access roads Effluents re-injection site No.1 (Central dome) Helicopter pad No.1 (Central dome) Water intake No.1 (Central dome) Temporary accommodation camp (Northern dome) Bridge crossings (Central and Southern domes) Motor roads (Central and Southern domes)	Development during 2019-2023 (design)	96.1915	
5н	Northern dome	Operational	Sand	535938	496271	0	488172	10099	GWP Nos.18-19 (Northern dome) Gas flow-line (Northern dome) Motor road (Northern dome) Bridge crossing (Northern dome)	Development during 2020 (design)	5.1861	12.4
8г	Northern dome	N/A	Sand	1003330	503355	503355	0	0	Motor roads Bridge crossing	N/A	48.4851	
			Clayey loam	116943	0	16273	0	100671	N/A	N/A		
8г Extension	Northern dome	N/A	Sand	N/A	378483	242535	90749	45199	Pipeline WWPS site (Northern dome) TSF No.4 Contractor's temporary construction support base (Northern dome) Temporary access road (Northern dome) SPPVZ (Northern dome)	N/A		
9г	Northern dome	N/A	Sand	1350640	850720	480611	N/A	870029	GWP No.16 Power Supply Complex No.2 Fuel depot (Northern dome) Gas flow-lines (Northern dome)	Construction of temporary water intake for domestic and	13.3388	14.8852

Quarry index	Location	Status of development	CMR type	CMR reserves, m^3	"Commercial" sand reserves, m^3	Demand for PIR-1 facilities, m^3	Demand for PIR-5 facilities, m^3	Remaining volume, m^3	CMR consumer facilities	Notes	Land area subject to reclamation at the end of activity, ha	Lake water area (for hydraulic-jetting quarries), ha
									Effluents re-injection site No.3 (Northern dome) Water intake facilities 3.1, 3.2 (Northern dome) Temporary water intake site at the quarry (Northern dome) Water treatment plant No.3 (Northern dome) Motor roads (Northern dome) TSF No.6 (Northern dome)	technical water supply		
			Clayey loam	180111	0	1639	0	178473		Construction of temporary water intake for domestic and technical water supply		
9г Extension	Northern dome	N/A	Sand	1018547	949082	0	922934	26148	GWP Nos.15-17 (Northern dome) Gas flow-lines (Northern dome) Methanol storage (Northern dome) DP/TC (Northern dome) Motor roads (Northern dome) Bridge crossings (Northern dome) TSF Nos. 3 and 7 (Northern dome)	Development during 2018-2020 (design)	17.9184	
10г	Northern dome	Operational	Sand	Block 1: 4306540 Block 2: 2524486 Block 3: 548405	2380338	0	0	2380338	N/A	Development during 2019-2024 (design)	11.4376	23.8835
10г Extension	Northern dome	Operational	Sand	1609231	1609231	0	0	1609231		N/A		
11н	Southern dome	Operational	Sand	1023136	898498	0	694980	203518	GWP Nos. 8, 10, 12 (Southern dome) Gas flow-lines (Southern dome) Motor roads (Southern dome)	Development during 2020-2021 (design)	30.8171	
25н	Northern dome	Development is completed	Sand	887176	780715	0	0	780715		Development in 2020 (design) Arrangement of temporary water intake for technical water supply for several facilities including PGTP-3	21.7708	
31н	Central dome	Land plot established	Sand	N/A	800219	0	0	800219	N/A	Development in 2020 (design) Arrangement of temporary water intake for technical water supply for several facilities including CGTP-1	61.7193	12.4731
37н	Central dome	Land plot established	Sand	1252467	1102172	0	0	1102172		Development during 2019-2020 (design)	27.0088	
51н	Southern dome	Land plot established	Sand	826997	723169	0	0	723169		Development during 2019 (design)	33.5421	
55н	Southern dome	Land plot established	Sand	358039	289485	0	0	289485		Development during 2021 (design)	8.2097	
										Total hydraulic-jetting quarries:	**462.4010**	
DRY-EXCAVATION QUARRIES												
1.2	Airport location area	Land plots established	Sand	500506	357150	N/A			Airport facilities	Development during 2 years (design)	18.6606	
2.1	Southern dome		Sand	535327	496586				N/A	Development during 4 years (design)	37.2905	
2.2	Southern dome		Sand	672991	633412					Development during 4 years (design)		
2.3	Southern dome		Sand	1130886	1077444					Development during 4 years (design)	19.6652	

Quarry index	Location	Status of development	CMR type	CMR reserves, m^3	"Commercial" sand reserves, m^3	Demand for PIR-1 facilities, m^3	Demand for PIR-5 facilities, m^3	Remaining volume, m^3	CMR consumer facilities	Notes	Land area subject to reclamation at the end of activity, ha	Lake water area (for hydraulic-jetting quarries), ha
3.1	Southern dome		Sand	601659	557790					Development during 4 years (design)	16.9202	
3.2	Southern dome		Sand	112786	98542					Development during 4 years (design)	16.7542	
3.3	Southern dome		Sand	267344	248126					Development during 4 years (design)		
4.3	Southern dome		Sand	66825	59941					Development during 4 years (design)	4.6130	
5.1	Central dome	Operational	Sand	351361	321190					Development during 4 years (design)	24.3573	
5.3	Central dome		Sand	286746	252807					Development during 4 years (design)		
5.4	Central dome		Sand	248694	223121					Development during 4 years (design)	7.0567	
5.5	Central dome		Sand	110717	93520					Development during 4 years (design)	4.4907	
5.6	Southern dome		Sand	541467	501050					Development during 4 years (design)	16.2565	
										Total dry-excavation quarries:	**166.0649**	
										Total all quarries	**628.4659**	

ANNEX 15

PHASING OF EARLY DEVELOPMENT FACILITIES OF THE SALMANOVSKOYE (UTRENNEYE) OGCF FACILITIES SETUP

This Appendix lists the main elements of the early development facilities of the Salmanovskoye (Utrenneye) OGCF Facilities Setup with reference to respective phases of implementation (1 through 13).

Phase 1. Motor road MR1 from the berth structures to helipad HP3: Section 1 from the berth structures to the point of joining the designed MR2 (refer to Phase 2 item 2.14)

Phase 2. System of areal and linear facilities in the area of the berth structures, power supply complex No.2 and gas and condensate well pad No.16.

2.1. Well R270 site, including wellhead assembly; well workover assembly; flare pit; fire engines and well survey mobile unit site; runoff water storage tank; lightning discharger; inhibitor feed system; site internal utility networks and roads.

2.2. Site of portable turbine power plant PGTPP No.2 comprising: 4 modules PGTPP-2500, package transformer substation (PTS), two automated emergency diesel power stations (EDPS) 250 kV each, indoor distribution switchgear 6kV, two transformers 6/10 kV, sectionalizing switchgear for OPL KRUN-SVL 10kV; control room (portable cabin); mineral oil facilities (oil preparation station for local needs, spent oil tank 5m^3); fuel gas treatment facility PBTG (fuel gas treatment unit, boiler station, air compressor station, air receiver, emergency drainage tank 8m^3); 45 m light pole (1 unit); fence; emergency transformer oil discharge tank 25m^3; lightning discharger, height 23 m; fire-fighting equipment storage container; storage site for auxiliary materials in containers; diesel fuel day tanks site for the diesel power station (DPS); diesel fuel day tank 25 m^3 (2 units); diesel fuel drainage vessel 3 m^3; domestic wastewater collection tank 25 m^3; runoff water collection tank 63 m^3; process and fire water storage tanks 300 m^3 each (2 units); road tankers site; methanol storage tank site; methanol dosing unit; emergency drainage vessel 63 m^3; nitrogen ramp with cylinders (10 units); site internal utility networks and roads.

2.3. Cabin camp site of PGTPP No2, including portable cabins for temporary accommodation of 2 persons (4 units); 32.5 m light poles (4 units); fence; cabin-based dining facility; repair workshop cabin; cabins with domestic facilities; domestic wastewater collection tank 25 m^3; surface runoff water collection tank 63 m^3; process water storage tank 10 m^3; cabin-based instrumentation control room; site internal utility networks and roads.

2.4. Trace heating PTS and DPS site comprising: three-transformer PTS No.2 and No.3; HV DPS No.2; fence.

2.5. Temporary Accommodation Camp (TAC) site comprising: water supply system (water treatment plants WTP-1 for technical water and WTP-2 for potable water; untreated drinking water storage tanks 100 m^3 - 2 units); heat and power supply system (boiler station and fuel supply system; diesel power station DPS-630 kW; diesel fuel day tanks for DPS and boiler station 25 m^3 - 4 units; fuel drainage vessel 3 m3); communications container, fire water pumping station; satellite communication antenna post with 90 m antenna mast structure (AMC); car park; gas distribution cabinet (GDC); packaged transformer substation (container PTS 2x1600kVA); industrial wastewater and runoff tank 12.5 m^3 covered; fire water pumping station with a fire-fighting tools store; valve chamber; process and fire water storage tanks 300 m^3; wastewater disposal system (wastewater pumping station WWPS; fence; light poles with lightning discharger 24 m (6 units); communications container; lightning dischargers, height 23 m (2 units); MSW storage site; fire hydrants (7 units); site internal utility networks and roads.

2.6. Water filters site comprising: mechanical water treatment facility (MWTF); treated water tank 20 m^3; filtrate drainage vessel 8 m^3; container PTS 2x400kVA; light pole 24 n; communications container; industrial wastewater and runoff tank 63 m^3 covered; three-transformer PTS No.1; HV DPS No.1; fence; site internal utility networks and roads.

2.7. Wastewater treatment plant (WWTP) site: full-cycle biological treatment of domestic wastewater (WWTP-1) and oily industrial wastewater treatment (WWTP-2); storage tank for untreated industrial wastewater and runoff 25 m^3; untreated domestic wastewater storage tank 25 m^3; treated domestic, industrial wastewater and runoff water storage tank 100 m^3; dewatered sludge storage site; fence; container PCPSU 2x160 kVA; light pole; lightning discharger; fire hydrants (2 units); site internal utility networks and roads.

2.8. Gas flare unit (FGU) site for wastewater disposal, with a burner flare, flare pit, gas regulation unit; site internal utility networks and roads.

2.9. Materials and equipment storage site near berth structures comprising: fire station building; reserve machinery park; light pole 32.5 m; domestic wastewater collection tank 8 m^3; industrial wastewater storage tank 8 n^3; container PTS 2x1000 kVA; site internal utility networks and roads; fence.

2.10. Offsite linear facilities associated with the site of PGTPP No.2 comprising: feed gas pipeline from well R270 site to PGTPP No. 2 site; methanol pipeline from PGTPP No. 2 site to well R270 site.

2.11. Offsite linear facilities associated with the sites of TAC, WWTP and GFU comprising: gas pipeline from the site of PGTPP No. 2 to TAC; branch from gas pipeline of PGTPP No. 2 site to GFU.

2.12. Heat supply network (main) from boiler station to the site of TAC and fire station at the materials and equipment storage site.

2.13. Electric networks: double OPL No.1 from the site of PGTPP No.2 to the site of filters with branches to the sites of TAC, HP No.2, fuel depot, materials and equipment storage site.

2.14. Motor roads (MR): MR No. 2 from the site of PGTPP No. 2 to the point of joining MR No. 1; access MR to the sites of water filters, TAC, WWTP, GFU, PGTPP No.2, cabin camp of PGTPP No.2; well R270; access MR Nos. 1, 2 and 3 to the materials and equipment storage site.

Phase 3. System of areal and linear facilities in the area of berth structures.

3.1. Materials and equipment storage facilities near the berth structures (additional to those built during Phase 2, site 2.9) comprising: cold storage (2 units), technical cylinder stores, oil store, warm store, outdoor bulk materials storage facilities (2 units), scrap metal store (1), containers store (1) and tubes store (1), service and maintenance building with a vehicle park, equipment steaming site; drainage vessel 5 m^3; operational maintenance module; untreated industrial wastewater and runoff water storage tank 8 m^3; untreated domestic wastewater storage tank 8 m^3; outdoor vehicle and machinery park; fence with a barrier and checkpoint; light poles 32.5 m (7 units).

3.2. Fuel, lubricants and methanol storage site (except for kerosene storage and offloading facilities, Phase 13) comprising: control room; diesel, petrol and methanol stores with filling and discharge bays, intra-park transfer pumping stations, reception modules, drainage vessels, tanks (diesel – 16 units 2000 m^3 each, gasoline and methanol – smaller capacity); nitrogen ramp; automated diesel power station ADPS 250 kW; container PTS 2x630 kVA; power control board module MCC; light poles 24 m (13 units); fire fighting system including water tanks (2 units 1000 m^3 each), pumping station, lightning dischargers 32 m (16 units), fire hydrants (7 units); fire fighting equipment storage container; industrial wastewater and runoff storage tanks (5 units 200 m^3 each and 1 unit 63 m^3) and domestic wastewater storage tank (1 unit, 8 m^3); fence with a barrier and checkpoint; site internal utility networks and roads.

3.3. Offsite linear facilities including kerosene pipeline from connecting assembly to the fuel, oil and methanol storage site; diesel fuel pipeline from connecting assembly to the fuel, oil and methanol storage site.

3.4. Access motor roads to the fuel, oil and methanol storage site (2 units).

Phase 4. Helicopter pad HP No.2 with package container power supply unit (PCPSU) and access road.

Phase 5. Temporary accommodation camp (TAC, refer to item 2.5) - construction of the following facilities in the existing site: dormitory, canteen, 2 warm passages, vegetables and food store.

Phase 6. Motor road MR No.1 from berth structures to HP No.3: Section No.2 from joining point of road MR No.2 to designed joining point of access road to MSW and Industrial Waste Landfill (note: construction of this section of access road has been cancelled, due to the change of designed location of the landfill site).

Phase 7. Single inter-site OPL No.2 from connection point to designed tapping point to the site of MSW and Industrial Waste Disposal Site (note: construction of this section of OPL has been cancelled, due to the change of designed location of the waste disposal site).

Phase 8. Motor road MR No.1 from berth structures to HP No.3: Section No.3 from the joining point of motor road at MSW and Industrial Waste Disposal Site (Phase 6) to PK197+44.

Phase 9. Motor road No.1 from berth structures to HP No.3: Section No.4 from PK 197+44 to HP No.3 – unpaved.

Phase 10. Systems of facilities:

10.1. Well P304. List of facilities – refer to item 2.1.

10.2. PGTPP No.1 site List of facilities – refer to item 2.2.

10.3. Utility networks comprising: feed gas pipeline from the site of well P304 to the site of PGTPP No. 1; gas pipeline from the site of PGTPP No. 1 to the site of well P304; methanol water pipeline from the site of PGTPP No.1 to well P304.

10.4. Access motor roads to the sites of well P304 and PGTPP No. 1.

Phase 11. Motor road No.1 from berth structures to HP No.3: Section No.4 from PK 197+44 to HP No.3 – unpaved.

Phase 12. Helicopter pad HP No.3.

Phase 13. Kerosene storage and offloading facilities at the existing site of fuel depot (Phase 2): truck loading bays; kerosene intra-park transfer pumping station; kerosene reception module; kerosene tank 2000 m^3 (4 units); kerosene drainage vessel 25 m^3.

ANNEX 16

CONSTITUENT ELEMENTS OF THE SALMANOVSKOYE (UTRENNEYE) OGCF FACILITIES SETUP LOGISTICS SYSTEM

Functions of the *field camp* (FC) are reception, storage, distribution of materials and equipment (equipment, rolled metal products of various designations), storage (70 units of cargo vehicles and specialized machinery) and maintenance of vehicles, fitting, welding, metalworking and repair.

Mechanical repair shop (MRS) location at the FC site. MRS will provide the necessary fitting, welding, metalworking for maintenance and repair, manufacturing of production tools, rehabilitation of worn-out assemblies and components, manufacturing of new components and spare parts, manufacturing of fixtures and other products.

MRS will also provide testing and technical inspection of cylinders for storage of compressed air, propane, acetylene, helium, hydrogen, oxygen, argon.

MRS facilities also include a section for setting and calibration of instrumentation, particularly microprocessor controllers, electronic calculation units, variable speed motors, primary transducers.

Vehicles maintenance shop. A two-floor building for servicing and maintenance of vehicles and specialized machinery, with a heated vehicle park for 70 units, intended for storage, servicing and maintenance110 of vehicles, including all-terrain vehicles and specialized machinery used for maintenance of technical facilities in the field. Heat-insulated parking premises are provided for storage of vehicles. The building upper floor is occupied by offices and domestic facilities. The following facilities are accommodated in the building:

- welding post;
- specialized premises for batteries charging and tire fitting;
- oil depot for packed storage of motor oil, transmission oil, hydraulic oil, coolants, greases;
- spares and materials store;
- storage facilities, tire store;
- clothes drying room;
- domestic and auxiliary facilities for engineering technicians and workforce (office and service building);
- dressing rooms;
- training room;
- dining room, shower and toilets;
- room for pre-trip medical examination of drivers and, when needed, provision of medical aid to personnel;
- truck loaders maintenance station;
- maintenance bays for TM-1, TM-2, SM.

List of the Field vehicles fleet assigned to the shop:

- passenger vehicles - 9 units;
- crew buses - 30 units;
- mobile repair workshop - 1 unit;
- mobile non-destructive testing laboratory - 1 unit;
- cesspoolage trucks - 2 units;
- dump trucks - 6 units;
- snow and swamp-going vehicles - 2 units;
- snowplows - 3 units;
- snow loaders - 3 units;
- waste trucks - 3 units;
- sand spreading machines - 2 units;
- sweeping trucks - 2 units
- fuel trucks - 3 units;
- road tankers - 3 units.

Most of the above vehicles have diesel engines. Diesel fuel storage tanks are located at the fuel depot constructed as part of the early development facilities. Vehicles fuelling will be conducted at the same site.

Besides the vehicles maintenance and mechanical repair shops, the following facilities will be provided at the FC site:

- storage site for filled and empty oxygen and propane cylinders;
- outdoor park for 50 cargo vehicles and specialized machines;

[110] Capital repair of machines and assemblies will be provided by remote specialized contractors

- packaged transformer substation;
- emergency diesel power station;
- road tankers unloading site;
- diesel fuel storage tank m^3 (2 units);
- emergency diesel fuel drainage vessel 10 m^3;
- container site for collection of industrial and domestic waste;
- domestic wastewater pumping stations No.1 and No.2;
- runoff water storage tank with a pump Nos.1 and 2;
- light pole (8 units);
- pressure washing site for external tube banks;
- industrial wastewater and runoff water storage tank with a pump Nos.1 and 2;
- logistics depot:
- substitute gas turbine engines store;
- warehouse with overhead crane (warm);
- shelter with vertical walls (warm);
- shelter (5 units);
- materials and equipment storage site (4 units);
- panel-and-frame buildings storage site (2 units);
- tubular products storage site (6 units);
- cranes and load-handling equipment site;
- warehouse (warm);
- outdoor storage for building materials and equipment;
- metal scrap collection site with a press;
- valves and fittings storage site;
- packaged goods storage site;
- domestic wastewater pumping station;
- runoff water storage tank with a pump Nos.1 and 2;
- checkpoint;
- light pole (18 units).

Logistics facilities are the stores intended for reception, storage and distribution of building materials, pump and compressor equipment, spare parts and materials, cable products, instrumentation and control equipment, sheet metalwork, shaped sections, tubes and pipeline fittings. In accordance with specifications issued by LLC "Arctic LNG 2", the following storage facilities are provided:

- substitute gas turbine engines store with an overhead electric crane, load capacity 2.0 t;
- warm warehouse with overhead crane, including paints storage and oil depot;
- warm warehouse for storage of chemicals and reagents;
- warm shelter with vertical walls for storage of cable products, personal protection equipment, laboratory equipment;
- cold shelters (5 units);
- outdoor storage for building materials and equipment, with a portal jib crane.

All goods are delivered to storage by road vehicles.

ANNEX 17
PROCESS OVERVIEW OF THE GBS LNG & SGC PLANT

The GBS LNG & SGC Plant process trains are manufactured in the NOVATEK-Murmansk LLC site in the Murmansk Region. The gravity-based structures for them will be manufactured in casting basin at the above site, whereas the topside modules will be manufactured at various sites located in Russia (including NOVATEK-Murmansk LLC) and other countries and transported to casting basins of NOVATEK-Murmansk LLC for integration into GBS.

The first stage of commissioning of the process equipment at each of the Plant's process trains will be conducted at NOVATEK-Murmansk LLC. Connections to the onshore infrastructure and final commissioning will be arranged after towage, installation and integration with onshore infrastructure at the designed location site of the Plant in the area of Salmanovskoye (Utrenneye) OGCF.

Main process flows at the Plant

Schematic view of the LNG Plant technological process is presented in Figure C1. The main process of gas/liquid separation takes place at the field infrastructure facilities which are located at a significant distance - up to 40 km - from the Plant. Feed stream is transported from the field to the Plant by four pipelines - two for natural gas, and two for unstabilised gas condensate. The pipelines will be installed on surface; within the artificial land plot of the Port, they will be installed on the pipe rack interconnecting the three process trains of the Plant.

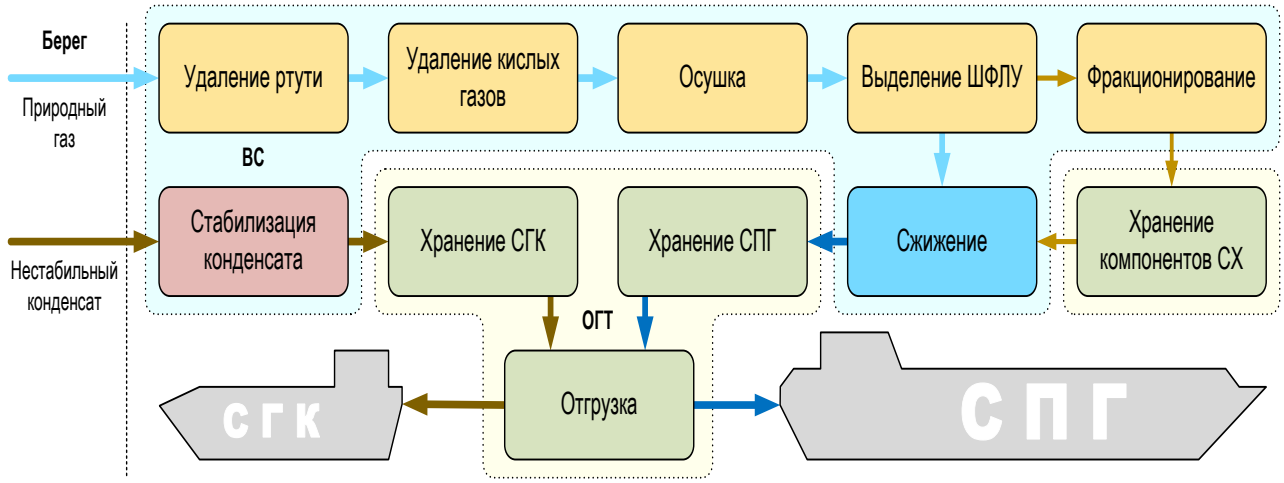

Figure A17.1: Schematic view of the Plant train

Feed gas is fed to the feed gas separator where entrained or condensed liquid is removed from the flow arriving from the onshore pipeline.

Feed gas is preheated in feed gas heater to about 30°C and supplied to the Acid Gas Removal Unit (AGRU).

Unstabilised condensate is heated in the inlet condensate heater and supplied to the three-phase separator of the Stabilisation Unit. Separated liquid which contains methanol is recirculated to the field infrastructure facilities for further processing. Hydrocarbon liquid from the separator is fed to the condensate stabilisation column for stripping of lighter components.

Operation of the Acid Gas Removal Unit is based on activated solvent adsorption process. Sweet gas from the absorber is cooled down in the inlet cooler of the Dehydration Unit. After that gas is dehydrated by adsorption process.

Mercury Removal Unit is designed as a non-regenerable catalyst bed in a pressurized vessel where trace mercury is captured. Sweet dehydrated gas is then passed through the afterfilters of the Dehydration Unit, with molecular sieves for removal of fine particles before feed to the NGL Extraction Unit.

Sweet feed gas is further fed to the Liquefaction Units. The Company purchased a license of Linde AG for the natural gas liquefaction process to be used for the Arctic LNG 2 Project.

Ethane, propane and butane which can be used as refrigerant are produced at the Fractioning Unit and stored in dedicated tanks which are provided at each GBS. The refrigerants are used to make-up for refrigerant losses in the mixed refrigerant cycles of the Liquefaction Unit. Ethane Refrigerant is stored in

double-barrier membrane tank similar to the LNG storage tank. Propane and Butane Refrigerants are stored in low-temperature carbon steel vessels.

Each refrigerant storage capacity is twice as large as the refrigerant volume in the liquefaction cycles, which is sufficient for any start-up scenario that requires filling of cycles in one liquefaction train.

LNG is supplied from a process train to two storage tanks. Storage temperature of LNG is about -161°C.

Each LNG tank is provided with four LNG offloading pumps which pump LNG through the offloading pipelines to the loading arms, with a flow rate of approx. 14,000 m^3/h. GBS1 and GBS2 will each have one set of loading arms. No loading arms will be provided at GBS3.

Stabilised condensate from Debutanizer and Stabilisation Unit is supplied to the condensate storage tank on GBS. For offloading, condensate is supplied to the loading arms by means of condensate pumps with a flow rate of approx. 8,000 m^3/h. Both loading arms are designed for offloading of liquid. Nitrogen blanket is provided in condensate storage tank, with safe vents to atmosphere in case of high pressure.

Process Train overview

Gravity-based structures are designed as caisson-type RC structures which are divided into compartments by slabs, walls, partitions and web stiffeners. The compartments accommodate LNG tanks and SGC tank, process utility storage, and ballast systems.

GBS supports the topside modules and marine systems for simultaneous mooring of LNG/SGC Carriers.

Main parameters of GBS[111]:

- Dimensions – L / W/ H -331.74/153.74/30.2 m;
- Cantilever width on long/short side of GBS – 22/15 m;
- Cantilever height – 13.75 m;
- GBS base slab depth – 14.7 m below sea level.

The process train will accommodate the main equipment for LNG and SGC production, as well as auxiliary systems.

GBS will also carry the auxiliary and main ballast systems to be used at the stages of construction, GBS float out, towing, installation and operation.

GBS will be manufactured at module-building yard in Murmansk (NOVATEK-Murmansk LLC) and towed to the Ob Estuary.

Towing in the Ob Estuary will be arranged with due regard to the sea channel depth during tidal high water, so that minimum water depth of 1 m under GBS bottom is guaranteed. In case of tide level below 0.4 m, GBS towing through the channel in the Ob Estuary will be suspended until adequate conditions are re-established.

Flare system

The relief and blowdown philosophy adopted for the Planned activity is based on a concept of "No continuous flaring for production". Short-term flaring is acceptable in the following situations:

- start-up,
- maintenance preparation,
- process upset,
- emergencies and shutdown.

The Flare System has been segregated into several systems as it is required to separate the warm wet discharges from the cold dry ones in order to prevent freezing and/or hydrate formation in the flare network. In addition, an independent low pressure (LP) system is required for safe connection of storage tank relieving devices (pressure safety valves and pressure control valves).

Hence, 3 separate systems have been envisaged as follows:

[111]Dimensions and other parameters of GBS will be verified against up-to-date design

- Warm Flare (high pressure - HP):

The Warm Flare system collects discharges from relief and blowdown valves located on the high-pressure equipment in the hot section of the Plant, i.e. Receiving Facilities, Condensate Stabilisation Unit, AGRU, Mercury Removal and Dehydration units.

- Cold Flare (high pressure - HP):

The Cold Flare system collects discharges from relief and blowdown valves located on the high-pressure equipment in the cold section of the Plant, i.e. NGL Extraction and Fractionation Units, Liquefaction Unit and BOG / Fuel Gas Unit.

- BOG Flare (low pressure - LP)

This system is low pressure and is dedicated to the collection of vapour relief from the LNG Storage, Refrigerant Storage and BOG handling system.

The Flare Systems include the collection headers running across the topside facilities of each Train. These headers then flow down to dedicated Flare Knock Out Drums and Flare Stacks, which are located onshore for the Warm and Cold Flare systems (common for the three Trains) and on the process trains for the BOG Flare System.

Warm and Cold Flare Systems are backed up by a common Spare Flare KO Drum and Spare Flare Stack to allow for the equipment maintenance. BOG Flare System is backed up by a Cold Vent System located on the process train.

Water Supply

The Company established the following general requirements for the water supply system:

- potable water shall be available at all work stations;
- ensuring adequate temperature of water in water supply systems;
- if surface water bodies are used as sources of water supply, water shall be adequately treated to meet the applicable standards, if required;
- if central water supply is infeasible, alternative solution is based on supply of bottled potable water.

As reported by the Subsoil Management Department of the Ural Federal District, no fresh groundwater deposits are available in the territory of the Salmanovskoye (Utrenneye) OGCF. Source water for domestic and utility water supply of the Arctic LNG 2 Project will be abstracted from surface water bodies. As natural water quality in the licence area is poor, the intake facilities will be extended to provide treatment of source water.

Construction of the water intake and treatment facilities is part of the Salmanovskoye (Utrenneye) OGCF Facilities Setup. These facilities will serve as water source for consumers at the Plant during construction and operation.

At the operation stage the Plant will have two separate water supply systems:

- utility water used as feed water for Demineralized Water system, wash water for equipment, and as firewater for the onshore Plant facilities;
- potable water for domestic needs of the Plant personnel.

Fire water system of the Plant will use water from the Ob Estuary which will be abstracted through fish-protection screens. The respective pumps will be provided in the process trains.

Wastewater disposal

Drainage systems of the Plant are designed in accordance with the "Zero Discharge" principle, which means that all effluents from the Plant are transported by pipelines and in road tankers to the wastewater treatment plant (WWTP) at the Salmanovskoye (Utrenneye) OGCF. Treatment processes at WWTP include mechanical, physical-chemical and biological treatment with discharge of effluent treated to meet regulatory standards to nonfreezing surface water body.

Associated formation water, construction brine solutions and major part of industrial wastewater will be injected into intake formations.

Waste Management

Domestic and industrial wastes management at Arctic SPG 2 LLC is based on the principle of minimization of environmental impacts through reduction of waste generation volumes and weight, recycling of certain

categories of wastes, and keeping landfill disposal to the minimum. All waste management procedures shall meet both Russian regulatory requirements and IFC standards. In particular, design solutions relating to a specific category of wastes shall first consider possibility of prevention of the waste generation, and then other solutions shall be considered in the following decreasing order of priority: minimization of waste volume and weight, reuse, recycling, energy recovery, and disposal at landfill.

At the Plant construction stage, wastes will be transported to the temporary accumulation sites which will be arranged by that time at the Salmanovskoye (Utrenneye) OGCF.

At present no waste disposal facilities are available in the license area, however a waste disposal site will be constructed as part of Salmanovskoye (Utrenneye) OGCF facilities setup and subsequently used also to serve the needs of the Plant. Design of the Plant will consider arranging temporary accumulation sites for solid wastes at the operation stage - on the process trains and in the area of the onshore facilities. The waste sorting, temporary accumulation and transportation requirements will be defined with due regard to hazard classes of the wastes and their recycling potential.

Power Supply

At the Plant construction phase, power supply for the construction sites and temporary site facilities of the Plant will be provided from Salmanovskoye (Utrenneye) OGCF facilities setup, using a portable truck-mounted generator PAES-2500. At the commissioning stage power supply will be provided from GTPP of the Salmanovskoye (Utrenneye) field (6 generation units with capacity of 6 MW each are to be commissioned at the first stage of the FIELD Infrastructure development).

At the *Plant operation phase*, gas turbine generators (GTG) with a minimum power capacity of 25 MW will be provided at each process train, for power supply for the main and auxiliary process units and onshore facilities.

The generator backup power supply system will consist of an emergency / backup switch board and several diesel generators connected to it. The backup system shall be capable of providing emergency power supply for the generator, and for cold start-up of any GTG.

ANNEX 18
VASCULAR PLANTS FLORA OF THE SALMANOVSKY (UTRENNY) LICENSE AREA

Table A18.1: Vascular plants flora of the Salmanovsky (Utrenny) License Area

Legend: I - sub-horizontal watershed surfaces with subshrub-cottongrass-moss tundras, II - subshrub tundras on ridge top surfaces with thin snow cover, III - slopes of river valleys, runoff valleys with subshrub willow tundras, IV - heave mounds top surfaces, V - steep and medium-steep slopes of ravines and depressions with late snow-melting, VI - bottoms of ravines and gulches, runoff valleys with sedge bogs and meadows, VII - waterlogged lowland bogs, sedge tundras in floodplains, VIII - sands in river floodplains, IX - lake shores with moss tundras, X - shallows in waterbodies, foreshore areas, XI - sandy slopes and deflated areas on sea coast, XII - seaside lichen and subshrub-lichen tundras, XIII - sedge and cottongrass bogs on laidas, XIV - filled sand, banks of sites, XV - exposed peat, tracks of all-terrain vehicles in tundras. Rarity category: 3 — rare species, * - species requiring special attention

Species	Watershed		Elements of erosional pattern				River valleys		Lakes		Sea coast complexes			Technogenic biotopes		Rarity category (Red Book..., 2010)
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	
Lycopodiaceae (Clubmosses)																
Lycopodium annotinum L.	+															
Diphasiastrum alpinum (L.) Holub		+														
Huperzia arctica (Tolm.) Sipliv.		+										+				
Equisetaceae (Horsetail family)																
Equisetum arvense L.			+		+	+								+		
Poaceae (Grasses)																
Alopecurus alpinus Sm.	+	+	+		+											
Alopecurus pratensis L.						+										
Arctagrostis latifolia (R. Br.) Griseb.									+				+			
Arctophila fulva (Trin.) Andersson						+	+			+			+			
Bromopsis vogulica (Soczava) Holub				+												3
Calamagrostis holmii Lange	+	+							+			+	+	+		
Calamagrostis lapponica (Wahlb.) Hartm.	+	+														
Calamagrostis neglecta (Ehrh.) Gaertn., B. Mey. & Schreb.													+			
Deschampsia borealis (Trautv.) Roshev.	+															
Deschampsia glauca Hartm.	+							+		+				+		
Dupontia pelligera (Rupr.) Á. Löve & Ritchie													+			
Festuca rubra subsp. *arctica* (Hackel) Govor.		+		+	+			+			+					
Hierochloe alpina (Sw.) Roem. & Schult.				+	+							+				
Hierochloe pauciflora R. Br.													+			

Species	Watershed		Elements of erosional pattern				River valleys		Lakes		Sea coast complexes			Technogenic biotopes		Rarity category (Red Book..., 2010)
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	
Koeleria asiatica Domin								+			+					
Poa alpigena (Blytt) Lindm.	+											+				
Poa alpigena subsp. *colpodea* (Th. Fr.) Jurtzev & V.V. Petrovsky	+	+	+		+	+		+			+			+		
Poa arctica R. Br.	+	+	+	+	+											
Trisetum molle Kunth	+															
Cyperaceae (Sedges)																
Eriophorum vaginatum L.	+								+							
Eriophorum angustifolium Honck.	+						+			+	+		+		+	
Eriophorum scheuchzeri Hoppe							+			+			+		+	
Carex aquatilis ssp. *stans* (Drejer) Hultén	+												+		+	
Carex bigelowii ssp. *arctisibirica* (Jurtzev) Á. Löve & D. Löve	+	+	+	+	+							+				
Carex chordorrhiza Ehrh.							+						+			
Carex lachenalii Schkuhr					+											
Carex rariflora (Wahlenb.) Sm.	+						+						+			
Carex rotundata Wahlenb.							+		+				+			
Carex vaginata Tausch												+				
Juncaceae (Rush family)																
Juncus biglumis L.												+				
Juncus castaneus Sm.		+											+			
Luzula confusa Lindeb.	+	+	+									+				
Luzula tundricola Gorodkov ex V.N. Vassil.		+														3
Luzula wahlenbergii Rupr.	+		+	+	+							+				
Melanthiaceae (Bunchflower family)																
Tofieldia coccinea Richardson		+														
Veratrum lobelianum L.			+													

Species	Watershed		Elements of erosional pattern				River valleys		Lakes		Sea coast complexes			Technogenic biotopes		Rarity category (Red Book..., 2010)
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	
Liliaceae (Lily family)																
Lloydia serotina (L.) Rchb.		+														
Salicaceae (Willow family)																
Salix arctica Pall.		+										+				
Salix glauca L.	+	+	+		+				+							
Salix nummularia Andersson		+		+								+				
Salix polaris Wahlenb	+	+		+								+				
Salix pulchra Cham.	+		+									+				
Salix reticulata L.		+														
Salix lanata L.	+		+						+							
Salix reptans Rupr.																
Betulaceae (Birch family)																
Betula nana L.	+					+										
Polygonaceae (Knotweed family)																
Rumex arcticus Trautv.						+	+		+				+			
Rumex graminifolius Lamb.			+								+					
Oxyria digyna (L.) Hill					+						+					
Aconogonon ocreatum (L.) H. Hara											+					
Bistorta vivipara (L.) Delarbre	+	+									+	+			+	
Caryophyllaceae (Carnation family)																
Stellaria ciliatosepala Trautv.	+	+	+		+				+							
Cerastium arvense L.				+				+			+					
Cerastium maximum L.				+												
Cerastium regelii Ostenf.		+							+				+			
Sagina intermedia Fenzl				+												
Honckenya peploides (L.) Ehrh.											+					
Minuartia macrocarpa (Pursh) Ostenf.		+														
Minuartia rubella (Wahlenb.) Heirn		+														
Eremogone polaris (Schischk.) Ikonn.											+					*

Species	Watershed		Elements of erosional pattern				River valleys		Lakes		Sea coast complexes			Technogenic biotopes		Rarity category (Red Book..., 2010)
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	
Dianthus repens Willd.											+					
Ranunculaceae (Buttercup family)																
Caltha arctica R. Br.							+			+						
Batrachium eradicatum (Laest.) Fr.										+						
Ranunculus hyperboreus Rottb.										+				+		
Ranunculus lapponicus L.									+							
Ranunculus pallasii Schltdl.										+						
Ranunculus pygmaeus Wahlenb.					+											
Ranunculus subborealis Tzvelev	+	+	+		+	+										
Ranunculus nivalis L.																*
Papaveraceae (Poppy family)																
Papaver lapponicum subsp. *jugoricum* (Tolm.) Tolm.									+							*
Brassicaceae (Cabbage family)																
Cardamine bellidifolia L.						+										
Cardamine nymanii Gand.													+			
Draba glabella Pursh				+												
Draba cinerea Adams	+															
Parrya nudicaulis (L.) Regel.		+														*
Saxifragaceae (Saxifrage family)																
Saxifraga bronchialis L.				+												
Saxifraga cernua L.			+		+	+							+			
Saxifraga cespitosa L.				+												3
Saxifraga foliolosa R. Br.	+	+	+	+								+				
Saxifraga hieracifolia Waldst. & Kit.	+		+		+											
Saxifraga nelsoniana D. Don					+								+			
Chrysosplenium tetrandrum (Lund ex Malmgren) Th. Fr.																

Species	Watershed		Elements of erosional pattern				River valleys		Lakes		Sea coast complexes			Technogenic biotopes		Rarity category (Red Book..., 2010)
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	
Rosaceae (Rose family)																
Rubus chamaemorus L.	+								+							
Comarum palustre L.										+			+			
Dryas octopetala ssp. *subincisa* Jurtzev	+	+	+	+												
Fabaceae (Bean family)																
Astragalus subpolaris Boriss. & Schischk.		+						+								
Oxytropis sordida (Willd.) Pers.		+			+			+								
Hedysarum arcticum B. Fedtsh.		+			+											
Onagraceae (Willowherb family)																
Epilobium alpinum L.															+	
Epilobium palustre L.															+	
Plantaginaceae (Plantain family)																
Hippuris vulgaris L.										+						
Lagotis minor (Willd.) Standl.		+	+		+											
Apiaceae (Umbellifers)																
Pachypleurum alpinum Ledeb			+		+											
Ericaceae (Heather family)																
Cassiope tetragona (L.) D. Don		+	+	+	+											
Empetrum nigrum L.		+		+												
Ledum decumbens (Aiton) Lodd. ex Steud.		+														
Pyrola grandiflora Radius	+															
Vaccinium uliginosa L.		+		+												
Vaccinium vitis-idaea L.	+	+		+								+				
Primulaceae (Primrose family)																
Androsace septentrionalis L.		+														
Gentianaceae (Gentian family)																
Comastoma tenellum (Rottb.) Toyok															+	

Species	Watershed		Elements of erosional pattern				River valleys		Lakes		Sea coast complexes			Technogenic biotopes		Rarity category (Red Book..., 2010)
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	
Polemoniaceae (Phlox family)																
Polemonium acutiflorum Willd. ex Roem. & Schult.	+					+			+							
Polemonium boreale Adams								+			+					3
Boraginaceae (Borage family)																
Myosotis asiatica (Vestergren) Schischk. & Serg.		+														
Orobanchaceae (Broomrapes)																
Pedicularis labradorica Wirsing	+												+			
Pedicularis sudetica Willd.	+	+														
Pedicularis verticillata L.			+			+										
Caprifoliaceae (Honeysuckle family)																
Valeriana capitata Pall. ex Link	+								+							
Campanulaceae (Bellflower family)																
Campanula rotundifolia L.					+						+					
Asteraceae (Sunflower family)																
Antennaria villifera Boriss.					+						+					
Artemisia borealis Pall.		+	+		+											
Artemisia tilesii Ledeb.		+	+		+											
Erigeron silenifolius (Turcz.) Botsch.					+											
Petasites frigidus (L.) Fr.			+				+		+							
Saussurea tilesii (Ledeb.) Ledeb.		+									+					
Tanacetum bipinnatum (L.) Sch. Bip.		+									+					
Tephroseris palustris (L.) Rchb.			+			+		+						+		
Tephroseris atropurpurea (Ledeb.) Holub	+											+				
Tripleurospermum hookeri Sch. Bip.								+						+		

ANNEX 19

COMPARISON OF TECHNOLOGICAL OPTIONS FOR NATURAL GAS LIQUEFACTION FOR ARCTIC LNG 2 PROJECT

This Annex provides a technical narrative and comparison of the options based on APCI (USA) and Linde Engineering (Germany) processes and technical input112.	В настоящем Приложении приведено описание и сравнение двух вариантов технологии сжижения природного газа на основе процессов и технических исходных данных компаний APCI (США) и Linde Engineering (Германия)
Process Technologies (APCI - DMR vs Linde - MFC)	Технологические основы (APCI DMR и Linde – MFC)
The objective of this section is to compare the two licensed processes, APCI DMR and Linde Engineering's (LE) MFC, from an engineering and technological viewpoint and highlight advantages and disadvantages of each process. Although, both the processes utilize mixed fluid refrigerant systems to cool and liquefy treated feed gas in the Coil Wound Heat Exchangers, APCI DMR uses two loops while Linde MFC uses three refrigerant loops. A total of 8 options have been studied, 4 using DMR and 4 using MFC. Both the licensed technologies were developed on the following premise: LNG Production target of 3 x 5.5 MTPA or 2 x 7.5 MTPA loaded onto carrier Single feed gas composition Average Gas (Winter 2030). No rating cases. Average ambient temperature of 0°C plus hot air recirculation allowance of 2°C. Siemens Trent 60 drivers for the Gas Turbine driver options Feed gas to Pre-cooler operating temperature 22°C and pressure of 7600kPaa for 5.5 MTPA case and as selected by licensor for 7.5 MTPA case. Availability of 90% for Electric Motor options and 88% for Gas Turbine options Linde have developed HMBs for all the four options (Options 3, 4, 7 and 8) and further engineered and modularised their basic design.	Целью данного раздела является сравнение двух лицензионных технологических процессов, процесса сжижения газа с применением двойного смешанного хладагента (DMR), разработанного компанией APCI, и последовательного процесса сжижения газа с помощью комбинированных хладагентов (MFC), разработанного компанией Linde Engineering (LE), с технической и технологической стороны, а также выделение преимуществ и недостатков каждого процесса. Несмотря на то, что в обоих процессах используются системы смешанного жидкого хладагента для охлаждения и сжижения подготовленного подаваемого газа в спиральном теплообменнике, в технологии DMR компании APCI используются две кольцевые линии, тогда как в технологии MFC компании Linde используются три кольцевые линии охлаждения. Всего было изучено 8 вариантов, 4 с использованием технологии DMR и 4 с использованием технологии MFC. Обе лицензионные технологии были разработаны в соответствии со следующими исходными условиями: Плановый объем производства сжиженного газа - 3 x 5,5 миллионов тонн в год или 2 x 7,5 миллионов тонн в год с отгрузкой на транспортное средство; Единый состав подаваемого газа - средний газ (зима 2030 г.). Другие варианты не рассматривались; Средняя температура окружающей среды 0°C плюс допуск на рециркуляцию горячего воздуха 2°C; Приводы марки Siemens Trent 60 для вариантов с газовыми турбинами; Рабочая температура газа, подаваемого на предварительный охладитель, составляет 22°C, а рабочее давление 7600 кПа для объема 5,5 миллионов тон

[112] Options Evaluation and Recommendation Report. - Document No. G098-KBRKCS-ALNG2-DOC-2057. - ALNG 2 LLC, KBR KVERNER, LINDE, 2016.

APCI have developed a HMB for only one option (Option 5 7.5 MTPA GT driven). KBR defined the basis of design for APCI work on Option 5 using the parameters derived from Stage 2 study. KBR have developed other DMR options (Options 1, 2 and 6) based on the work done by APCI in this stage and the previous stages. KBR in-house simulations for the DMR process have evolved over a period of time incorporating experience gathered from the past projects with APCI DMR technology and are considered suitably accurate for the current stage of this Project. DMR Option 6 is based on APCI Option 5, while Options 1 and 2 are based on the work done by APCI in Stage 1 and developed by KBR in Stage 2. No review has been undertaken by APCI in Stage 3 for Options 1, 2 and 6. If the 5.5 MPTA option is progressed APCI will optimise the design (with KBR/KCS) to ensure that the correct balance between exchanger area, driver power and GBS size is achieved. In addition, KBR carried out further engineering and modularisation of all the APCI DMR options.	в год и в зависимости от выбора владельца лицензии для 7,5 миллионов тонн в год; Коэффициент эксплуатационной готовности - 90% для вариантов с электродвигателями и 88% для вариантов с газовыми турбинами. Компания Linde разработала тепловые и материальные балансы для всех 4 вариантов (вариант 3, 4, 7 и 8) и провела дальнейшие инженерно-технические работы и модульное проектирование для своего базового проекта. Компания APCI разработала тепловой и материальный баланс только для одного варианта (варианта с производительностью 5 - 7,5 млн т/год и газотурбинным приводом). Компания KBR определила основы проектирования для работы компании APCI по Варианту 5 с использованием параметров, полученных по результатам исследования на Этапе 2. Компания KBR разработала другие варианты технологии DMR компании APCI (варианты 1,2 и 6) на основе работы, проведенной компанией APCI на этом и предыдущих этапах. Модель технологического процесса DMR, выполненная компанией KBR собственными силами, со временем была доработана с учетом опыта предыдущих проектов с использованием технологии DMR компании APCI и считается приемлемо точной для текущего этапа проекта. Вариант 6 с использованием технологии DMR основан на Варианте 5, подготовленном компанией APCI, тогда как Варианты 1 и 2 основаны на результатах работ, выполненных компанией APCI в ходе Этапа 1 и доработанных компанией KBR в ходе Этапа 2. В течение Этапа 3 рассмотрение Вариантов 1, 2 и 6 компанией APCI не производилось. При продолжении работ над вариантом 5,5 млн. т/год APCI оптимизирует проект (совместно с KBR/KCS) для достижения надлежащего баланса между площадью теплообменника, мощностью привода и размерами ОГТ. Кроме того, компания KBR провела дальнейшие инженерно-технические работы и модульное проектирование для всех вариантов технологии DMR компании APCI.
Air Cooler Minimum Approach Temperature The cooling duty for the LNG production is provided by air cooling. All the options are developed with 2°C air temperature at inlet to	Минимальный перепад температуры между входящими и исходящими потоками воздушного охладителя.

the air coolers (0°C ambient air + 2°C allowance for hot air recirculation). The temperature of process fluid exiting the air coolers depends upon the minimum approach temperature that the air coolers are designed for. Higher minimum approach temperature leads to lower heat exchange surface area and vice versa, keeping other parameters constant. Also higher minimum approach temperature adversely affects the process efficiency. The two licensed processes have used a different minimum approach temperature for design development. Based on an analysis carried out during a previous Project phase KBR used a minimum approach of 23°C for all the DMR options, while Linde based on their own analysis used a minimum approach of 13°C. The resultant impact on GBS design is discussed in detail later in this section.	Охлаждение при производстве сжиженного газа выполняется посредством воздуха. Все варианты разработаны с расчетом температуры воздуха 2°C на входе в воздушные охладители (0°C - температура воздуха окружающей среды и + 2°C с учетом допуска на рециркуляцию горячего воздуха). Температура технологического флюида, выходящего из воздушного охладителя, зависит от минимального перепада температуры между входящим и исходящим потоками, на который рассчитаны воздушные охладители. Более высокий перепад температуры между входящим и исходящим потоками приводит к снижению площади поверхности теплообмена и наоборот, при этом другие параметры остаются неизменными. Также более высокий перепад температур между входящим и исходящим потоками отрицательно сказывается на эффективности технологического процесса. В двух лицензионных технологических процессах при проектировании используются различные минимальные перепады температур между входящим и исходящим потоками. На основании расчетов, выполненных на предыдущей стадии проекта, компания KBR использовала минимальный перепад температур 23°C для всех вариантов, использующих технологию DMR, в то время как расчеты компании Linde основываются на минимальном перепаде температур 13°C. Влияние этого различия в показателях на проектирование ОГТ подробно рассматривается далее в данном разделе.
Feed Gas Circuit and End Flash In the APCI DMR process the feed gas enters the Pre-cooler at 22°C and exits the MCHE at about -151 to -153°C as subcooled liquid. In the Linde MFC process the feed gas enter the Pre-cooler at 22°C, is further cooled in the Liquefier and exits the Sub-cooler at -156°C. In each of the processes the difference in intermediate temperature is attributed to the composition, pressure and temperature of the refrigerant providing the cooling duty in the respective section. In the 7.5 MTPA APCI DMR (Options 5 and 6) the subcooled liquid is further expanded (reduced in pressure) isentropically using 2 x50% parallel LNG Hydraulic Turbine, as compared to isenthalpic expansion across a Joule-Thompson valve in the other process options. Although isentropic expansion contributes towards increased efficiency of the process it also adds to operational complexity due to additional rotating equipment items (LNG	Схема подачи газа и концевое испарение В технологии DMR компании APCI подаваемый газ входит в предварительный охладитель при температуре 22°C и выходит из основного криогенного теплообменника при температуре примерно от -151 °C до -153°C в виде переохлажденной жидкости. В технологии MFC компании Linde подаваемый газ входит в предварительный охладитель при температуре 22°C, затем охлаждается в ожижителе и выходит из переохладителя при температуре -156°C. В каждом процессе разница между средними температурами связана с составом, давлением и температурой хладагента, которые обеспечивают режим охлаждения в соответствующем участке. В технологии DMR компании APCI, рассчитанной на 7 млн т/год (варианты 5 и 6) переохлаждённая жидкость продолжает изоэнтропически расширяться (при уменьшении давления) с использованием параллельной гидравлической турбины СПГ 2x50%, по сравнению с изэнтальпическим расширением через редукционный газовый клапан Джоуля-Томсона, которое происходит в других

Hydraulic Turbines). LNG Hydraulic Turbines are well proven in the LNG industry with decades of operating experience at multiple locations and therefore not seen as novelty. The use of a parallel hydraulic turbine configuration has been proven on the 7.8MTPA AP-X LNG trains in Qatar. APCI has used feed gas pressure of 78bara at the inlet to the Pre-coolers for 7.5 MTPA production options, compared to 76bara for other options.	технологических вариантах. Хотя изоэнтропическое расширение способствует увеличению эффективности процесса, оно также усложняет работу в связи с использованием дополнительного вращающегося оборудования (гидравлических турбин СПГ). Гидравлические турбины СПГ хорошо зарекомендовали себя в сфере СПГ, так как десятилетиями эксплуатируются на множестве объектов и не являются чем-то новым. Применение конфигурации с параллельной гидравлической турбиной хорошо зарекомендовало себя на технологических линиях СПГ AP-X в Катаре производительностью 7,8 млн т/год. Компания APCI использовала подачу газа под давлением 78 бар на входе в предварительные охладители при работе в вариантах, рассчитанных на производство 7,5 млн т/год, тогда как для других вариантов давление на входе составляло 76 бар.
Refrigerant Compressor Loops Based on process technology (DMR or MFC) and LNG train capacity (5.5 or 7.5 MTPA) six different compressor configurations are proposed. These are either driven by Siemens Trent 60 Gas Turbines or Electric Motors. Each of the eight process options has either one or two Warm Refrigerant Loop(s) and single Cold Refrigerant Loop. In the DMR process for all 5.5 MTPA GBS options and the 7.5 MTPA EM option the Cold loop power is split such that HP stage of Cold MR is mounted on the Warm loop power and provides flexibility to optimise the heat load between the refrigeration loops but does increase the complexity of the train start-up operation. In the 7.5 MTPA GT driven option both the Warm and Cold loops have standalone compressors without any split. The 7.5 MTPA EM driven option, however, uses the “Split MR” configuration. In the MFC process both the Warm loop casings (MR1 and MR2) are mounted on a single shaft and the Cold loop (MR3) has a standalone machine, regardless of the GBS capacity. Compression of two different refrigerant loops on the same shaft will require two separate casings on that shaft. This increases the	Кольцевые линии компрессора хладагента В зависимости от технологического процесса (технологии DMR или MFC), а также пропускной способности технологической линии СПГ (5,5 или 7,5 млн т/год), предлагается шесть разных конфигураций компрессора. Компрессоры работают на газовых турбинах Siemens Trent 60 или электродвигателях. Каждый из 8 технологических вариантов имеет 1 или 2 кольцевые линии для теплого хладагента и единственную кольцевую линию для холодного хладагента. В технологии DMR для всех вариантов 5,5 млн т/год и варианта 7,5 тонн в год с электродвигателями мощность холодной кольцевой линии разделена таким образом, что ступень высокого давления холодного смешанного хладагента смонтирована на вале компрессора теплой кольцевой линии. При такой конфигурации с разделением смешанного хладагента (Split MR) используется вся доступная мощность привода и обеспечивается гибкость для оптимизации тепловой нагрузки между охлаждающими кольцевыми линиями, но при этом усложняется процесс запуска технологической линии. Для варианта 7,5 млн т/год с газовыми турбинами предусмотрены автономные компрессоры для теплой и холодной кольцевой линии, без разделения. Однако в варианте производительностью 7,5 млн т/год с приводом от электродвигателей используется конфигурация Split MR.

compressor complexity from an operation and maintenance viewpoint and also impacts the layout and piping arrangement. In such designs the outboard compressor casing is mostly a barrel type but the inboard casing could be horizontally split for ease of maintenance. In this project, the Client preference is for provision of barrel type for both the inboard and outboard casings. Although this simplifies the piping, additional layout space is required for removal of the outboard barrel in order to maintain the inboard casing. Therefore, configurations using single casings for all of the compressors are the simplest from an operation, maintenance and layout viewpoint. In the DMR options at least one shaft uses a single casing in all of the options, whereas in each of the MFC options both shafts are designed with two casings each. In general, the least number of compressor casings will reduce the maintenance demand and capital spares requirement. The DMR options result in fewer compressor casings than the MFC options, per train and overall. Option 7 (MFC 7.5 MTPA GT) results in the highest number of compressor casings (10) per GBS, thereby increasing operational complexity and maintenance requirements. Linde has provided a gear box between the driver and the compressor for all of their options to increase the operating speed of the compressor. This will limit the impeller diameter to 925mm, which Linde reports to be the maximum referenced size for Siemens compressors using barrel casings. Introduction of a gear box leads to slight loss in power, but is compensated by increased compressor efficiency due to optimised design. It will also lead to increased maintenance and operational complexity for the MFC options. However, even with the use of gear boxes the required compression power in the MFC options is much lower than the available GT power, thereby providing a good power margin. This is mostly owing to the lower air cooler exit temperatures, as mentioned above. Further, Linde reports that their compressor design for Options 7 and 8 is slightly above the referenced limit for impeller design, due	В технологии MFC обе теплые кольцевые линии (MR1 и MR2) монтируются на одном валу, а холодная кольцевая линия (MR3) имеет автономный механизм, вне зависимости от производительности установки на ОГТ. Сжатие двух разных контуров хладагента на одном валу требует два отдельных кожуха на валу. Это увеличивает сложность компрессора с точки зрения эксплуатации и обслуживания, а также влияет на схему расположения и размещения трубопроводов. При таких конструкциях внешний кожух компрессора в основном является компрессором типа «цилиндр», тогда как внутренний кожух может быть горизонтально разделен для облегчения обслуживания. В данном проекте Заказчик предпочел, чтобы и внешний и внутренний кожух были типа «цилиндр». Хотя это и упрощает трубную обвязку, все же необходимо дополнительное пространство, чтобы снять внешний цилиндр для обслуживания внутреннего кожуха. Поэтому конфигурация с использованием единого кожуха для всех компрессоров является самой простой сточки зрения эксплуатации, обслуживания и расположения. В вариантах DMR как минимум один вал имеет единый кожух во всех вариантах, тогда как в каждом варианте MFC конструкция обоих валов предусматривает два кожуха для каждого. В целом минимальное количество кожухов компрессора снизит необходимость обслуживания и потребность в запчастях для капитального ремонта. В вариантах технологии DMR предусмотрено меньше кожухов, чем в технологии MFC, на каждую технологическую линию и в общем. В варианте 7 (технология MFC, 7,5 млн т/год, с газовыми турбинами) предусмотрено наибольшее количество кожухов компрессора (10) на ОГТ, при этом усложняются требования к эксплуатации и обслуживанию. Компания Linde предусмотрела редуктор между приводом и компрессором для всех вариантов технологии компании для увеличения рабочей скорости компрессора. Это уменьшает диаметр рабочего колеса уменьшается до 925 мм, что, по словам компании Lшnde, является максимальным базисным размером для компрессоров компании Siemens с цилиндрическими кожухами. Добавление редуктора приводит к незначительной потере мощности, но это в достаточной мере компенсируется увеличением эффективности компрессора благодаря оптимизированной конструкции. Это также может привести к усложнению обслуживания и эксплуатации для вариантов MFC. Тем не менее, даже с использованием редукторов требуемая мощность компрессора в

to the fact that the coupling design constraints are limiting the compressor speed.

Linde has selected relatively high operating pressure (~8000 to 8100kPaa) for the HP MR3 Compressor discharge for Options 7 and 8. However, the design pressure selected for this section is 9100kPag, which seems to be inadequate. In absence of the compressor curves, considering about 20% rise over the normal operating pressure the design pressure could be about 9620kPag, which would require parts of the compressor discharge system piping to be 900# rating (eg. up to Aftercoolers), thereby increasing the weight of the system. The HP MR3 compressor discharge for the Options 3 and 4 should fall within 600# piping limit and LP MR3 could be 300# or 600# depending on the system settle-out pressure. MR1 and MR2 compressors should fall within 300# piping limit.

All DMR options, except Option 6 (7.5 MTPA EM) have compressors directly connected to the drivers without a gear box, thus operating at lower speed. Owing to this and to higher suction volumes, the DMR options have larger impeller diameters (800mm to 1450mm) and casing sizes. This will generally result in heavier compressors for the DMR options, as compared with the MFC options. Option 6, however, uses gear boxes to increase the compressor speed.

Siemens have reported a number of operating references with large diameter impellers. However, these impellers are mostly housed in horizontally split casings rather than barrels, which have been selected for this project. Due to relatively low operating pressures, the design pressure of the HP stages of WMR and CMR compressors fall within 300# and 600# limits, respectively. The LP stage design pressures are dependent on system settle-out pressure.

In the 7.5 MTPA APCI DMR (Options 5 and 6) the sub-cooled heavy MR liquid is further expanded (reduced in pressure) isentropically using an HMR Hydraulic Turbine, as compared to isenthalpic expansion across a Joule-Thompson valve in the other process options. Although isentropic expansion contributes towards

вариантах MFC намного ниже, чем полезная мощность газовой турбины, при этом предусмотрен хороший запас мощности. Как указано выше, это в основном связано с низкими температурами на выходе в воздушный охладитель.

Кроме того, компания Linde заявляет, что конструкция компрессора для Вариантов 7 и 8 по своим характеристикам слегка превышает рекомендованный предел, предусмотренный для конструкции рабочего колеса в связи с тем, что ограничения в конструкции соединений ограничивают скорость компрессора.

Компания Linde подобрала относительно высокое рабочее давление (-8000-8100 кПа (абс.) смешанного агента высокого давления MR3 на выходе компрессора для вариантов 7 и 8. Тем не менее расчетное давление, подобранное для данного участка, составляет 9100 кПа (изб.), что не соответствует требованиям. При отсутствии характиристических кривых компрессоров, учитывая примерно 20% превышения нормального рабочего давления, расчетное давление должно составлять примерно 9620 кПа (изб.), для чего потребуется частичная обвязка системы выхода компрессоров трубами класса 900# (например, до концевых охладителей), при этом вес системы будет увеличен. Выход компрессора смешанного хладагента высокого давления MR3 в вариантах 3 и 4 должен быть обвязан трубами 600#, а хладагента низкого давления MR3 - трубами на 300# или 600# в зависимости от балансового давления системы. Обвязка компрессоров смешанного хладагента MR1 и MR2 должна быть выполнена из труб 300#.

Во всех вариантах технологии DMR, кроме Варианта 6 (7.5 млн т/год, электрические приводы), предусмотрены компрессоры, подключенные напрямую к приводам без редуктора, и таким образом работающие на малой скорости. По этой причине, а также из-за более высоких объемов на входе, в вариантах технологии DMR предусмотрены рабочие колеса большего диаметра (800-1450 мм) и кожухи большого размера. Это обычно предполагает использование более высокомощных компрессоров в вариантах технологии DMR по сравнению с вариантами технологии MFC. Однако в Варианте 6 для увеличения скорости вращения компрессоров используются редукторы.

Компания Siemens дала несколько рекомендаций по рабочим колесам большого диаметра. Тем не менее, данные рабочие колеса чаще всего

increased efficiency of the process it also adds to operational complexity due to additional rotating equipment. HMR Hydraulic Turbines are well proven in the LNG industry with decades of operating experience at multiple locations and therefore not seen as novelty. Thus comparison between the DMR and the MFC options with respect to Refrigerant Compressor loops is summarised below. Due to the use of back-to-back casings for the Warm MR compressors, DMR Options result in fewer numbers of casings and seals than the corresponding MFC options, saving weight, space, maintenance requirement and OPEX. MFC Option 7 results in highest number of casings, 10 per GBS. Four large capacity WMR Pumps (2 sets of duty and standby) are required to be installed per DMR Option, contributing to increased weight, space, maintenance and operational complexity. The pumps also increase the hydrocarbon leak potential due to addition of several flanges and seals. MFC Options generally have smaller casings resulting in weight and space saving. However, provision of gear boxes in these options is likely to partly offset any benefits. A gear box adds complexity to the design as it requires regular maintenance and larger lubrication units. It also introduces rotodynamic issues like vibration. Reliability of large size gear boxes is an issue that needs to be further investigated in the next project phase. For DMR Options, large size barrel type compressor casings housing large impellers is considered as a step-out from Siemens references and needs further investigation with the vendor. In MFC Options 7 and 8, the HP MR3 discharge system piping is likely to be 900# rating up to and including the air coolers, leading to more burden on that section of the central pipe rack. Due to lower suction volume flows in the MFC options than the corresponding DMR options the pipe sizes for the MFC are likely to be smaller than the DMR process, saving weight and space. However, lower refrigerant flows for the MFC options are resultant from lower minimum approach temperature used by Linde. As	смонтированы в горизонтально разделенных кожухах, а не в цилиндрах, подобранных для данного проекта. Из-за относительно низкого рабочего давления расчетное давление ступеней высокого давления компрессоров теплого и холодного смешанного хладагента классифицируется в пределах 300# и 600# соответственно. Расчетные давления ступени низкого давления зависят от балансового давления системы. В технологии DMR компании APCI, рассчитанной на 7,5 млн т/год (варианты 5 и 6), переохлажденная жидкость смешанного хладагента высокой плотности продолжает изоэнтропически расширяться (при уменьшении давления) с использованием гидравлической турбины смешивания хладагента высокой плотности, по сравнению с изоэнтальпическим расширением через редукционный газовый клапан Джоуля-Томсона, которое происходит в других вариантах. Хотя изоэнтропическое расширение способствует увеличению эффективности процесса, оно также усложняет работу в связи с использованием дополнительного вращающегося оборудования. Гидравлические турбины HMR (смешанного хладагента высокой плотности) зарекомендовали себя в сфере СПГ, так как десятилетиями эксплуатируются на множестве объектов и не являются чем-то новым. Сравнение вариантов технологии DMR и технологии MFC в отношении кольцевых линий компрессора хладагента представлено ниже. В силу использования сдвоенных кожухов на компрессорах тёплого смешанного хладагента в вариантах технологии DMR предусмотрено меньшее количество кожухов и уплотнений, чем в соответствующих вариантах технологии MFC, при этом требуются меньше производственные площади, уменьшается вес, требования к техническому обслуживанию и эксплуатационные затраты. В варианте 7 технологии MFC предусмотрено большее количество кожухов, 10 на ОГТ. Четыре насоса для тёплого хладагента большой производительности (2 штатных и резервных) необходимо установить для каждого варианта технологии DMR, что приводит к увеличению веса, производственной площади, усложняет обслуживание и эксплуатацию. Насосы также увеличивают вероятность возникновения утечки углеводородов в связи с добавлением нескольких фланцев и уплотнений.

explained further in this section, the flows are likely to become higher in order to reduce the air cooler footprint. DMR Options 5 and 6 have increased complexity and additional weight burden due to the use of 3 hydraulic turbines (2 for LNG and 1 for HMR) in each option. The compressor stage efficiencies as quoted by Siemens for all the eight options are within a similar range. However, the concern is that the quoted efficiencies are quite optimistic and likely to become slightly lower in future. Options 6 and 8 require large VSD electric motors (~70MW) with limited references. However, both Siemens and GE have both constructed motors in this range and have testing facilities for this size of motor. Siemens have built and tested a 78MW VSD electric motor for Iran LNG. GE have offered a 75MW VSD motors for Freeport LNG, USA and have a large VSD electric motor string test facilities at their factory in Italy.	В вариантах технологии MFC предусмотрены кожухи меньшего размера, что экономит производственную площадь и уменьшает вес. Тем не менее, установка редукторов в данных вариантах частично сводит на нет все преимущества. Наличие редуктора усложняет конструкцию, поскольку он требует регулярного технического обслуживания и более мощных систем смазки. Также возникают динамические осложнения, такие как вибрация. Вопрос надежности редукторов большого размера требует более подробного изучения на следующем этапе проекта. Для вариантов DMR кожухов габаритного компрессора типа «цилиндр» с большим рабочим колесом считается отклонением от рекомендаций компании Siemens и требует более детального последующего изучения этого вопроса с поставщиком. В вариантах 7 и 8 технологии MFC обвязка на выходе смешанного хладагента высокого давления MR3 сделана из труб 900# до воздушных охладителей включительно, что ведет к большей нагрузке на этой секции центральной трубной эстакады. Из-за более низкого объема расхода на входе в вариантах технологии MFC, чем в соответствующих вариантах технологии DMR, размеры труб для технологии MFC должны быть меньше, чем при технологии DMR, при этом экономится производственная площадь и уменьшается вес. Однако более низкая скорость расхода хлалдагента в вариантах, использующих технологию MFC, является следствием использования компанией Linde более низкого значения минимального перепада температур между входящим и исходящим потоками. Как разъясняется далее в данном разделе, скорости расхода, по всей вероятности, будут увеличены в целях уменьшения площади, занимаемой воздушными охладителями. В вариантах 5 и 6 технологии DMR предусмотрено усложнение и увеличение весовой нагрузки в связи с использованием 3 гидравлических турбин (2 для СПГ и 1 для смешанного хладагента высокой плотности) в каждом варианте. КПД ступени компрессора, заявленные компанией Siemens для всех восьми вариантов, находятся в одинаковых диапазонах. Но проблема заключается в том, что заявленные КПД слишком оптимистичны и со временем скорее всего станут немного меньше. Варианты 6 и 8 требуют применения электродвигателей с регулируемой скоростью большой мощности (~70 МВт), опыт применения которых

	ограничен. Однако и компания Siemens, и компания GE имеют опыт изготовления электродвигателей в данном диапазоне мощностей и располагают испытательным оборудованием для электродвигателей подобных размеров. Компания Siemens изготовила и испытала электродвигатель с регулируемой скоростью мощностью 78 МВт для завода СПГ в Иране, а компания GE предложила электродвигатель с регулируемой скоростью мощностью 75 МВт для завода СПГ в Фрипорте (США) и располагает испытательным стендом для мощных электродвигателей с регулируемой скоростью на своем заводе в Италии
Coil Wound Heat Exchangers Both the technologies use Coil Wound Heat Exchangers which comprise tube paths arranged spirally within an outer shell. The DMR process for this project, regardless of the LNG capacity, is designed with two parallel Pre-coolers and one Main Cryogenic Heat Exchanger (MCHE). Linde MFC Process for 5.5 MTPA LNG capacity is designed with one Pre-cooler, one Liquefier and one Sub-cooler, all in series. However, two parallel sub-coolers have been provided for 7.5 MTPA MFC options. Linde has selected stainless steel metallurgy for the shell and tubes of their CWHEs whereas APCI has proposed Aluminium metallurgy for both shell and tubes of their CWHEs. Also, Linde MFC requires an additional (fourth) exchanger to be installed for the 7.5 MTPA options. Owing to this the total weight of Linde exchangers is 38% higher for 5.5 MTPA options and 58 to 68% higher for 7.5 MTPA options as compared to corresponding APCI exchangers. The positive aspect of stainless steel CWHEs is their robustness during transit in vertically installed position from module yard to GBS construction site and then to the Project site. Linde has built CWHEs up to 4.7 m diameter, which includes those built for Sakhalin LNG with up to 4.5m diameter and 29m height. Further, Linde is currently building 2 CWHEs each with three bundles with the largest bundle of diameter 4.8m, at their Schalchen workshop. The overall height of each CWHE is 60m, weight 550 tonnes and both are built in Stainless Steel. Linde have	Спиральные теплообменники В обеих технологиях используются спиральные теплообменники, которые включают в себя линии трубок, установленные спирально в наружном корпусе. Процесс по технологии DMR для этого проекта, вне зависимости от объема СПГ, предусматривает два параллельных предварительных охладителя и один основной криогенный теплообменник. Процесс по технологии MFC компании Linde с производительностью 5,5 млн т/год предусматривает один предварительный охладитель, один ожижитель и один переохладитель, соединенные последовательно. Однако для вариантов производительностью 7,5 млн т/год с использованием технологии MFC предусмотрено два параллельных переохладителя. Компания Linde выбрала нержавеющую сталь в качестве материала корпуса и трубок для своих спиральных теплообменников, а компания APCI предложила алюминий для корпуса и трубок своих спиральных теплообменников. Кроме того, технология MFC компании Linde требует установки дополнительного (четвертого) теплообменника для вариантов производительностью 7,5 млн т/год. В связи с этим теплообменники компании Linde на 38% тяжелее в вариантах с производительностью 5,5 млн т/год и на 58 - 68% тяжелее в вариантах с производительностью 7,5 млн т/год по сравнению с соответствующими теплообменниками компании APCI. Преимуществом спиральных теплообменников из нержавеющей стали является прочность при перевозке в вертикальном положении с базы на площадку строительства ОГТ, а затем на проектный объект. Компания Linde соорудила спиральные теплообменники диаметром до 4,7 м, в частности для проекта Сахалин диаметром 4,5 м и высотой 29 м. Кроме того,

mentioned that a large oil and gas company has recently qualified Linde workshop for manufacture of 5.3m diameter CWHEs, justifying selection of this size limit for Arctic LNG Project. APCI have proposed Aluminium metallurgy for their CWHEs, which has been widely used worldwide. As a result the total weight of exchangers is much lower than the corresponding Linde options. Further, APCI has proposed 3 exchangers for all the 8 options as against four CWHEs proposed by Linde for 7.5 MTPA train options, thereby saving layout space and topside weight. Due to Aluminium metallurgy of the shell, transportation of CWHEs in vertical installed position from module yard to the GBS construction yard and then to the Project site is a concern. The exchangers must be made motion-worthy for both these voyages. APCI have successfully built exchangers up to 4.8m at their USA workshop and have a capability to build exchangers greater than 5.2m diameter and 57.8m height. APCI has selected 5.2 m dia x 51m height exchanger size for the 7.5 MTPA options, which is within their planned progression limit. In both the composite curves, the hot composite is closely following the cold composite indicating optimised designs. The inflections on the cold composite curve represent transition from one MR composition to the other on the shell side or in other words represent transition between one CWHE bundle to the other. The closer the two curves the larger the exchanger surface area / size (UA) but lower the refrigerant flow / power. In designing the liquefaction process each licensor has balanced the available driver power (refrigerant circulation rate), available air cooler footprint (approach temperature) and size/number of CWHEs.	компания Linde сейчас сооружает 2 спиральных теплообменника, каждый стремя трубными пучками, причем самый крупный пучок имеет диаметр 4,8 м, на своем предприятии в Шальхене. Каждый из спиральных теплообменников имеет высоту 60 м, вес 550 тонн, и оба они изготовлены из нержавеющей стали. Компания Linde указала, что крупная нефтегазовая компания недавно избрала цех компании Linde для изготовления спиральных теплообменников диаметром 5,3 м, обосновав именно это ограничение по размеру для своего проекта СПГ в Арктике. Компания APCI предложила использовать алюминий для своих спиральных теплообменников, он используется по всему миру. В результате общий вес теплообменников значительно ниже, чем в соответствующих вариантах компании Linde. К тому же компания APCI предложила 3 теплообменника для всех 8 вариантов по сравнению с четырьмя спиральными теплообменниками, предложенными компанией Linde для вариантов технологической линии с пропускной способностью 7,5 млн т/год, таким образом сокращаются производственные площади и вес верхних строений. Из-за использования алюминия перевозка в вертикальном положении с базы на площадку строительства ОГТ, а затем на проектный объект является проблемным вопросом. Теплообменники должны быть сделаны так, чтобы их можно было транспортировать по обоим маршрутам. Компания APCI успешно соорудила теплообменники размером до 4,8 м в собственном цехе, расположенном в США, и имеет возможность сооружать теплообменники диаметром более 5,2 м и высотой до 57,8 м. Компания APCI подобрала размер для теплообменников с диаметром 5,2 м х высотой 51 м, что находится в пределах запланированной последовательности. На обеих кривых комбинированного охлаждения горячая составляющая вплотную следует за холодной составляющей, что является признаком оптимизированных конструкций. Изгибы холодной составляющей кривой представляют переход от одного состава смешанного хладагента к другому со стороны корпуса или, другими словами, представляют переход от одного узла спирального теплообменника к другому. Чем ближе две кривые, тем больше площадь поверхности/размер теплообменника (UA), но ниже расход хладагента/мощность. При проектировании процесса сжижения каждый владелец лицензии сбалансировал полезную мощность привода (скорость

	циркуляции хладагента), доступную зону обслуживания воздушного охладителя (перепад температуры между входящим и исходящим потоками), а также размер/количество спиральных теплообменников.
Air Cooler Design There are two aspects of air cooler designs that significantly impact the GBS design. 1. Physical air cooler dimensions (surface area, layout, weight for various options) 2. Influence of Process technology on the air cooler design and influence of air cooler design on the overall process design. The former is more dependent on the selected minimum approach temperature rather than the technology, whereas the latter is more of a technological issue. A sensitivity analysis was performed in the Stage 1 of the project to determine the impact of air cooler minimum approach temperatures on the APCI DMR process. This is covered in Section 4.0 of Stage-3 Final Report. Reducing minimum approach temperature from 23°C to 15°C resulted in more enthalpy in the Warm refrigerants rejected at the air coolers rather than in the Pre-coolers, resulting in overall reduction in the WMR compression power by about 20%. The benefits of lower power must be balanced against the 21% increase in air cooler footprint and resulting impact on topside and GBS design. Since accommodating the air coolers on the GBS piperack was more of a concern at that Stage, minimum approach temperature of 23°C was selected at that time. As a conservative approach KBR continued to use the same for Stages 2 and 3 of the project, as the concern over air cooler footprint still prevails. Accordingly, APCI was advised to use a minimum approach temperature of 23°C, leading to a minimum process fluid temperature exiting the air coolers of 25°C. Linde used a minimum approach temperature of 13°C, leading to a minimum process fluid	Конструкция воздушного охладителя Существует две конфигурации конструкции воздушного охладителя, которые значительно влияют на конструкцию ОГТ. 1. Физические размеры воздушного охладителя (площадь поверхности, схема расположения, вес для различных вариантов) 2. Влияние технологического процесса на конструкцию воздушного охладителя и влияние конструкции воздушного охладителя на общий проект технололгического процесса. Первое в большей степени зависит от подобранного минимального перепада температуры между входящим и исходящим потоками, чем технология, при этом последнее больше относится к технологической стороне. В ходе Этапа 1 проекта был выполнен анализ чувствительности с целью определения влияния минимальных перепадов температур между входящими и исходящими потоками воздушных охладителей на технологический процесс DMR компании APCI. Этот вопрос рассмотрен в Разделе 4.0 итогового отчета по Этапу 3 [1]. Снижение минимального перепада температур с 23°C до 15°C привело к тому, что отвод энтальпии теплых хладагентов через воздушные охладители превысил отвод через предохладители, что повлекло за собой снижение мощности компрессоров теплого хладагента примерно на 20 %. Преимущества более низкой мощности необходимо уравновесить увеличением площади, занимаемой воздушными охладителями, на 21 % с соответствующим влиянием на конструкцию верхних строений и ОГТ. Поскольку на том этапе работы размещение воздушных охладителей на трубной эстакаде ОГТ представлялось более важной задачей, был выбран минимальный перепад температур 23°C. В рамках консервативного подхода компания KBR продолжила использовать это значение для Этапов 2 и 3 проекта, поскольку проблема площади, занимаемой воздушными охладителями, по-прежнему сохраняет первостепенное значение. Соответствующим образом, компании APCI было рекомендовано использовать минимальный перепад температуры между входящим и исходящим потоками

temperature exiting the air coolers of 15°C. With lower refrigerant fluid temperature entering the Pre-coolers, MFC options have a thermodynamic advantage over the DMR options, however, this should not be considered as a true reflection on the technologies. The lower selected air cooler minimum approach temperature by Linde has resulted into a more efficient process design giving lower compressor powers but increased air cooler sizes. The DMR air coolers, on the other hand have relatively compact design due to higher minimum approach temperature but have utilised all of the available driver power (GT option).

The air coolers are installed in bays arranged adjacent to each other on either side over the central pipe-rack in two rows. Each row or a bay is 15.24m wide corresponding to the cooler standard tube length. The length of the bay depends on the heat duty. Most air coolers comprise a number of bays. The total length of piperack available for air cooler installation varies with the options. Some of the cooler bays can extend over the edge of the pipe-rack module and hang over the intermodule space, supported by cantilevers. This is typically done to accommodate multiple bays of a single cooler on one module.

The feasibility of achieving higher productions is more dictated by available air cooler area, available power and GBS weight limits rather than the CWHE size.

In all the options the air coolers appear to fit within the available pipe-rack layout space leaving varying degrees of spare unused space. The DMR options are generally using a smaller plot space leaving spare pipe-rack length of 10 to 12% for 5.5 MTPA designs and 19 to 21% for 7.5 MTPA designs. This allows sufficient space for future growth. In addition, KBR has considered 10% overdesign margin for the DMR options as growth margin/performance margin. The overdesign margin is in addition to the application of air cooler fouling factors which are determined based on industry norms.

The MFC options occupy significant proportion of inter-module gaps (cantilever) and leave less than 5% spare pipe-rack length,

23°C, при этом минимальная температура технологического флюида на выходе из воздушного охладителя должна составлять 25°C. Компания Linde установила минимальный перепад температуры между входящим и исходящим потоками 13°C, при этом минимальная температура технологического флюида на выходе из воздушного охладителя должна составлять 15°C. При более низкой температуре охлаждающей жидкости на входе в предварительные охладители варианты технологии MFC имеют термодинамическое преимущество над вариантами технологии DMR, но этот фактор не является решающей характеристикой технологий. Выбор более низкого минимального перепада температуры между входящим и исходящим потоками воздушного охладителя компании Linde сделал технологию процесса более эффективной, с более низкими компрессорными мощностями, но это привело к увеличению размеров воздушных охладителей. С другой стороны, воздушные охладители в рамках технологии DMR имеют относительно компактную конструкцию из-за минимального перепада температуры между входящим и исходящим потоками, но при этом потребляют всю доступную мощность привода (вариант с газовой турбиной).

Воздушные охладители устанавливаются на теплообменных секциях, примыкающих друг к другу или любой стороне над центральной трубной эстакадой, в два ряда. Каждый ряд или теплообменная секция шириной 15,24 м соответствует стандартной длине трубки охладителя. Длина секции зависит от тепловой нагрузки. Большинство воздушных охладителей содержат несколько теплообменников. Общая длина трубной эстакады, доступной для установки воздушного охладителя, варьируется в зависимости от варианта. Некоторые теплообменники охладителя могут выходить за края модуля трубной эстакады и подвешиваться над внутримодульным пространством на кантилеверах. Это обычно делается для того, чтобы вместить несколько теплообменных секций одного охладителя на модуле.

Возможность достижения более высоких уровней производительности определяется в большей степени доступной площадью для размещения воздушных охладителей, доступной мощностью и ограничениями по весу ОГТ, нежели размерами спиральных теплообменников.

Для всех вариантов воздушные охладители вписываются в свободное место размещения трубной эстакады, при этом остается резервное неиспользуемое место разной площади. В вариантах технологии DMR обычно используется

practically leaving no space for future growth. Besides, Linde has provided 10% allowance to account for fouling but only 5% overdesign margin over fouled surface area. For a PreFEED design a robust approach would be to apply a 10% margin to allow for design development. Applying 10% margin the air cooler layout requirement in the MFC options will exceed the available pipe-rack space. This is considered as a risk to the Linde MFC design and it means that Linde has to change proc reduce the current air cooler plot space and manage future growth. However, due to available spare power it is recognised that the air cooler design can be optimised to mitigate the layout risk and therefore, no penalty has been imposed on the MFC design in the Technical Risk scoring matrix.

Minimising the air cooler approach temperatures for the MFC options also requires a lower air temperature rise and therefore a higher air flow. The ability to supply higher quantities of air to the air coolers will need to be confirmed by a detailed Hot Air Recirculation study. It should be noted that the modules have wind walls that deflect air away from the central pipe rack. The permanent wind walls means the air flow to the central air-cooler fans will need to be carefully modelled to ensure that LNG production is not adversely affected for prevailing summer wind directions.

In the DMR process WMR is partially condensed in the WMR 1st Stage Condenser (1E-1615) and separated in the WMR 2nd Stage KO Drum (1V-1622). The liquid phase is pumped in WMR Pump (1P-1621A/B) and the vapour phase is compressed in HP WMR Compressor and de-superheated in the Aftercooler. Both the phases are then mixed and passed through WMR Condenser (1E-1614) for complete condensation. Uniform distribution of this two phase mixture through the WMR Condenser tubes is a key requirement to ensure total condensation, as any maldistribution could leave vapours uncondensed leading to underperformance.

Measures to mitigate this concern may result in higher power consumption or increased exchanger area due to optimisation of

площадь меньшего размера с выделением места для резервной длины трубной эстакады от 10 до 12% при конструкции, рассчитанной на 5,5 млн т/год, и от 19 до 21% при конструкции, рассчитанной на 7,5 млн т/год. Таким образом остается место для дальнейшего расширения. Кроме того, компания KBR предусмотрела расчет с 10% запасом для вариантов технологии DMR в качестве запаса на увеличение/запаса по характеристикам. Этот запас предусматривается в дополнение к применению коэффициентов загрязнения воздушных охладителей, которые определяются по отраслевым нормам.

В вариантах технологии MFC значительная часть внутримодульных пространств занята (кантилевер) и остается меньше 5% резервной длины трубной эстакады, что практически не оставляет места для дальнейшего расширения. Кроме того, компания Linde предусмотрела допуск 10 % на загрязнение, но всего 5 % запаса сверх площади загрязненной поверхности. Для проекта на этапе предпроектной проработки надежным подходом было бы применение запаса 10 % с учетом дальнейшей доработки проекта. При применении 10% запаса требования к размещению воздушного охладителя в вариантах технологии MFC превысит доступное пространство трубной эстакады. Это является риском в проекте по технологии MFC компании Linde и означает, что компания Linde должна изменить технологические параметры использования «резервной мощности», чтобы сократить площадь действующего воздушного охладителя и проконтролировать дальнейшее расширение. Тем не менее, принимая во внимание доступную свободную мощность, конструкция ABO может быть оптимизирована для снижения рисков по размещению и, таким образом, не будет снижения оценки на конфигурацию MFC в критериях оценки технических рисков.

Минимизация перепада температуры между входящим и исходящим потоками воздушного охладителя в технологии MFC и его вариантах также требует небольшого повышения температуры воздуха и, соответственно, большего расхода воздуха. Возможность подавать большее количество воздуха на воздушные охладители необходимо подтвердить подробным анализом рециркуляции горячего воздуха. Необходимо отметить, что модули имеют ветрозащитные стены, которые отводят воздух от центральной трубной эстакады. Стационарные ветрозащитные стены, которые обеспечивают направление воздуха к центральным вентиляторам воздушного охладителя,

the air cooler approach temperatures. It is recommended that a solution to this concern be developed in conjunction with the air cooler vendor(s) and the licensor in the next project phase. No such issue arises in the MFC process as the inlet to all of the air coolers is only in the vapour phase. It is a known fact that air coolers under very low ambient temperature conditions are prone to overcooling if inlet air temperature is not controlled; even more so in Arctic weather conditions. The exit temperature of all the Aftercoolers at compressor discharges for both DMR and MFC processes is normally controlled. However, simple control schemes such as fan pitch or speed control have their own practical limits. The DMR Process is more likely to be affected as overcooling in WMR 1st Stage Condenser (1E-1615) can also potentially lead to considerable reduction in vapour flow to the HP WMR Compressor, thereby forcing this stage in recycle mode. In order to avoid condensation (or over-condensation) other mitigating measures such as inlet air heating or air recirculation might have to be explored and implemented for the affected air coolers. The DMR options, as currently designed are better placed to accommodate the growth in air cooler area due to air recirculation cabinets, if implemented in future. The MFC air cooler design can also meet this requirement provided the design is optimised in future phase.	необходимо тщательно смоделировать, чтобы производство СНГ не сильно подвергалось влиянию преобладающих направлений летнего ветра. В процессе по технологии DMR теплый смешанный хладагент частично конденсируется в 1й ступени газоохладителя теплого смешанного хладагента (1E-1615) и сепарируется во 2й ступени каплеотбойника теплого смешанного хладагента (1V-1622). Жидкая фаза закачивается в насос теплого смешанного хладагента (1 P-1621 A), а паровая фаза сжимается в компрессоре теплого смешанного хладагента высокого давления и охлаждается после перегрева в охладителях газа, расположенных за компрессором. Обе фазы затем смешиваются и проходят через газоохладитель теплого смешанного хладагента (1E-1614) для осуществления полной конденсации. Равномерное распределение смеси этих двух фаз в трубках газоохладителя теплого смешанного хладагента является ключевым требованием для обеспечения полного охлаждения, так как при неудачном распределении пары могут остаться не охлажденными, что приведет к снижению эффективности работы. Меры по снижению воздействия данного фактора могут привести к росту потребляемой мощности или увеличению площади теплообменника вследствие оптимизации градиента температуры АВО. Рекомендуется проработать решение данного вопроса совместно с поставщиком (поставщиками) воздушных охладителей и лицензиаром на следующем этапе проекта. Такая проблема не возникает при применении технологии MFC, так как на вход во все воздушные охладители поступает только паровая фаза. Известно, что при очень низкой температуре окружающего воздуха существует предрасположенность к переохлаждению, если температура воздуха на входе не контролируется, тем более в арктических погодных условиях. Температура на выходе всех концевых охладителей, расположенных выходе компрессоров в обоих процессах, по технологии DMR и технологии MFC, как правило, контролируются. Тем не менее, простые схемы управления, такие как контроль вращения или скорость работы вентилятора могут иметь свои собственные практические ограничения. На процесс по технологии DMR может повлиять переохлаждение в 1й ступени газоохладителя теплого смешанного хладагента (1E-1615), что также может привести к значительному сокращению потока пара к компрессору теплого смешанного хладагента высокого давления, при этом переводя эту ступень в режим рециркуляции. Во избежание конденсации (или избыточной конденсации), для соответствующих воздушных охладителей

	могут быть рассмотрены и приняты другие меры, такие как подогрев поступающего воздуха или рециркуляция воздуха. Охладитель регенерированного раствора в блоке очистки от кислых газов может служить примером возможного применения камер рециркуляции воздуха. Варианты с использованием технологии DMR в их существующем виде более приспособлены к возможному увеличению площади воздушных охладителей из-за применения рециркуляции воздуха, если в будущем будет принято такое решение. Конструкция воздушных охладителей в технологии MFC также может соответствовать данному требованию, при условии, что конструкция будет оптимизирована на следующем этапе.
Energy Efficiency There exists a difference in design philosophies between APCI DMR and Linde MFC design options. The DMR options have used almost all the available Gas Turbine power thereby minimising the air cooler layout space requirement. The MFC options have focussed more on maximising the process efficiency leaving spare power with the Gas Turbines. As a result, the MFC options have used almost all the available space for air coolers. However, either process technology could be designed using the others philosophy. In other words, APCI DMR can tighten the air cooler approach temperature to reduce power consumption and /or size of their CWHEs, while Linde MFC can utilise some spare power to increase the air cooler approach temperature thereby reducing air cooler plot space. Recognising this direct correlation between power and approach temperature and to allow direct comparisons to be made between technologies, KBR has re-estimated the refrigerant compression power required for the 5.5 MTPA DMR Options using 13°C minimum approach for the air coolers. This "normalised" refrigerant compression power has been used for comparison in this section and the Technical Risk scoring matrix. Equally, the MFC Options have not been penalised for potentially exceeding the available air cooler plot space. No adjustment has been made to the MFC options to account for potential modifications that may be necessary to mitigate air cooler footprint.	Энергоэффективность Существует разница в принципе проектирования вариантов технологии DMR компании APCI и технологии MFC компании Linde. В вариантах технологии DMR используется практически вся доступная мощность газовой турбины, при этом минимизируется площадь, необходимая для расположения воздушного охладителя. Варианты технологии MFC больше фокусируются на увеличении эффективности процесса с сохранением резервной мощности газовых турбин. В результате, в вариантах технологии MFC используется практически все доступное пространство для воздушного охладителя. Но каждый технологический процесс может быть спроектирован по другому принципу. Другими словами, технология двойного смешанного хладагента компании APCI может сократить перепад температуры между входящим и исходящим потоками воздушного охладителя, чтобы уменьшить потребление мощности и/или размер их спиральных теплообменников, тогда как при технологии MFC компании Linde может использоваться резервная мощность для увеличения перепада температуры между входящим и исходящим потоками воздушного охладителя, при этом сокращается площадь участка воздушного охладителя. Принимая во внимание прямую зависимость между мощностью и перепадом температуры между входящим и исходящим потоками воздушного охладителя, чтобы сделать прямое сравнение технологий, KBR пересчитал мощность компримирования хладагента вариантов 5.5 млн.т/г DMR используя минимальный перепад температур для воздушных охладителей 13°C.Эта «приведенная» мощность компримирования хладагента была использована для сравнения в данном разделе и в критериях оценки технических рисков. Также, у вариантов MFC не снимали баллы за возможное увеличение места для

Parameters such as Specific Power and Auto-consumption are a good indication of energy efficiency of the process. Specific power (kWh/tonne) of LNG is the refrigerant compression power required to produce one tonne per hour of LNG. Since feed gas pressure can influence the refrigerant compression power, Feed Gas Booster Compressor power has been factored into the specific power to differentiate between options with differing feed gas pressure. Auto-consumption is a measure of percentage of feed gas that does not result in product. It is calculated as: Auto-consumption (%) = (LHV of all inlet streams LHV of all product streams) ÷ (LHV of all inlet streams) For the options with electric motor drivers, auto-consumption is based on combined cycle power generation in the Onshore Power Plant. DMR Options (1 and 2) is only slightly higher than the corresponding MFC Options (3 and 4). Optimising the air cooler approach temperature to the normalised Specific Power of the 7.5 MTPA DMR Options (5 and 6) would completely negate the need for the use of higher feed gas pressure and hydraulic turbines. The GT driven options nearly use the same specific power as the corresponding Electric Motor driven options. Auto-consumption is higher for the Electric Motor driven options as lower HP fuel gas consumption due to combined cycle power generation is offset by higher LP fuel gas consumption for heating medium fired heaters. However, based on the previous discussion it can be said that designs based on either process technology (DMR or MFC) would require modifications/ optimization which would narrow down the efficiency difference between them.	воздушных охладителей. Для вариантов MFC не было сделано никаких корректировок с учетом возможных модификаций, которые могут потребоваться для уменьшения места для воздушных охладителей. Такие параметры как удельная мощность и самопотребление являются надежным признаком эффективного использования энергии в процессе. Удельная мощность (кВтч/т) СПГ - это мощность сжатия хладагента, необходимая для производства одной тонны СПГ в час. Так как давление подаваемого газа может влиять на мощность сжатия хладагента, мощность дожимного компрессора подаваемого газа была заложена в расчет удельной мощности, чтобы установить различие между вариантами с различным давлением подаваемого газа. Самопотребление — это процент подаваемого газа, который не влияет на продукцию. Он рассчитывается следующим образом: Самопотребление (%) = (низкая теплотворная способность всех входных потоков - низкая теплотворная способность всех потоков продукта) ÷ (низкая теплотворная способность всех входных потоков) В вариантах с электродвигателями самопотребление основывается на комбинированном цикле выработки электроэнергии на наземной электростанции. При сравнении «приведенных» удельных мощностей для вариантов 5.5 МТГ, потребление у DMR вариантов (1 и 2) немного выше чем у соответствующих вариантов MFC (3 и 4). При оптимизация перепада температур воздушных холодильников для расчета приведенной удельной мощности вариантов 7.5 млн.т/г DMR (5 и 6), привела бы к устранению необходимости использования более высокое давление сырьевого газа и гидравлических турбин. Варианты с ГТ используют практически одинаковые удельные мощности как варианты с ЭД. Самопотребление выше в вариантах с использованием электродвигателей, так как более низкое потребление топливного газа высокого давления, из-за комбинированного циклом выработки электроэнергии, компенсируется более высоким потреблением топливного газа низкого давления для нагрева пламенного подогревателя среды.

	Однако по результатам состоявшихся ранее обсуждений можно сказать, что проекты, основанные на любой из технологий (DMR или MFC) потребуют уточнения и оптимизации, которая приведёт к уменьшению различий в эффективности между ними.
Licensor Guarantee and Design Margins The Licensor/ Contractor guarantees on LNG production are subject to the contractual and financial negotiations with the Client for the EPC Contract. The actual guarantee values will then be dependent on the liquidated damages and make good requirements. KBR while detailing the APCI DMR process options have considered 10% overdesign margin over the heat and material balance parameters. This generally applies to the design of vessels, exchangers and piping with a few exceptions. KBR has successfully implemented this philosophy in several past projects. Linde while detailing the MFC process options have considered a 5% overdesign margin. In the next project phase the over design margin is likely to be revised upwards for the Linde options.	Гарантии лицензиара и расчетные запасы Гарантии Лицензиара/Подрядчика по выработке СПГ являются предметом контрактных и коммерческих переговоров с Заказчиком при заключении контракта EPC. Фактические гарантийные значения будут зависеть от суммы ответственности и будут являться строгими требованиями. При проработке вариантов с технологией APCI DMR компания KBR приняла расчетный запас 10% в отношении параметров тепловых и материальных балансов. Он применяется, как правило, при проектировании емкостей, теплообменников и трубопроводов. Компания KBR успешно применяла такой подход на нескольких предыдущих проектах. Компания Linde при проработке вариантов с технологией MFC приняла расчетный запас 5%. На следующем этапе проекта указанный расчетный запас для вариантов с технологией Linde с большой вероятностью будет пересмотрен в сторону увеличения.
Technology Past Experience As indicated before both the technologies, DMR and MFC are quite similar from conceptual viewpoint. Shell licensed DMR technology has been successfully implemented at Sakhalin, Russia and is also being implemented on Shell Prelude FLNG. However, APCI DMR technology is not yet implemented in any LNG Project. LNG trains with Linde MFC technology are operational in Norway. However, these trains are smaller capacity and are direct seawater cooled. The larger trains in Iran using MFC technology, electric motor driven compressors and water cooling are still under construction. There are currently no references for Linde designed air cooled LNG trains.	Опыт использования технологий Как указывалось ранее, обе технологии, DMR и MFC, достаточно похожи по своей концепции. Технология DMR, лицензируемая компанией Shell, успешно применяется на заводе на о. Сахалин в России, а также предусматривается на плавучем заводе СПГ Prelude компании Shell. При этом технология DMR фирмы APCI пока не была реализована на каком-либо проекте СПГ. Технологические линии производства СПГ по технологии MFC фирмы Linde действуют в Норвегии. Однако эти линии имеют меньшую производительность, и на них используется прямое охлаждение морской водой. Более крупные технологические линии на объекте в Иране, на которых предусматривается использование технологии MFC, компрессоров с электродвигателями и водяного охлаждения, на данный момент еще находятся на стадии строительства. В настоящее время нет сведений об аналогичных

APCI as a licensor is more experienced in providing technology (not DMR) for large capacity plants, Linde's experience, on the other hand is restricted to the 4.2MTPA Hammerfest (Snohvit) train.	технологических линиях производства СПГ с воздушным охлаждением, спроектированных компанией Linde. Компания APCI, как лицензиар, имеет больший опыт в предоставлении технологий (не DMR) для крупных заводов. При этом опыт компании Linde ограничивается технологической линией на заводе Hammerfest (Snohvit) с производительностью 4,2 млн т/год.
Plant Capacity (5.5 MTPA versus 7.5 MTPA)	Производительность завода (5,5 млн. т/год и 7,5 млн. т/год)
In the previous stages of this project the configuration that was studied was 3 GBS of 5.5 MTPA capacity. The main driver for investigating 2 x 7.5 MTPA GBS options in this phase was the schedule and cost benefit it offers. The total design production could be achieved about 12 months earlier with the two larger GBS. On the operation and maintenance side both of the capacity options have certain advantages and disadvantages. On the engineering and construction side the 7.5 MTPA options would have inherent risks associated with the high capacity and large GBS size. Both the DMR and MFC processes have been proven on LNG trains for capacities within the 4-5 MTPA range. However neither technology is referenced for LNG production greater than 5 MTPA. Although the AP-X LNG trains installed in Qatar have train capacities greater than 7.5 MTPA it is not recommended to use this technology for the GBS concept due to weight and footprint limitations. The scale up of any technology has inherent risks which need to be identified and suitable mitigation plans developed to ensure that the risk is manageable. The GBS LNG train is being developed within tight contraints relating to topside footprint, topside weight and GBS design. The uncertainties associated with the novelty of a 7.5 MTPA train represent a major risk. Nevertheless, both the licensors have designed for 5.5 and 7.5 MTPA and both claim that they could achieve higher productions if given opportunity. Apart from the design of the liquefaction unit, capacity has influence on the design of inlet facilities, warm end, NGL and utilities as well. Equipment design for these units is mostly dependent on the feed	В предыдущих этапах этого проекта была изучена конфигурация 3 ОГТ мощностью 5,5 млн т/год. Основным драйвером для исследования варианта 2 x 7.5 млн т/год на этом этапе были преимущества с точки зрения сроков и стоимости, которые этот вариант предлагает. Выход на полную мощность производства с 2-мя ОГТ может быть достигнут примерно на 12 месяцев раньше. Что касается эксплуатации и технического обслуживания, оба варианта имеют определенные преимущества и недостатки. С инженерной и строительной точек зрения, варианты 7,5 млн т/год имеют присущие им риски, связанные с высокой производительностью и большими размерами ОГТ. Оба процесса DMR и MFC были подтверждены в производстве СПГ с производительностью в диапазоне 4-5 млн т/год. Однако ни одна из технологий не была применена в СПГ с производительностью более 5 млн т/год. Хотя AP-X СПГ линии, установленные в Катаре, имеют единичную производительность более 7,5 млн т/год, не рекомендуется использовать эту технологию для концепции ОГТ из-за ограничений в весе и пространстве. Масштабированию любой технологии присущи риски, которые должны быть определены. Также должны быть разработаны подходящие планы по управлению этими рисками. Технологическая линия производства СПГ на ОГТ разрабатывается в условиях жестких ограничений по площади верхних строений, весу верхних строений и конструкции ОГТ. Факторы неопределенности, связанные с инновационностью технологической линии производительностью 7,5 млн т/год, представляют существенный риск. Тем не менее, оба лицензиара сделали проект для 5,5 и 7,5 млн т/год и оба утверждают, что они могут достичь более высоких производительностей, если будет предоставлена возможность.

gas volumetric and/or mass flow rate which differs only slightly between the four 5.5 MTPA options. Therefore, equipment design is the same for all of the 5.5 MTPA options in this phase of the project. This philosophy applies to the 7.5 MTPA options as well. The Inlet Facility and Condensate Stabilisation (U1000) equipment sizes for the 5.5 MTPA options fall within the current operating reference range. Even after scaling up for 7.5 MTPA the equipment sizes are within KBRs experience range. The Condensate Stabilisation unit was designed for much higher liquid flows in the previous stages. Owing to revision in feed composition in Stages 2 and 3 the liquid flows have reduced significantly. However, for the purpose of equipment design the project has decided to maintain the same basis as used for the previous stages. As a result the equipment in Condensate Stabilisation can potentially reduce in size for both capacity cases. Another potential impact is that after revision in the design basis both the Condensate Stabiliser and the Stabiliser Overhead Compressors will receive significantly reduced volumetric vapour flow raising a doubt on centrifugal type machine selection for all of the capacity cases. More detailed investigation with close interaction with vendors is suggested in the next project phase. The Mercury Removal Unit (U1100) catalyst bed is designed for a 3 year change-out period in line with the plant shutdown cycle. The bed sizes are within referenced limits for all the cases and could be further optimised with vendor interaction in the next project phase. The Acid Gas Removal Unit (U1200) has been simulated in-house using Promax, duly benchmarked using BASF OASE package licenced to KBR. The estimated solvent circulation flow rates are on the low side in line with the low CO2 concentration in the feed gas. Although the Acid Gas Absorber column size is large, it is still within KBR references. Equipment sizes on the solvent regeneration side have been kept the same for simplicity due to the minor variation in solvent flow rate between various options. In the next project	Помимо конструкции установки сжижения, прозводительность влияет на дизайн входных сооружений, теплого узла, ШФЛУ, а также вспомогательных систем. Конструкция оборудования для этих установок в основном зависит от объемного расхода и/или массового потока сырьевого газа, который незначительно отличается между четырьмя вариантами 5,5 млн т/год. Таким образом, дизайн оборудования одинаков для всех вариантов 5,5 млн т/год на данном этапе проекта. Эти основные принципы относятся и к 7,5 млн т/год. Размеры оборудования входных сооружений и стабилизации конденсата (U1000) для вариантов 5,5 млн т/год попадают в диапазон работы для текущих производств. Даже после масштабирования на 7,5 млн т/год размеры оборудования находятся в диапазоне опыта КБР. Установка стабилизации конденсата была спроектирована для гораздо больших потоков жидкости на предыдущих этапах. Благодаря пересмотру состава сырья на этапах 2 и 3, потоки жидкости значительно снизились. Тем не менее, для проектирования оборудования было решено сохранить тот же базис, который использовался на предыдущих этапах. В результате, оборудование стабилизации конденсата может потенциально уменьшиться в размерах для обоих случаев мощности. Другое потенциальное изменение состоит в том, что после пересмотра основ для проектирования для установки стабилизации конденсата, компрессор выходящих газов получит значительно меньший объемный поток паров, вызывая сомнение относительно выбора машины центробежного типа для всех случаев мощности. Более подробное исследование вместе с тесным сотрудничеством с поставщиками предлагается в следующей фазе проекта. Слой катализатора установки удаления ртути (U1100) расчитан на 3-х летний срок эксплуатации в соответствии с циклом останова завода. Размеры слоев катализатора находятся в пределах уже использующихся для всех вариантов и может быть дополнительно оптимизирован после плотной работы с поставщиками в следующем этапе проекта. Установка удаления кислых газов (U1200) была смоделирована в офисе с помощью Pгotax, должным образом протестированные с помощью приложения BASF OASE, лицензия которого имеется у KBR. Расчетные скорости потока циркуляции раствора низкие, в соответствии с низкой концентрацией CO2 в сырьевом газе. Хотя размер абсорбера кислого газа большой, он по-прежнему не выходит за границы нормативов KBR. Размеры оборудования в части регенерации были оставлены одинаковыми из-за незначительных различий в

phase licensor inputs need to be obtained for optimised equipment sizes. The main equipment items in the Dehydration Unit (U1300) are sized for 3 year change-out period in line with the plant shutdown cycle. The bed size for the 5.5 MTPA options is close to that for projects with similar capacity and has been scaled up for 7.5 MTPA option.For the selected bed dimensions the bed diameter is high in proportion to the bed height, particularly for 7.5 MTPA cases. As this could potentially lead to very high regeneration gas flow rates to avoid channelling, the dimensions should be optimised further in consultation with the specialist vendors. The key equipment items in the NGL unit are Feed Gas Expander Compressor, Feed Gas Booster Compressor and the Fractionation columns. The Demethaniser top section is normally designed by the gas volumetric flow, while the bottom section and the other three columns are designed by the liquid loading. The Feed Gas Booster Compressor size is large in both the capacity options but lies within the Siemens reference range. The Feed Gas Expander Compressor with 14.4MW load in 7.5 MTPA options has limited operating experiences and is considered as a step-out for a single machine. Installation of two parallel machines is feasible but increases operational complexity. Therefore, the preferred solution would be to reduce the Expander-Compressor load to within referenced limits (~12MW) by optimising the design of the Demethaniser overhead circuit in the next project phase. The size of GBS has not increased in proportion to a rise in capacity from 5.5 MTPA to 7.5 MTPA. For 5.5 MTPA options two LNG tanks are located longitudinal along the central row, while four Condensate tanks are located along the two outer rows. However, for the 7.5 MTPA options, the GBS design has been modified to interchange the location of the LNG and the Condensate tanks in order to maximise LNG storage. As a result, the total LNG storage for 7.5 MTPA options (606000m3) is about 88% of the total storage for 5.5 MTPA options (689000m3).	скорости потока раствора между. На следующем этапе проекта должны быть получены входные данные от лицензиара для оптимизации размеров оборудования. Основные единицы оборудования в установке осушки (U1300) рассчитаны для 3-летнего периода в соответствие с циклом отключения завода. Размер слоя для вариантов 5,5 млн т/год близог к тому, что применялся для проектов с аналогичной мощностью и был масштабирован для варианта 7,5 млн т/год. Для выбранных размеров слоя адсорбента, диаметр слоя больше, чем высота слоя, в частности, для варианта 7,5 млн т/год эта пропорция. Так как это может потенциально привести к очень высоким расходам газа регенерации, чтобы избежать образование каналов, размеры должны быть еще более оптимизированы после консультаций с поставщиками. Ключевым оборудованием в блоке ШФЛУ явлфются турбодетандерный компрессор, дожимная компрессорная станция сырьевого газа и ректификационные колонны. Верхня часть деметанизатора обычно проектируется на объемный поток газа, в то время как нижняя секция и остальные три колонны рассчитаны для загрузки жидкости. Компрессор сырьевого газа больших габаритов для обоих вариантов производительности, но находится в пределах норм размеров Siemens. Турбодетандерный компрессор мощностью 14.4 МВт в варианте 7,5 млн т/год имеет ограниченный опыт эксплуатации и рассматривается выходящий за пределы для одной машины. Установка двух параллельных машин возможна, но увеличивает сложность эксплуатации. Поэтому предпочтительным решением было бы снизить нагрузку турбодетандера в пределах упомянутых ограничений (~ 12 МВт) за счет оптимизации верхней части деметанизатора на следующем этапе проекта. Размер ОГТ не увеличился пропорционально увеличению производительности от 5,5 млн т/год до 7,5 млн т/год. Для вариантов 5,5 млн т/год две резервуара СПГ расположены продольно вдоль центрального ряда, а четыре резервуара конденсата расположены вдоль двух внешних рядов. Однако для вариантов 7,5 млн т/год конструкция ОГТ была изменена, чтобы поменять местами резервуары СПГ и конденсата с целью увеличения объемов хранения СПГ. В результате общий объем хранения СПГ для вариантов 7,5 млн т/год (606000

As currently planned the GBSs will be commissioned progressively with an interval between them of approximately one year. For the 5.5 MTPA options during the first year of GBS 1 operation the total LNG available storage would be 229 600m3. As a result, the buffer volume of 59 600m³ (difference between GBS LNG storage and LNG carrier size) provides for just over a single day of GBS 1 operation. In other words, if a carrier is delayed by more than a day the LNG production will need to be stopped as the storage tanks will be full. Post start-up of second GBS the buffer volume would provide for about 3.7 days of shipping delays and once all the GBSs start operation the buffer volume would provide for 4.5 days of shipping delays. For the 7.5 MTPA options the situation is more manageable post start-up of the first GBS as the buffer volume would provide for about 2.5 days of shipping delays. After both the GBSs are in operation the buffer volume would provide for about 4.1 days of shipping delays. In short, for the 5.5 MTPA single GBS operation due to lower buffer volume available there exists more likelihood of LNG production turndown or shutdown due to shipping delays as compared with the 7.5 MTPA options. In the case of Condensate product there is ample storage volume available in all the options providing sufficient buffer volume for the shipping delays, even during first year of operation with single GBS. As mitigation for 5.5 MTPA options, it is currently under consideration to swap the LNG tanks with Condensate tanks to obtain more LNG storage capacity in the next phase if a 3 x 5.5 MTPA design is progressed.	м3) составляет около 88% от общего объема хранения для вариантов 5,5 млн т/год (689 000 м3). Как планировалось, ОГТ будут введены в эксплуатацию постепенно с интервалом между ними примерно один год. Для вариантов 5.5 млн т/год в течение первого года работы ОГТ1 общий доступный объем хранения СПГ будет составлять 229 600 м3. В результате буферный объем 59 600 м3 (разница между объемом хранения СПГ и вместимостью танкера СПГ) обеспечивает чуть более одного дня работы ОГИ. Другими словами, если танкер задерживается более чем на один день, производство СПГ должно быть остановлено, поскольку емкости хранения будут заполнены. После пуска ОГТ2 буферный объем будет обеспечивать около 3,7 дней задержки танкера, и когда будут эксплуатироваться все ОГТ, буферный объем будет обеспечивать 4,5 дней задержки отгрузки. Для вариантов 7,5 млн т/год ситуация более управляемая после запуска первого ОГТ т.к. буферный объем обеспечит около 2,5 дней задержки доставки. После того как оба ОГТ будут введены в эксплуатацию буферный объем будет обеспечивать около 4,1 дней задержки отгрузки. Другими словами, для вариантов 5,5 млн т/год с одним ОГТ из-за меньшего объема буфера, существует большая вероятность останова или снижения производства СПГ из-за задержек отгрузки, по сравнению с вариантами 7,5 млн т/год. В случае конденсата имеется более чем достаточных объема для хранения для всех вариантов, обеспечивающих достаточный буферный объем для задержки отгрузки, даже в течение первого года работы с единственным ОГТ. В качестве меры по снижению последствий для вариантов производительностью 5,5 млн т/год в настоящее время рассматривается возможность поменять резервуары СПГ местами с резервуарами конденсата, чтобы обеспечить большую вместимость хранилищ СПГ на следующем этапе, если будет принято решение о продолжении работы по варианту с производительностью 3 x 5,5 млн т/год.
Flare The HP Warm Wet and the HP Cold Dry Flare Stacks are common for all the GBSs in all the eight options and are located onshore.	Факел Теплый влажный факел ВД и холодный сухой факел ВД являются общими для всех ОГТ во всех восьми вариантах и расположены на берегу. Холодный сухой

The LP Cold Dry Flare (BOG and the Cold vent are located on each GBS. In all of the options the cold dry flare system is sized based on the blocked discharge of the MR compressors that results in highest relief flow to flare. For the DMR cases it is estimated to be the HP CMR Compressors and for the MFC cases the MR1 Compressors. Due to the higher refrigerant flows the HP Cold Dry Flare system capacity is likely to be moderately higher (10 to 15%) for the DMR options, as compared with the corresponding MFC cases. The warm wet flare system is sized for the failure of one let down valve in the inlet pressure let down station at the GBS battery limit. The resultant flow is likely to be the similar for all the 5.5 MTPA options and proportionately higher for all the 7.5 MTPA options. The BOG flare is sized based on the loss of the BOG compressors during loading mode operation. The flare system capacity is within a close range for all the eight options. The LNG storage tanks relief valves located over the tank gas dome will relieve into the cold vent for release to atmosphere at a safe location, rather than the LP Cold Dry flare. Vapours evolved from the LNG tanks are normally routed to the BOG header. Excess BOG will be routed to the LP Flare system and ultimately can be vented to atmosphere via the Cold Vent. As per the Stage 2 Emergency Depressurisation Philosophy G098-KBRKCS-DOC-0049, the emergency blowdown will be staggered on module basis to ensure that the flare capacity set by the relief cases is not exceeded. However, more detailed work is required in the next project phase to ensure practical implementation of this philosophy.	факел НД (факел отпарных газов) и холодная свеча расположены на каждом ОГТ. Во всех вариантах параметры сухого холодного факела рассчитываются, исходя из случая закрытия выхода компрессора смешанного хладагента, что приводит к самому большому сбросу в факел. Для вариантов DMR, по нашим оценкам, это будут компрессоры холодного смешанного хладагента ВД, а для вариантов MFC это будут компрессоры MR3. Из-за более высоких потоков хладагента в (см. табл, xxx) пропускная способность системы холодного сухого факела ВД, вероятно, будет незначительно выше (на 10 15%) для вариантов DMR, по сравнению с соответствующими вариантами MFC. Факельная система теплых влажных сбросов рассчитана на отказ одного спускного клапана на стороне высокого давления станции понижения давления на границе ОГТ. Весьма вероятно, что полученный поток будет аналогичным для всех вариантов 5,5 млн т/год и пропорционально выше для всех вариантов 7,5 млн т/год. Факел отпарного газа рассчитывается на основании отказа компрессоров отпарного газа во время работы в режиме загрузки. Производительность факельной системы находится в узком диапазоне для всех восьми вариантов. Предохранительные клапаны системы хранения СПГ, расположенные сверху газового хранилища, будут осуществлять сброс на холодную свечу в атмосферу в безопасное место, а не в холодный сухой факел НД. Пары от емкостей СПГ штатно направляются на коллектор отпарного газа. Избыток отпарного газа может быть отправлен в систему факела низкого давления и затем выведен в атмосферу через холодную свечу. В соответствии с основными принципами сброса давления Этапа 2 G098- KBRX-flOK-0049, аварийный сброс будет произведен по очереди с каждого модуля для того, чтобы производительность факела, установленная для определенных случаев, не была превышена. Тем не менее, более детальная работа потребуется на следующем этапе проекта, чтобы обеспечить практическую реализацию этих основных принципов.
Refrigerant Compressor Drivers (Gas Turbines versus Electric Drives)	Приводы компрессоров хладагента (газовые турбины и электрические двигатели)

In the Driver Selection Report KBR (and Linde) have concluded that the Siemens Trent 60 will be the selected driver for the refrigerant compressors in all the GT driven options and for power generation in Options 1 and 3. Although use of this GT model is proven for power generation and as a mechanical drive (15 references), the Trent 60 has not yet been used for driving refrigerant compressors in the LNG industry or in any continuous baseload operation where sparing is not provided.	В отчете по выбору приводов KBR (и Linde) пришли к выводу, что Siemens Trent 60 будет выбран в качестве привода для холодильных компрессоров вариантов с приводами ГТ и выработки электроэнергии в вариантах 1 и 3. Хотя использование этой модели ГТ доказано для выработки электроэнергии и в качестве механического привода (15 ссылок), Trent 60 до сих пор не использовался в качестве привода компрессоров хладагента в отрасли СПГ или в каких-либо работах с непрерывной базовой нагрузкой без резервирования мощностей.
In Options 2 and 4 the required rating for the VSD electric motors (51 to 55MW) is within the proven range. However, in Options 6 and 8 the required motor rating for the VSD electric motors (68 to 70MW) is a slight step-out from the past references, with VSD EMs up to only 65MW proven till now.	В вариантах 2 и 4 необходимая номинальная мощность электродвигателей с регулируемой скоростью (51 до 55 МВт) находится в пределах проверенного диапазона. Однако в вариантах 6 и 8 требуемая мощность электродвигателей с регулируемой скоростью от 68 до 70 МВт немного выходит из пределов использования в последних случаях применения, на сегодняшний день проверены электродвигатели с регулируемой скоростью только до 65 МВт.
One of the key drivers of the Arctic LNG Project is to minimise onshore construction in the harsh arctic environment. However, in all the options under consideration there is a requirement to construct a power generation facility of varying size onshore.	Один из ключевых факторов проекта Арктик СПГ является сведение к минимуму строительство на суше в суровых арктических условиях. Тем не менее, во всех рассматриваемых вариантах существует требование по строительству на берегу электростанции различных размеров. Варианты 1 и 3 (5,5 млн т/год ГТ) имеют выработку электроэнергии на ОГТ, но по-прежнему требуют небольшой электростанции на берегу, чтобы выполнить требование по энергоснабжению береговых объектов. Все варианты с электроприводом компрессоров хладагента требуют электростанции 1100 МВт на берегу.
Options 1 and 3 (5.5 MTPA GT driven) have power generation on-board GBS, but still require a small power plant onshore to fulfil the Onshore Facility power demand.	
All the options with electric motor driven refrigerant compressors require a 1100MW power plant onshore.	
Although Options 5 and 7 are GT driven the size of the required power generation facility is too large for GBS installation and therefore has been located onshore.	Хотя Варианты 5 и 7 основаны на ГТ, размер необходимой энергоцентра является слишком большим для установки на ОГТ и поэтому его разместили на берегу.
The onshore power generation, except for the Options 1 and 3, increases construction difficulty but also comes with the following advantages. It is based on combined cycle and hence more efficient with relatively low HP fuel gas consumption. The Electric Motor driven options have better availability than the GT driven options, less maintenance outages mainly due to use of industrial GTs for power production rather than aero derivatives.	Выработка электроэнергии на берегу, кроме Вариантов 1 и 3, увеличивает сложность строительства, но при этом обладает следующими преимуществами. На электростанции используется комбинированный цикл, что позволяет повысить ее КПД при относительно низком потреблении топливного газа высокого давления. Варианты с использованием электродвигателей в качестве приводов обладают более высокой эксплуатационной готовностью, чем варианты с газотурбинными приводами и требуют меньшего количества остановок для технического обслуживания, главным образом в силу

The other difference between the EM and GT driven options is in the utility demand. The HP fuel gas consumption (for Gas Turbines) is generally lower in the Electric Motor driven options than the GT driven options owing to combined cycle power generation. However, due to increase in the LP fuel gas consumption for the EM driven cases, mainly for heating medium fired heater duties, the overall fuel consumption stands higher for the EM driven cases. All hot oil heating for the EM Options is provided by LP fuel gas fired furnaces. For the EM driven options, the opportunity exists to integrate the Combined Heat and Power with the Brash Ice Management System. Low grade heat rejected at the surface condensers of the steam turbines can be redirect to the port to ensure that it is kept free of brash ice during the winter months.	использования промышленных газотурбинных агрегатов вместо газотурбинных агрегатов на базе авиационных двигателей. Другое различие между вариантами с приводами ЭД и ГТ в требовании вспомогательных средств. Расход топливного газа ВД (для газовых турбин), в целом ниже в вариантах с приводами от электродвигателей чем с ГТ благодаря электростанции комбинированного цикла. Тем не менее, вследствии увеличения потребления топливного газа НД топлива для вариантов с электродвигателями, в основном из-за нагрева теплоноситель в печах, общее потребление топливного газа оказывается выше для вариантов с электродвигателями. Весь нагрев масляного теплоносителя для вариантов с использованием электрических приводов обеспечивается огневыми нагревателями, работающими на топливном газе низкого давления. Для вариантов с электрическими приводами имеется возможность интегрировать электростанцию комбинированного цикла с системой управления ледовой обстановкой. Низкотемпературное тепло, отводимое с поверхностных конденсаторов паровых турбин, может быть направлено в порт для обеспечения очистки акватории от ледяной каши в зимние месяцы.
Availability A high level availability study has been carried out to estimate availability of various options relative to Option 1, which was considered as a base case with 88% availability. As the design of the Inlet Facility, Mercury Removal, AGRU, Dehydration and NGL units is the same for all the options, the difference in availability is mainly owing to the difference in the liquefaction unit configuration. The biggest contributor to non-availability in Option 1 is the refrigeration system which includes multiple GTs. Each GT has significant downtime due to scheduled maintenance in addition to equipment failure. In Option 2 the GTs in the refrigeration system are replaced with electric motors with improved failure data and minimal individual scheduled maintenance requirement.	Эксплуатационная готовность Общее исследование эксплуатационной готовности было проведено для оценки готовности различных вариантов по отношению к варианту 1, который был принят в качестве базового с готовностью равной 88%. Поскольку проекты входных сооружений, установки удаления ртути, установки удаления кислых газов, осушки и ШФЛУ одинаковые для всех вариантов, разница в эксплуатационной готовности, в основном, из-за разницы в конфигурации установки сжижения. Самый большой вклад в неготовность в варианте 1 вносит система охлаждения, которая включает в себя несколько газовых турбин. Каждая газовая турбина имеет значительное время простоя из-за планового ремонта в дополнение к неисправности оборудования. В варианте 2 газовые турбины в системе охлаждения заменены электродвигателями с улучшенными показателями отказа и минимальным требованием к индивидуальному плановому ремонту. Эти два фактора могут

These two factors could potentially result in a gain in availability of greater than 2% over the base case. However, power generation has been excluded from the availability analysis. Therefore, factoring in the non-availability of upstream facilities, power generation for the motors and limited nature of failure data for large size VSD electric motors, the overall availability for Option 2 is considered as 90%. Option 3 includes an increased amount of equipment compared with Option 1 with an additional compressor in the refrigeration system. This results in a marginal decrease in availability when compared to Option 1. However, for practical purpose the availability is considered as same. Also, the availability of Option 4 is considered same as Option 2. Option 5 reduces the number of GBSs from three to two but produces approximately the same total amount of product. Although each system / equipment within Option 5 processes more product than in Options 1 to 4, the failure rates for individual equipment items do not change (i.e. equipment size make no difference to failure data). However, the increased capacity of the warm MR trains (from 50 60%) increases the availability of Option 5 by about 0.5% compared with Option 1. This increase also includes the reduced amount of restart time required due to the Cold MR trains being configured as 3 x 33% when compared to 2 x 50%. Options 6 and 8 have same configuration as Options 2 and 4 respectively resulting into same availability. The annualised LNG production for GT and EM options is the same. The lower GT availability is offset by higher instantaneous production.	потенциально привести к выигрышу в эксплуатационной готовности более 2% по сравнению с базовым сценарием. Однако производство электроэнергии не учитывалось при проведении анализа эксплуатационной готовности. Таким образом, с учетом неготовности систем, расположенных выше по технологическому потоку, и электрогенераторов, питающих электродвигатели, а также ограниченного объема данных по отказам для больших электродвигателей с регулируемой скоростью, общая эксплуатационная готовность для Варианта 2 принята равной 90%. Вариант 3 включает в себя увеличение количества оборудования по сравнению с вариантом 1 с дополнительным компрессором в системе охлаждения. Это приводит к очень незначительному уменьшению в показателе готовности по сравнению с вариантом 1. Однако для практических целей показатель эксплуатационной готовности рассматривается как равный. Также готовность в Вариант 4 считается такой же, как в варианте 2. Вариант 5 уменьшает количество ОГТ стрех до двух, но производит примерно такое же общее количество продукта. Хотя каждая система / оборудование в варианте 5 производит больше продукта, чем в вариантах 1- 4, количество отказов для каждого оборудования не изменится (т.е. размер оборудование не влияет на данные об отказе). Тем не менее, повышение производительности линий теплого хладагента (с 50 - 60%) повышает готовность Варианта 5 примерно на 0,5% по сравнению с вариантом 1. Это увеличение включает в себя также уменьшенное количество времени перепуска линий холодного хладагента с конфигурацией 3 x 33% холодной по сравнению с конфигурацией 2 x 50%. Варианты 6 и 8 имеют такую же конфигурацию как Варианты 2 и 4 соответственно, что ведет к одинаковым показателям эксплуатационной готовности. Годовая выработка СПГ на вариантах ГТ и ЭД одинакова. Менее высокая эксплуатационная готовность ГТ компенсируется более высокой мгновенной производительностью.
GBS	ОГТ

GBS elements applicable for technical discussions are such elements, like nonquantities, not directly measured through cost. For the GBS, the following two elements are identified for technical discussion: a) GBS dimensions b) GBS weight margins Both these elements are considered critical related to Ob Bay ship channel. 55 km of the channel will be dredged to a seabottom width of 295 m and a water depth of - 14.15 (LAT).	К элементам ОГТ, требующим технического обсуждения/ пояснения, относятся аспекты, не подлежащие количественной оценке, которые невозможно напрямую оценить сточки зрения стоимости. Что касается ОГТ, для технического обсуждения были определены следующие два аспекта: a) Размеры ОГТ b) Запасы по весу ОГТ Оба эти аспекта считаются принципиально важными сточки зрения судоходного канала Обской губы. Настоящий канал, 55 км, будет проложен путём дноуглубления до - 14,15 (НТУ) с расширением до 295м в районе морского дна.
GBS Dimension One key challenge for the GBS concept is the Ob bay channel depth to be dredged to 14.15m LAT. This depth limits maximum draft of the GBS to 13.35m to allow a margin for safety during the tow. This draft constraint, combined with the overall required topside layout area as well as the storage volumes required in GBS units, dictates the overall sizing requirements of the GBS. This means that the width of the GBS units for options 1, 3 and 5 to 8 are slightly above the limit. The width limitation of the GBS is based on the channel width of the dredged channel (295m). Based on general guidelines (best practice) the channel width should be minimum 2x width of the structure. In principle, since the width of the channel is 295 m, the max GBS width should be not more than 148m. This means that the width of the GBS units for options 1, 3 and 5 to 8 with side cantilever are slightly above the limit. Measures to mitigate the GBS width for towing in the channel will be:	Размеры ОГТ Одним из проблемных аспектов концепции ОГТ является необходимость дноуглубления судоходного канала Обской губы до отметки 14,15 НТУ. Данная глубина ограничивает максимальное значение осадки ОГТ, обеспечивающее достаточный запас для безопасной буксировки, до 13,35 м. Общие требования к размерам ОГТ определяются ограничениями по осадке вкупе с общей потребной площадью под верхние строения, а также необходимыми объёмами хранилищ в ОГТ. Из этого следует, что ширина ОГТ для вариантов 1, 3 и с 5 по 8 несколько больше. Ограничения по ширине ОГТ определяются шириной углубленного судоходного канала (295 м). Исходя из общих рекомендаций (лучших общепринятых практик), ширина судоходного канала должна составлять как минимум две ширины конструкции. В общей сложности, поскольку ширина канала составляет 295 м, максимальная ширина ОГТ не должна превышать 148 м. Из этого следует, что ширина ОГТ для вариантов 1,3ис5по8с бортовым кантилевером являются немного превышает заданную величину.

Weather restricted operation. Limited towing duration; planned 15 hours. Additional towing assistance, with tractor tugs attached to the GBS for increased side control. Measures to mitigate GBS width will be additional towing assistance and more restricted weather conditions for the towing window through the ship channel. Additional towing assistance is applicable, but is considered only to mitigate relative small deviations. Increased weather restrictions for a planned towing duration of 15 hours is considered as too risky, when considering that all delays in GBS installation is critical due to the Arctic condition and "summer season" of only 10 weeks.	Для снижения рисков, связанных с шириной ОГТ при буксировке по судоходному каналу следует учесть и применить следующее: Операция, имеющая погодные ограничения Ограниченное время для буксировки; отводится 15 часов Потребуется дополнительное буксирное сопровождение: буксиры- тягачи, сцепленные с ОГТ - усиление бокового контроля удерживания ОГТ. Для решения вопросов, связанных с шириной ОГТ, при буксировке будут применяться дополнительные вспомогательные средства, кроме того, будут наложены дополнительные ограничения на погодные условия в период буксировки по судоходному каналу. Дополнительные буксировочные вспомогательные средства применимы, но их использование рассматривается только в целях нивелирования относительно незначительных отклонений. Ужесточение погодных ограничений для планируемой продолжительности буксировки, составляющей 15 часов, считается слишком рискованным, поскольку все задержки при установке ОГТ критичны в силу арктических условий и с продолжительностью «летнего сезона», составляющей лишь 10 недель.
The GBS length limitation is governed by wave induced bending moment during tow. Simplified calculations show that 320 m is close to an absolute length limit. This means that 7.5 MTPA options (5 to 8) with a top slab length of 320m have less robustness than the 5.5 MTPA options with 300m length.	Ограничения по длине ОГТ определяются изгибающим моментом от волны во время буксировки. Согласно упрощённым расчётам, значение 320 м близко к абсолютному максимуму длины. Это означает, что варианты с производительностью 7,5 млн. тонн в год (5-8) с длиной верхней плиты 320 метров менее надёжны, чем варианты с производительностью 5,5 млн. тонн в год и длиной 300 м.
Measures to mitigate GBS length increase above 320 m is (as discussed in the Stage 3 Final Report) to increase the height of the GBS, which will increase the maximum draft and accordingly require more dredging to increase water depth in the ship channel. Other mitigations to optimize the topside layout are; a) Increase use of module cantilever b) More condensed topside layout.	Для решения вопросов, связанных с увеличением длины ОГТ до значений, превышающих 320 м, как пояснено в Итоговом отчёте по этапу 3, применяется увеличение высоты ОГТ, которое увеличит максимальную осадку и, соответственно, потребует больших объёмов дноуглубления для увеличения глубины судоходного канала Другими вариантами мер для оптимизации компоновки верхних строений являются: a) Увеличить использование модульной конструкции кантилевера b) Уплотнить компоновку верхних строений

Finally, from a construction point of view and also operability point of view, side cantilever will increase complexity related to: a) Access/crane utilization during construction. b) LNG Carrier offloading and berthing arrangements. However, such issues are reflected in the cost estimates.	Наконец, сточки зрения строительства и эксплуатации, конструкция боковых кантилеверов будет усложнена в связи с: a) Доступом/использованием кранов в процессе строительства b) Системами отгрузки продукта на танкеры СПГ и их швартовки Тем не менее, эти вопросы отражены в оценках стоимости
GBS Weight Margins One key challenge for the GBS concept is the Ob bay channel depth. This draft constraint, combined with the overall GBS and topside weight, dictates the weight capacity of the GBS in floating condition. Measures to increase the weight capacity during floating condition will be to increase the buoyancy or to increase the channel depth. This is already incorporated in all options through use of cantilevers (pontoons). The issue for discussion will be to evaluate available weight margins for the different options and how to mitigate an unforeseen weight increase. Measures to compensate for weight increase: a) Increase amount of cantilever b) Temporary buoyancy tanks for towing through the dredged part of Ob Bay ship channel. c) Increase dredging depth of the channel As stated above, the general measures to compensate for weight increase will be to add on more cantilevers. However, for Options 5 to 8, maximum amount of cantilevers are incorporated in the design. Accordingly, for these cases, temporary buoyancy tanks or increased dredging depth are the applicable measures to compensate for increased weight. To evaluate cost effectiveness of the different measures, a sensitivity case of adding 10 000 tonnes more weight to the GBS for floating condition has been studied.	Ограничения по весу ОГТ Одним из проблемных аспектов концепции ОГТ является необходимость дноуглубления судоходного канала. Общие требования к весу ОГТ на плаву определяются ограничениями по осадке вкупе с общим весом ОГТ и верхних строений. Для увеличения веса на плаву потребуется увеличение плавучести или увеличение глубины канала. Это уже учтено во всех вариантах (использование кантилеверов (понтонов)). Предметом обсуждения будет оценка возможных ограничений по весу для различных вариантов и нивелирование негативного эффекта от непредвиденного увеличения веса. Для компенсации увеличения веса: a) Увеличить количество кантилеверов b) Обеспечить временные спонсоны для буксировки по подвергшемуся дноуглублению участку судоходного канала Обской губы. c) Увеличение глубины дноуглубления Как указано выше, общим методом компенсации увеличения веса является увеличение количества кантилеверов. Тем не менее, для Вариантов 5-8 сам проект подразумевает максимально возможное количество кантилеверов. Соответственно, допустимыми способами компенсации увеличения веса, для данных вариантов являются временные споносоны или увеличение глубины судоходного канала. Для оценки экономической эффективности различных способов была изучена степень влияния увеличения веса ОГТ на плаву на 10 000 тонн.
Increase of Cantilever	Увеличение количества кантилеверов

Cost of cantilever per 10 000 tonnes of net buoyancy has extracted out of the GBS cost estimate and presented below.	Стоимость кантилевера на 10 000 тонн чистой плавучести не учитывалась в оценке стоимости ОГТ и представлена ниже.
Temporary Buoyancy Tanks	Временные спонсоны
Two units are planned for, each consisting of a 3-cylinder cluster, with diameter 6 m and length 72 m. Weight of each cluster unit is approx. 1400 tonnes. Net buoyancy of each unit of 5000 tonnes, gives an extra buoyancy of 10 000 tonnes for the two units.	Планируется два временных спонсона, из 3 цилиндрических кластеров диаметром 6 м и длиной 72 м каждый. Вес каждого кластера составляет примерно 1 400 тонн. Чистая плавучесть каждой единицы в 5 000 тонн обеспечивает плавучесть в 10 000 тонн для двух спонсонов.
Construction: The units can be constructed at several construction places and towed to location. However, it is assumed that the most cost-effective way is to perform the construction in GBS dry dock with the following reason Utilize infrastructure and work force on site No extra transport. No heavy lift crane is necessary. The units will be floated up when water filling the dry dock.	Производство: Спонсоны могут изготавливаться на нескольких площадках и затем буксироваться на место назначения. Тем не менее, наиболее экономически эффективным считается их изготовление в сухих доках на верфи. Это связано с: Использованием инфраструктуры и персонала данной производственной площадки Отсутствием необходимости в дополнительной транспортировке Отсутствием необходимости в кранах большой грузоподъёмности. Спонсоны всплывут при затапливании сухого дока
Equipment Buoyancy units: Bulkheads for strength and ballasting purpose Mechanical equipment for ballasting and de-ballasting operation Heavy duty brackets and bracings for connection and tensioning to the GBS. Towing and mooring brackets GBS: Heavy duty brackets and special design elements on GBS.	Оборудование Единицы оборудования для обеспечения плавучести: Переборки, обеспечивающие прочность и стабилизацию Механическое оборудование для балластировки и дебалластировки Высокопрочные скобы и раскосы для подсоединения и натяжения ОГТ Буксирные и швартовные скобы ОГТ: Высокопрочные скобы и специализированные элементы на ОГТ Направляющие для позиционирования спонсонов на ОГТ

Guides for positioning the buoyancy units to GBS	
Operation The Buoyancy units will be towed from construction location to the estuary of Ob bay by ocean going tractor/harbour tugs. Before the GBS enters into the dredged channel the buoyancy units will be connected to the GBS with the following step by step process: Ballasting the units to gain neutral submerged equilibrium. By means of the tractor tugs manoeuver the buoyancy units into position and connect to GBS wall. De-ballast the units to gain full buoyancy, and reduce the GBS draft. The units will stay connected until the GBS is through the dredged channel where they will be reconnected in opposite way than installation.	Эксплуатация Споносоны будут буксироваться с производственной площадки в устье Обской губы спомощью океанских\ портовых буксиров. До входа ОГТ в проложенный судоходный канал, к нему подсоединяются спонсоны. Это происходит в описанной ниже последовательности: Балластировка спонсонов для нейтрального равновесия в полупогружённом состоянии С помощью маневрирования азимутальных буксиров достигается необходимое положение и соединение со стеной ОГТ Дебалластировка спонсонов для достижения максимума плавучести, уменьшение осадки ОГТ. Спонсоны остаются присоединёнными к ОГТ до конца буксировки по проложенному судоходному каналу, по окончании которой они отсоединяются в порядке, обратном порядку установки.
Storage and re-use: After installation of the first GBS the buoyancy units can be towed back to GBS construction site for storage, or they can be stored in a suitable location in Ob bay.	Хранение и повторное использование. После установки первого ОГТ спонсоны могут быть отбуксированы обратно на Стройплощадку ОГТ либо оставлены на хранение на подходящем для этих целей участке Обской губы.
Increased dredging depth Area of increased dredging is the ship channel and the terminal access channel/port. The ship channel area is 55 km x 300 m = 16,5 mill. m², while the terminal access channel/port is approximately 20 km x 300 m = 6 mill. m².	Увеличение глубины дноуглубления Зона большего объёма дноуглубления находится в районе судоходного канала и подходного канала. Площадь судоходного канала составляет 55 км x 300 м = 16,5 млн м2, тогда как площадь подходного канала терминала\порта составляет приблизительно 20 км x 300 м = 6 млн м2.

Parameters / Параметр для сравнения	Water Plane Area, Towing	Additional draft required for 10 000 tonnes	Additional Dredging Volume; Ship Channel Дополнительный объем дноуглубления	Additional Dredging Volume; Terminal Access Channel/Port	Total Additional dredging volume

	Площадь водной поверхности для этапа буксировки	Дополнительная осадка для дополнительных 10 тыс. тонн веса	для морского судоходного канала	Дополнительный объем дноуглубления для подходного канала к Порту	Общий дополнительный объем дноуглубления
Units / Единицы измерения	m2/м2	m/м	Million m3/млн. м3		
Options / Варианты 1, 3	45800	0.22	3.64	1.31	4.95
Options / Варианты 2, 4	41700	0.24	3.99	1.44	5.43
Options / Варианты 5... 8	52500	0.19	3.17	1.14	4.31

Cost estimates of the 3 mitigations have also been assessed and compared. As can be seen, the cost difference is marginal. Buoyancy tank solution is considered less attractive since the connection/disconnection of the tanks are scheduled as a 2 days operation in a time critical period during GBS installation. Increased cantilever is at this stage applicable only for Options 1 to 4. Accordingly, increased dredging is from an overall technical, cost and schedule perspective the most attractive mitigation for weight increase. Note, that this mitigation would postpone the need for maintenance dredging and that such savings are not included.	Сравнительная оценка затрат на работы по дноуглублению показала, что разница между вариантами в стоимости соответствующих работ не имеет определяющего значения. Техническое решение с применением спонсонов является менее выгодным т.к операция по соединению/ разъединению баллонов занимает 2 дня, приходящиеся на критический период работ по установке ОГТ. Увеличение количества кантилеверов, на данном этапе, применимо только для Вариантов 1-4. Соответственно, с технической точки зрения, сточки зрения экономичности и графика, увеличение глубины является наиболее выгодным решением по нивелированию рисков, связанных с увеличением веса. Следует отметить, что такие меры увеличат сроки между периодическим проведением планового дноуглубления, и что экономия средств, в результате этого, не учитывалась при оценке общих затрат.
CONCLUSION AND RECOMMENDATIONS	ВЫВОДЫ И РЕКОМЕНДАЦИИ
The objective of the study was to analyse the benefits and risks associated with each of the eight options available to enable the following key decisions to be taken: LNG GBS Capacity: 3 x 5.5 MTPA vs 2 x 7.5 MTPA	Задача исследования заключалась в анализе преимуществ и рисков, связанных с каждым из восьми вариантов, для принятия следующих основных решений: Производительность ОГТ по СПГ: 3ОГТ по 5,5 млн т/г в сравнении с 2 ОГТ по 7,5 млн т/г

Refrigerant Compressor Driver: Electric motor or Gas Turbine driven Liquefaction Technology Provider: APCI DMR or LE MFC An evaluation matrix has been prepared to score each option under consideration over various categories to differentiate between the options. Each of the categories has been assigned a weighting to account for its relative importance in the final decision. The scores within each category have initially been grouped together into Technology Risk and Execution and Operations Risk. An overall score has then been determined by combining the grouped scores in a 70:30 ratio, in favour of the Execution and Operations Risk. This ratio recognises the fact that many of the Technology Risks can be adequately managed during the FEED phase provided suitable mitigation plans are in place across all high risk aspects of the project. The CAPEX and operational risks have been assigned a higher weighting in line perceived risks of construction and installation of the GBS within the remote Arctic. It is recognised that Execution and Operations Risks have the potential to have greater financial consequences on the project if not managed proficiently.	Приводы компрессоров системы охлаждения: электрические или газотурбинные Технология сжижения: DMR компании APCI или MFC компании LE Подготовлена оценочная таблица для оценки в баллах каждого из рассматриваемых вариантов по различным категориям для определения различий между вариантами. Каждой из категорий присвоен весовой коэффициент, отражающий её относительную значимость при принятии итогового решения. Баллы по каждой категории изначально сгруппированы по технологическому риску и риску реализации и эксплуатации. Общее количество баллов определялось по сумме сгруппированных баллов в соотношении 70:30, в пользу риска реализации и эксплуатации. Это соотношение учитывает тот факт, что многие из технологических рисков могут быть надлежащим образом взяты под контроль на этапе предварительного проектирования (FEED), при условии наличия соответствующих планов уменьшения рисков, связанных с со всеми аспектами проекта, сопряженными с высоким уровнем риска. Капитальным затратам и эксплуатационному риску присвоен больший вес в связи с осознаваемым риском при строительстве и установке ОГТ в удаленном арктическом регионе. Учитывается, риски реализации и эксплуатации потенциально имеют более серьезные финансовые последствия для проекта, если не будет обеспечено должное управление ими.
The evaluation of the options available focussed on four critical aspects of the LNG GBS concept to aid in selecting the most suitable design for the challenging Arctic environment. The evaluation placed greatest emphasis on the following elements: Total CAPEX (including onshore power generation if applicable) EPCI Schedule Technology selection GBS design and construction	Оценка вариантов сконцентрирована на четырех важных аспектах концепции завода СПГ на ОГТ с целью выработки наиболее приемлемых проектных решений для сложных условий Арктики. Основное внимание при оценке уделено следующим элементам: Общие капитальные затраты (включая выработку электроэнергии на берегу, если будет выбран этот вариант) График проектирования, МТО, строительства и монтажа Выбор технологии Проектирование и строительство ОГТ

There are many other aspects that differentiate between the options available but the parameters listed above are deemed to have a major bearing on the success of the project throughout the definition and execution phases.	Присутствуют и многие другие аспекты, различающие варианты, но перечисленные выше параметры считаются оказывающими основное воздействие на проект на этапах определения и реализации проектных решений.
LNG GBS Capacity The Stage 3 study evaluated two capacities for the GBS concept. The 3 x 5.5 MTPA GBS options match the Yamal LNG facility production but need 3 GBS to be constructed, transported and integrated at the site. The 2 x 7.5 MTPA option only utilises 2 GBS but have a 36% larger capacity per GBS. The evaluation concluded that the 2 x 7.5 MTPA GBS concept is favourable primarily due to lowest CAPEX per tonnes LNG (10%) and improved construction schedule (1 year). A critical aspect of the GBS constructability is the availability of two dry docks in Murmansk, which drives the selection towards the 7.5 MTPA solution, even though this option represents greater technical risk. The risks associated with the 7.5 MTPA options are related to the scale of the GBS and topsides. The construction of the larger GBS and topsides is undoubtedly more complex and results in smaller weight margins. The increased LNG production capacity adds significant technical risk as these trains will be the largest air cooled LNG trains in the world using the largest CWHEs ever built.	Производительность ОГТ по СПГ В рамках исследования по Этапу 3 выполнена оценка двух уровней производительности установок на ОГТ. Варианты с 3-мя ОГТ производительностью по 5,5 млн т/г соответствуют производственным мощностям «Ямал СПГ-2», но при этом требуется строительство, транспортировка и интеграция на площадке трех ОГТ. Вариант с 2 ОГТ по 7,5 млн т/г использует всего 2 ОГТ, но производительность каждой технологической линии выше на 36%. По результатам оценки сделан вывод о том, что концепция из 2-х технологических линий по 7,5 млн т/г является приемлемой преимущественно благодаря наименьшему размеру капитальных затрат на тонну производимого СПГ (10%) и улучшенному графику строительства (1 год). Критичным аспектом обеспечения технологичности строительства ОГТ является наличие двух сухих доков в Мурманске, что направляет выбор в сторону варианта с уровнем производительности 7,5 млн т/г, даже если этот вариант сопряжен с более высоким техническим риском. Риски, ассоциируемые с вариантами производительностью 7,5 млн т/г, обусловлены размерами ОГТ и верхних строений. Строительство более габаритных ОГТ и верхних строений несомненно является более сложным и характеризуется меньшими запасами по весу. Увеличенная производительность по ОГТ в значительной степени повышает уровень технического риска, так как эти технологические линии будут крупнейшими в мире технологическими линиями СПГ с воздушным охлаждением, использующими крупнейшие когда-либо построенные спиральные теплообменники.
Refrigerant Compressor Driver The evaluation of refrigerant drivers considered aero-derivative gas turbines and electric motor driver options. The gas turbine driver selection study concluded that the most suitable gas turbine is the	Привод компрессора хладагента При оценке приводов компрессоров хладагента рассматривались газотурбинные агрегаты на базе авиационных двигателей и электродвигатели. По результатам исследования по выбору газотурбинных приводов был сделан

Siemens Trent 60, even though this does not have many running hours in continuous baseload service. The evaluation concluded that the GT driven option is preferable due to the avoidance of the large onshore power station and the additional electrical infrastructure that is required to be located on the causeway. The electrical motor driven option has slight advantages with respect to CAPEX and availability but these are outweighed by the risks associated with building and operating a large combined heat and power facility in the deep Arctic region.	вывод, что наиболее приемлемым газотурбинным агрегатом является Trent 60 компании «Siemens», хотя для него и отсутствует опыт длительной эксплуатации при непрерывной базовой нагрузке. Вывод по итогам оценки состоял в том, что вариант с газотурбинными приводами предпочтительнее, поскольку позволяет отказаться от строительства большой электростанции на берегу и дополнительной инфраструктуры электроснабжения, которую потребовалось бы смонтировать на насыпной дамбе. Варианты с электродвигателями имеют небольшое преимущество сточки зрения капитальных затрат и эксплуатационной готовности, но его перевешивают риски, связанные со строительством и эксплуатацией крупной комбинированной теплоэлектростанции в условиях Арктики.
Liquefaction Technology Provider The assessment between DMR and MFC liquefaction processes is predominantly about technical risk. The evaluation of the Liquefaction Technology provider concluded that overall both licensors carry similar levels of risk for the 7.5 MTPA options when consideration is given to manufacturing capability, proven concepts and scale up. Both technology providers adopted differing design philosophies which made direct comparison of the submitted designs more difficult. When the APCI DMR designs are normalised to the same approach temperature as used by the LE MFC process there is little difference in process efficiency between the two technologies. The LE MFC options have been designed to achieve maximum process efficiency while the APCI DMR options have been designed to minimise the air cooler footprint. The difference in design philosophies is not a reflection on the technology itself and either licensed process could be designed to optimise the process efficiency and air cooler footprint. Both approaches are equally valid but it is recommended that detailed air cooler designs are developed in conjunction with a Hot Air Recirculation (HAR) study to optimise the air cooler minimum	Поставщик технологии сжижения Сравнение технологий сжижения DMR и MFC связано преимущественно с техническими рисками. Оценка поставщиков технологии сжижения показала, что в целом для обоих лицензиаров уровни риска для вариантов производительностью 7,5 млн т/год существенно не различаются, учитывая производственные возможности, опыт применения концепции и возможности масштабирования. Поставщики технологии придерживаются разных принципов проектирования, что затрудняет прямое сравнение предложенных проектов. При приведении проекта технологии DMR компании APCI к показателям перепада температур на входе и на выходе аппаратов воздушного охлаждения, принятым для технологического процесса MFC компании LE различия между уровнями эффективности технологий незначительны. Варианты с использованием технологии MFC компании LE проектировались с расчетом на достижение максимального КПД процесса, тогда как варианты с использованием технологии DMR компании APCI проектировались с расчетом на минимизацию площади, занимаемой аппаратами воздушного охлаждения. Разница в подходах к проектированию не может служить отражением технологии в целом, и любой из предложенных для лицензирования технологических процессов может быть спроектирован с учетом оптимизации КПД технологического процесса и площади аппаратов воздушного охлаждения. Оба подхода имеют равное право на существование, но

approach temperature and ensure that sufficient air flow can be provided to the coolers to satisfy the process duty for all prevailing conditions. The optimum design approach is expected to yield an approach temperature between 13°C and 23°C and leave sufficient spare power and air cooler footprint to mitigate for unforeseen design changes. Both licensors are at the forefront of technical innovation but APCI has greater LNG references and proven history in providing step changes in LNG train production capacity. LE have fewer operating LNG references but the MFC process can be tailored to obtain optimum performance over the wide range of conditions encountered at Salmanovskye.	рекомендуется выполнить детальное проектирование аппаратов воздушного охлаждения в сочетании с исследованием по рециркуляции нагретого воздуха с целью оптимизации минимального перепада температур входящего и исходящего воздуха на аппаратах воздушного охлаждения и обеспечения скорости расхода воздуха на аппаратах воздушного охлаждения, достаточной для удовлетворения потребностей технологического процесса при преобладающих условиях. Ожидается, что оптимальный подход к проектированию даст перепад температур на входе и выходе аппаратов воздушного охлаждения в диапазоне от 13°C до 23°C и оставит достаточный запас мощности и площади аппаратов воздушного охлаждения, чтобы смягчить последствия непредвиденных изменений в проекте. Оба лицензиара относятся к числу наиболее инновационных компаний отрасли, однако компания APCI обладает более значительным портфелем проектов в сфере СПГ и доказанной истории поэтапного наращивания производительности технологических линий производства СПГ. В портфеле компании LE меньше действующих предприятий по производству СПГ, однако технология MFC может быть специально приспособлена для оптимальной работы в широком диапазоне условий, имеющихся на Салмановском месторождении.

ANNEX 20

SUMMARY TABLE OF DAMAGE TO WATER BODIES AND RECOMMENDED OFFSET ACTIVITIES FOR ARCTIC LNG 2 PROJECT

Facility type	Facility	Reason, authority	Damage to aquatic biological resources in kind, kg	Offset activities																														
				Muksun			Peled			Sturgeon			Nelma			Broad Whitefish			sterlet sturgeon		Siberian whitefish		Siberian whitefish			Sterlet			Year pf completion	Comment	Approved fish type	weighed portion, g	Fish factory
				Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost, thou. RUR	Number of species	Cost, thou. RUR.	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR					
2015																																		
Field facilities setup of Salmanovsky (Utrenny) OGCF	Early development facilities at SOGCF	Conclusion of FA on fishery	210,89	356 111	11,00	3 917 221																						2015		Muksun	1,9	JSC "Yugorsky fish-breeding plant«»
Hydraulic quarries	Dredged sand quarry №9	Conclusion of FA on fishery	233,97																									2015				
Hydraulic quarries	Dredged sand quarry № 8	Conclusion of FA on fishery	233																									2015				
Hydraulic quarries	Dredged sand quarry №5	Conclusion of FA on fishery																												Muksun	1,5	
Hydraulic quarries	Dredged sand quarry №8	Conclusion of FA on fishery																										2015		Muksun	1,6	FSBI «Glavrybvodp»
Well construction	P-289	Conclusion of FA on fishery	13,97																															
Hydraulic quarries	Dredged sand quarry №10	Conclusion of FA on fishery	310,46																									2015				
TOTAL in 2015				**356 111**	**11**	**3 917 221**																												
2016																																		
Utrenny terminal	Arrangement of berthing facilities at Salmanovsky (Utrenny) oil and gas condensate field	Conclusion of FA on fishery	10 262,000	3 770 037	11,69	44 071 733																						2016		Muksun	1	NPO 'Sob fish-breeding plant"»
Utrenny terminal	Arrangement of berthing facilities at Salmanovsky (Utrenny) oil and gas condensate field	Conclusion of FA on fishery					13 031	2,09	27 235																			2016		Peled	1	NPO 'Sob fish-breeding plant"»
Well construction	Well № P-281	Conclusion of FA on fishery	23,3	809	11,69	9 457																						2016		Muksun	1	JSC "Yugorsky fish-breeding plant«»
TOTAL in 2016				**3 770 846**	**23**	**44 081 190**	**13 031**	**2**	**27 235**																									
2018																																		
Utrenny terminal	Repair dredging works on the water area of the berthing facilities of the Salmanovsky (Utrenny) OGCF	Conclusion of FA on fishery	30 315,000	1 122 777	17,00	19 087 209																						2018		Muksun	0,5	NPO 'Sob fish-breeding plant"»
TOTAL in 2018				**1 122 777**	**17**	**19 087 209**	**13 031**	**2**	**27 235**																									
2019																																		
Field facilties setup of Salmanovsky	PIR 1	Conclusion of FA on fishery № 597-c	480,330												40 028	6,60	264 184,80											2019		Broad Whitefish	0,5	NPO 'Sob fish-breeding plant"»

Facility type	Facility	Reason, authority	Damage to aquatic biological resources in kind, kg	Offset activities																								Year pf completion	Comment	Approved fish type	weighed portion, g	Fish factory
				Muksun			Peled			Sturgeon			Nelma			Broad Whitefish			sterlet sturgeon		Siberian whitefish		Siberian whitefish			Sterlet							
				Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost, thou. RUR	Number of species	Cost, thou. RUR.	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR					
(Utrenny) OGCF		от 03.07 2018 г.																														
Field facilties setup of Salmanovsky (Utrenny) OGCF	PIR 5	Conclusion of FA on fishery	22 878,210													1 906 518	6,60	12 583 018,80										2019	-	Broad Whitefish	0,5	NPO 'Sob fish-breeding plant"»
Hydraulic quarries	Dredged sand quarry №4Н	Conclusion of FA on fishery	410,100													34 175	6,60	225 555,00										2019	-	Broad Whitefish	0,5	NPO 'Sob fish-breeding plant"»
Hydraulic quarries	Dredged sand quarry №5Г	Conclusion of FA on fishery	11 765,540													980 462	6,60	6 471 049,20										2019	-	Broad Whitefish	0,5	NPO 'Sob fish-breeding plant"»
Hydraulic quarries	Dredged sand quarry №9Г. Extention.	Conclusion of FA on fishery	209,270													17 439	6,60	115 097,40										2019	-	Broad Whitefish	0,5	NPO 'Sob fish-breeding plant"»
Hydraulic quarries	Dredged sand quarry №8Г. Extention.	Conclusion of FA on fishery	177,930													14 828	6,60	97 864,80										2019	-	Broad Whitefish	0,5	NPO 'Sob fish-breeding plant"»
Hydraulic quarries	Dredged sand quarry №31Н	Conclusion of FA on fishery	422,620													35 218	6,60	232 438,80										2019	-	Broad Whitefish	0,5	NPO 'Sob fish-breeding plant"»
Well construction	Well № P-297	Conclusion of FA on fishery																										9	No offset activities	Less than 10 kg. No offset is required		
Well construction	Well pad № 16 и № 2	Conclusion of FA on fishery																											No offset activities	Less than 10 kg. No offset is required		
TOTAL in 2019			**36 344,000**													**3 028 668,000**		**19 989 208,800**														
2020																																
Hydraulic quarries	Dredged sand quarry №2н	Conclusion of FA on fishery	815,940	30 220	18,00	543 960							8 118						85 875		114 538								2020		To be clarified	To be clarified	Different variants are considered
Hydraulic quarries	Dredged sand quarry №51н	Calculations	149,305	5 530	18,00	99 537																							2020	It is expected to receive a conclusion from Rosrybolovstvo	To be clarified	1,5	NPO 'Sob fish-breeding plant"»
Hydraulic quarries	Dredged sand quarry №25н	Calculations	151,425	5 608	18,00	100 950																							2020	It is expected to receive a conclusion from Rosrybolovstvo	To be clarified	1,5	NPO 'Sob fish-breeding plant"»
Hydraulic quarries	Dredged sand quarry №11 at Salmanovsky (Utrenny) OGCF	Conclusion of FA on fishery	464,890	17 218	18,00	309 927																							2020		To be clarified	1,5	NPO 'Sob fish-breeding plant"»
Hydraulic quarries	Dredged sand quarry №5н	Calculations	106,540	3 946	18,00	71 027																							2020	It is expected to receive a conclusion from Rosrybolovstvo	To be clarified	To be clarified	Different variants are considered
Hydraulic quarries	Dredged sand quarry №37н	Conclusion of FA	1 348,435	49 942	18,00	898 957																							2020		To be clarified	1,5	NPO 'Sob fish-

Facility type	Facility	Reason, authority	Damage to aquatic biological resources in kind, kg	Offset activities																								Year pf completion	Comment	Approved fish type	weighed portion, g	Fish factory
				Muksun			Peled			Sturgeon			Nelma			Broad Whitefish			sterlet sturgeon		Siberian whitefish		Siberian whitefish			Sterlet							
				Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost, thou. RUR	Number of species	Cost, thou. RUR.	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR					
		on fishery																														breeding plant”»
Hydraulic quarries	Dredged sand quarry №2н (корректировка)	Calculations	511,870	18 958	18,00	341 247																							2020	It is expected to receive a conclusion from Rosrybolovstvo	To be clarified	To be clarified	Different variants are considered
Hydraulic quarries	Dredged sand quarry №55н	Calculations	139,775	5 177	18,00	93 183																							2020	It is expected to receive a conclusion from Rosrybolovstvo	To be clarified	1,5	NPO ‘Sob fish-breeding plant”»
Hydraulic quarries	Dredged sand quarry №10 Г. Eztentione	Calculations	2 112,760	78 250	18,00	1 408 507																							2020	It is expected to receive a conclusion from Rosrybolovstvo	To be clarified	1,5	NPO ‘Sob fish-breeding plant”»
Hydraulic quarries	Dredged sand quarry №31Н (2 stage)	Calculations																											2020	It is expected to receive a conclusion from Rosrybolovstvo	To be clarified		
Utrenny Terminal	Utrenny Terminal (Preparatory phase, phases: 4, 5, 6)	Conclusion of FA on fishery	24 863,670	920 857,00	18,00	16 575 426																							2020		To be clarified	0,5	NPO ‘Sob fish-breeding plant”»
LNG Plant	Plant	Conclusion of FA on fishery	3 610,966	133 739,00	18,00	2 407 302																							2020		To be clarified	1,5	NPO ‘Sob fish-breeding plant”»
Utrenny Terminal	Utrenny Terminal	Conclusion of FA on fishery	106 690,139	493 937	240,00	118 544 880																							2020		To be clarified	более 10	ФГБУ "Главрыбвод"
LNG Plant	Plant	Conclusion of FA on fishery	14 443,864	66 871	240,00	16 049 040																							2020		To be clarified	более 10	ФГБУ "Главрыбвод"
TOTAL in 2020				**1 269 446**		**3 867 293**																							2020				
2020-2026																																	
Utrenny terminal	Terminal (dredging)	Conclusion of FA on fishery №8505-ми/у02 от 11.09.2018																												Sturgeon		
			131 553,810	4 872 363	18,00	87 702 540				8 858 842	120,00	1 063 061 091				4 698 350	10,00	46 983 503,571											2020	Investor funds			
			5 642,480	208 981	18,00	3 761 653				379 965	120,00	45 595 798				201 517	10,00	2 015 171,429											2021	Investor funds			
			31 226,785	1 156 548	18,00	20 817 857				2 102 814	120,00	252 337 657				1 115 242	10,00	11 152 423,214											2022	Investor funds			
			6 284,513	232 760	18,00	4 189 675				423 200	120,00	50 783 943				224 447	10,00	2 244 468,929											2023	Investor funds			
			0,000	0	18,00	0				0	120,00	0				0	10,00	0,000											2024	Investor funds			

Facility type	Facility	Reason, authority	Damage to aquatic biological resources in kind, kg	Offset activities																											Year pf completion	Comment	Approved fish type	weighed portion, g	Fish factory
				Muksun			Peled			Sturgeon			Nelma			Broad Whitefish			sterlet sturgeon		Siberian whitefish		Siberian whitefish			Sterlet										
				Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost, thou. RUR	Number of species	Cost, thou. RUR.	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR							
			3 685,160	136 487	18,00	2 456 773				248 159	120,00	29 779 071				131 613	10,00	1 316 128,571													2025	Investor funds			
TOTAL for Terminal (Investor funds)			**174 708**	**6 470 651**		**116 471 725**				**11 76 4 82 1**		**1 41 1 77 8 48 9**				**6 239 557**		**62 395 567**	**#ССЫЛКА!**	**#ССЫЛКА!**	**#ССЫЛКА!**	**#ССЫЛКА!**										Investor funds			
			330 578,260	12 243 639	18,00	220 385 507				22 261 162	120,00	2 671 339 475				11 806 366	10,00	118 063 664,286													2020	Federal budget			
			370 559,840	13 724 439	18,00	247 039 893				24 953 525	120,00	2 994 422 949				13 234 280	10,00	132 342 800,000													2021	Federal budget			
			36 658,300	1 357 715	18,00	24 438 867				2 468 572	120,00	296 228 687				1 309 225	10,00	13 092 250,000													2022	Federal budget			
TOTAL for Terminal (Federal budget)			**737 796**	**27 325 793**		**491 864 267**				**49 68 3 25 9**		**5 96 1 99 1 11 1**	**#ССЫЛКА!**	**#ССЫЛКА!**		**26 349 871**		**263 498 714**	**0**	**0**	**0**	**0**										Federal budget			
2020-2026																																			
LNG Plant	Plant	Conclusion of FA on fishery № 7433-МН/702 от 15.08.2018																																	
			18 054,830	668 697	18,00	12 036 553				1 215 813	120	145 897 616				644 815	10,00	6 448 154													2020	Investor funds			
			33 591,880	1 244 144	18,00	22 394 587				2 262 079	120	271 449 535				1 199 710	10,00	11 997 100													2021	Investor funds			
			31 295,870	1 159 106	18,00	20 863 913				2 107 466	120	252 895 919				1 117 710	10,00	11 177 096													2022	Investor funds			
			544,620	20 171	18,00	363 080				36 675	120	4 400 970				19 451	10,00	194 507													2023	Investor funds			
			25 860,990	957 814	18,00	17 240 660				1 741 481	120	208 977 697				923 607	10,00	9 236 068													2024	Investor funds			
			10 046,580	372 096	18,00	6 697 720				676 537	120	81 184 485				358 806	10,00	3 588 064													2025	Investor funds			
			54 258,290	2 009 566	18,00	36 172 193				3 653 757	120	438 450 828				1 937 796	10,00	19 377 961													2026	Investor funds			
TOTAL for LNG Plant			**173 653**	**6 431 595**		**115 768 707**				**11 69 3 80 9**		**1 40 3 25 7 05 1**	**0**	**0**		**6 201 895**		**62 018 950**																	
2021																																			
Well construction	Well 261	Conclusion of FA on fishery №438-с от 20.04.2020		1 704	18	**30 672**	**9 390**	2	18 780,00	3 098	120	371 760	**575**	**2**	1 150	**3 834**	10	38 340,00					1 555	10	15 550	6 084	100	**60 8 40 0**							

Total/Planned (Investor funds)

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024

Facility type	Facility	Reason, authority	Damage to aquatic biological resources in kind, kg	Offset activities																														
				Muksun			Peled			Sturgeon			Nelma			Broad Whitefish			sterlet sturgeon		Siberian whitefish		Siberian whitefish			Sterlet			Year pf completion	Comment	Approved fish type	weighed portion, g	Fish factory
				Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost, thou. RUR	Number of species	Cost, thou. RUR.	Number of species	Cost per one specie , RUR with VAT	Cost, RUR	Number of species	Cost per one specie , RUR with VAT	Cost, RUR					
Total released/planned to release, species			356 111	3 783 068	0	1 122 777	3 028 668,000	1 269 446	0	0	0	0																						

Total released/planned to release (Federal budget)			
YEAR	2019	2020	2021	2022
Total released/planned to release, species		11 806 366	13 234 280	1 309 225