ТРИНИТИ
РОСАТОМ

LASER TECHNOLOGIES of TRINITI JSC

Moscow, Troitsk

Alexander Petrovskiy
Project Manager

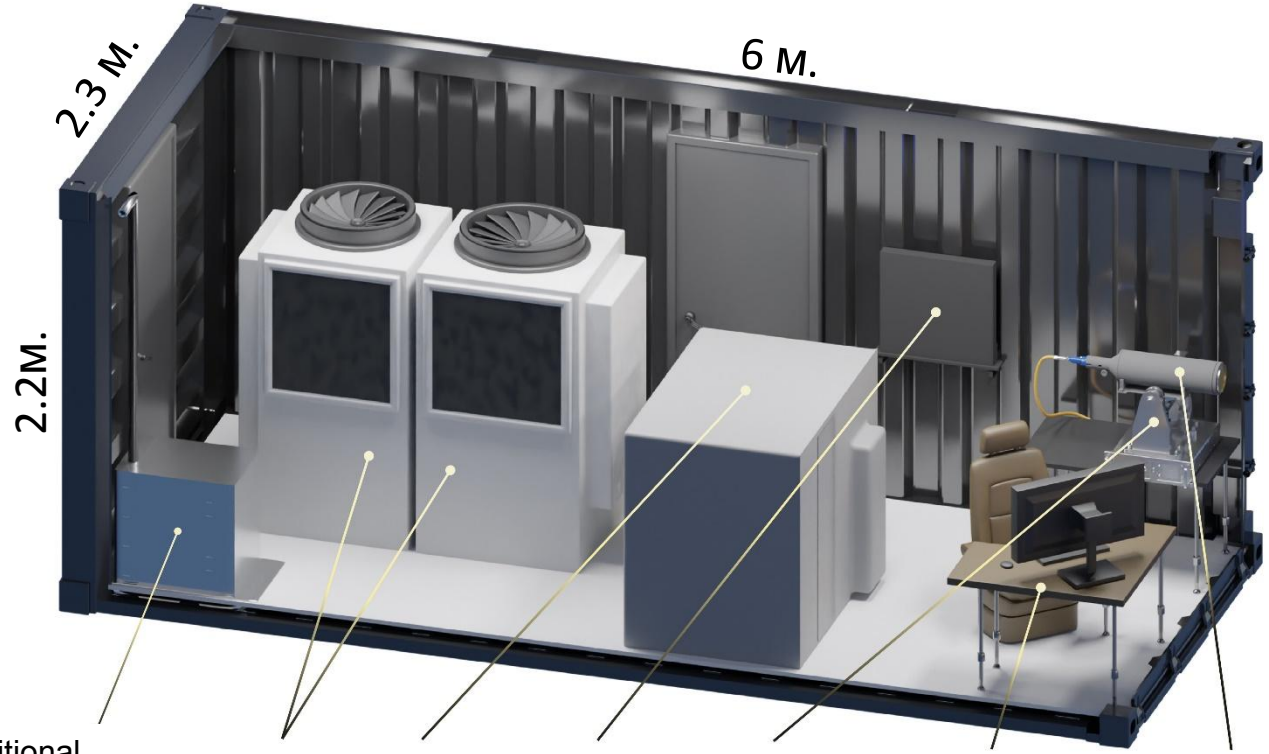
ТРИНИТИ
РОСАТОМ

1. **Mobile laser technological complex (MLTC)**
2. **Solutions for elimination of emergency oil and oil-product spills in various conditions, including the Arctic ones, using MLTC**
3. **Mobile laser technological complex for underwater cutting**

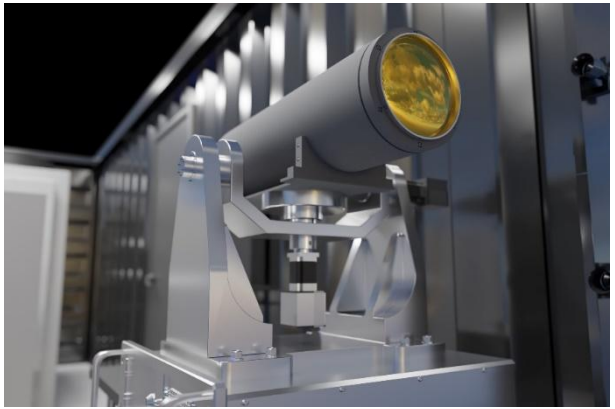
ТРИНИТИ
РОСАТОМ

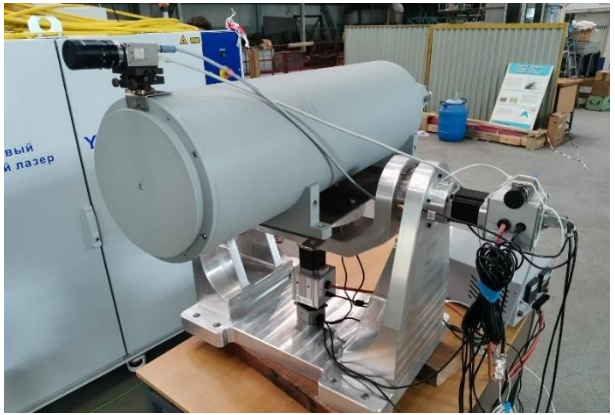
1. Mobile laser technological complex

1. Mobile laser technological complex (MLTC)



MLTC equipment





The following equipment is arranged in a container:

- ❑ a laser source
- ❑ a single-channel forming telescope
- ❑ chilling units (chillers)
- ❑ beam position control system with electric precision guidance, complex control system
- ❑ operator’s desk

The mentioned facilities provide a spot size on the target about 10 mm.

MLTC performance capabilities

Remote laser cutting (up to 300 m):

- liquidation of accidents, including those with open gushing, at gas and oil fields;
- Cutting (dismantlement) and fragmentation of the large-sized thick-walled metal and building structures (including submarines and ships);
- destruction of ice formations;
- elimination of pollution of the coastline and nearshore zone in case of emergency oil spills.

Remote laser cutting using transport optical fiber (up to 100 m):

- fragmentation of equipment (steam generators, reactor vessels etc.) of the dismantled NPP units;
- underwater gas-laser cutting of metal structures.

MLTC technical characteristics

Up to 50 kW

Laser output power

Up to 440 mm

Demonstrated cutting depth

Up to 300 m

Remote exposure range

Up to 150 kW

Power supply

From 1 to 20 m/h

Speed of laser cutting of metal structures up to 100 mm thick in automatic mode

From -50 to +40 °C

Climatic conditions

Transport block-container

Format

60 minutes

Complex setup time

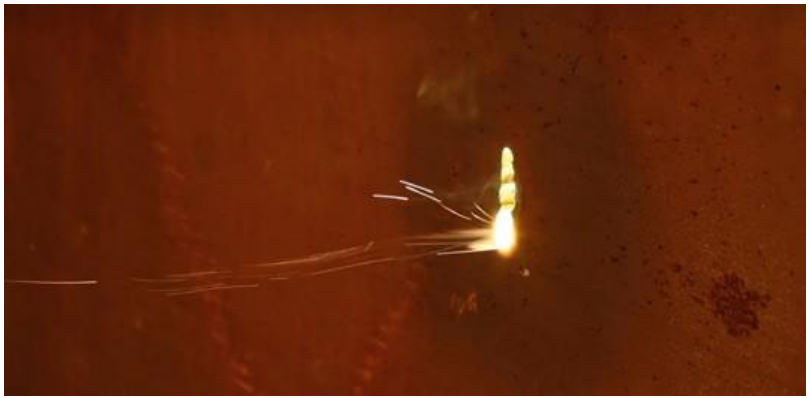
Possible scenarios for the MLTC use: fragmentation of elements of the NPP reactor vessel

The technology of laser cutting (severing) of thick-walled (up to 440 mm) metal structures has been developed and successfully demonstrated.

Cutting of metal structures is carried out at a distance of up to 100 m through transporting laser radiation via a flexible transport fiber, which makes it possible to locate all the equipment of the laser complex and the operating personnel in the "clean" zone.

Feasibility demonstration

Test concrete block 780*660*510 mm



Cutting of thick-walled metal imitating the body of a nuclear reactor vessel (cutting depth is 440 mm)

Examples of laser cutting of structures destroyed in a gas well accident

MLTK-20 complex, created in 2010 by order of Gazprom-gazobezopasnost, was first used in 2011 during elimination of the accident at gas well №506 at the operating field in the Yamalo-Nenets Autonomous District.

After this accident, the MLTK-20 complex was used for elimination of three more severe accidents:

- August 2013-Samburg oil and gas field (Yamal-Nenets Autonomous District);
- July 2014-Verkhnekolik-Yeganskoye oil and gas field (KHMAO);
- January 2015-Severgubkinskoye oil and gas field (simultaneous open gushing of an oil and gas well at temperatures up to -32◦C).

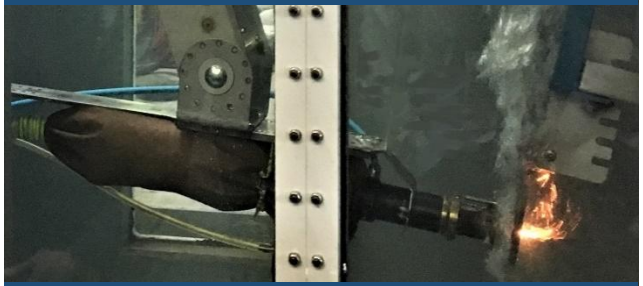
All these accidents occurred under the conditions of a burning oil and gas open gushing.

Main application areas

Fragmentation of the NPP equipment

Fragmentation of large-sized thick-walled metal and concrete building structures

Elimination of accidents at gas and oil fields

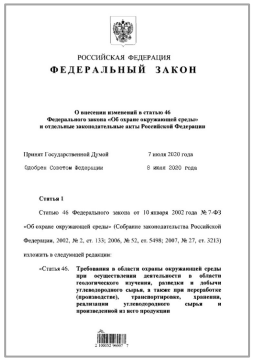


Underwater gas-laser cutting of metal structures

ТРИНИТИ
РОСАТОМ

2. Solutions for elimination of emergency oil and oil-product spills in various conditions, including the Arctic ones, using MLTC

Federal law “On Amendments to Article 46 of the Federal Law "On Environmental Protection“” and certain legislative acts of the Russian Federation



РОССИЙСКАЯ ФЕДЕРАЦИЯ

ФЕДЕРАЛЬНЫЙ ЗАКОН

О внесении изменений в статью 46 Федерального закона «Об охране окружающей среды» и отдельные законодательные акты Российской Федерации

Принят Государственной Думой 7 июля 2020 года

Одобрен Советом Федерации 8 июля 2020 года

Статья 1

Статью 46 Федерального закона от 10 января 2002 года №7-ФЗ «Об охране окружающей среды» (Собрание законодательства Российской Федерации, 2002, № 2, ст. 133; 2006, №.52, ст. 5498; 2007, №.27, ст. 3213) изложить в следующей редакции:

«Статья 46. Требования в области охраны окружающей среды при осуществлении деятельности в области геологического изучения, разведки и добычи углеводородного сырья, а также при переработке (производстве), транспортировке, хранении, реализации углеводородного сырья и произведенной из него продукции

Art. 1

Paragraph 2. During production, processing, transportation, storage and sale of oil and oil products, measures should be taken to prevent and eliminate spills of oil and oil products as well as other negative impacts on the environment.

Paragraph 5. The plan for the prevention and elimination of oil and oil products spills is to be approved by the organization that produces, processes, transports, stores and sells oil and oil products in the territories (hereinafter referred to as the operating organization), subject to the availability of:...

approval of the federal executive body authorized to carry out state environmental supervision.

From the explanatory note to the Federal Law:

…instead of the mandatory presence of the conclusion of the state environmental expertise, the draft law introduces the approval of the draft plan by Rosprirodnadzor, which is more optimal in terms of timeframes and procedures (for example, it does not require an environmental impact assessment, a simplified procedure for making changes to the plan).

Application option

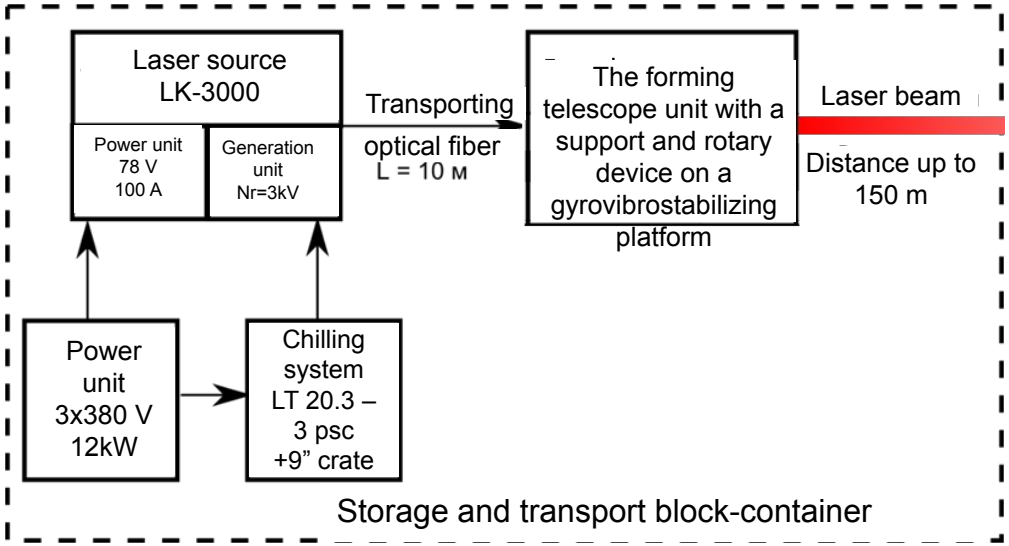
1. Operational installation of booms of the oil spill guard
2. Laser ignition from the MLTC carrier
3. Self-sustained spill burn (up to thickness ≤1.0 mm)

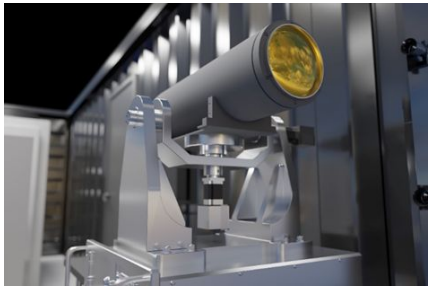
where appropriate:

4. Application of surfactants
5. Laser afterburning of residues near booms

The optimal firing distance is 150 m.

Equipment outline





- Laser – 850*800*1100 – 140 kg.
- Chiller – 400*480*550 – 46 kg.
- Battery – 600*650*170 – 600 kg.
- Telescope - 600*250 – 30 kg.

Public sources: official internet stores:

1. https://sveton-ibp.ru/kupit-desyat-kilovatt-i-bolee/besperebojnoe-pitanie-kottedzh-15kvt-16kvtch/ - Батарея
2. https://www.deltatherm.com/en/products/industrial-cooling-systems/ - Чиллер
3. https://www.gophotonics.com/products/lasers/ipg-photonics/29-152-yls-3000-sm - Лазер

Approximate cost of developing the complex and providing services

Components and works	Price, mln Rub
Laser source 3kW	10
Telescope	10
Stabilizer (gyrovibrostabilizing)	40
Chillers	3-4
Power supply– 12 kW generator	0,35-0,80
Development works	20
Total	**85**

The service cost is about 5 mln Rub, including:

Transportation

Storage (including depreciation)

Salary and additional charges

Terms:

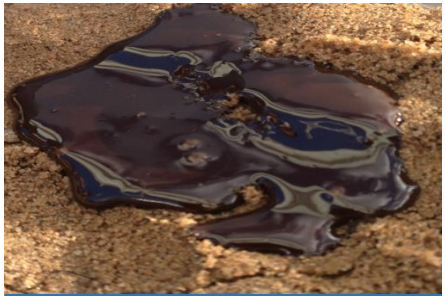
Development of the complex will take 6-7 months (excluding the time that purchasing procedures of Rosatom take)

Successful demonstration of oil spill elimination

Remote laser ignition and oil spill scanning makes it possible to maintain a steady burning on water with ice, under snow, on ice, during snowfall and rain

Resistant oil emulsion on water

After the treatment



Resistant oil emulsion on sand

After the treatment

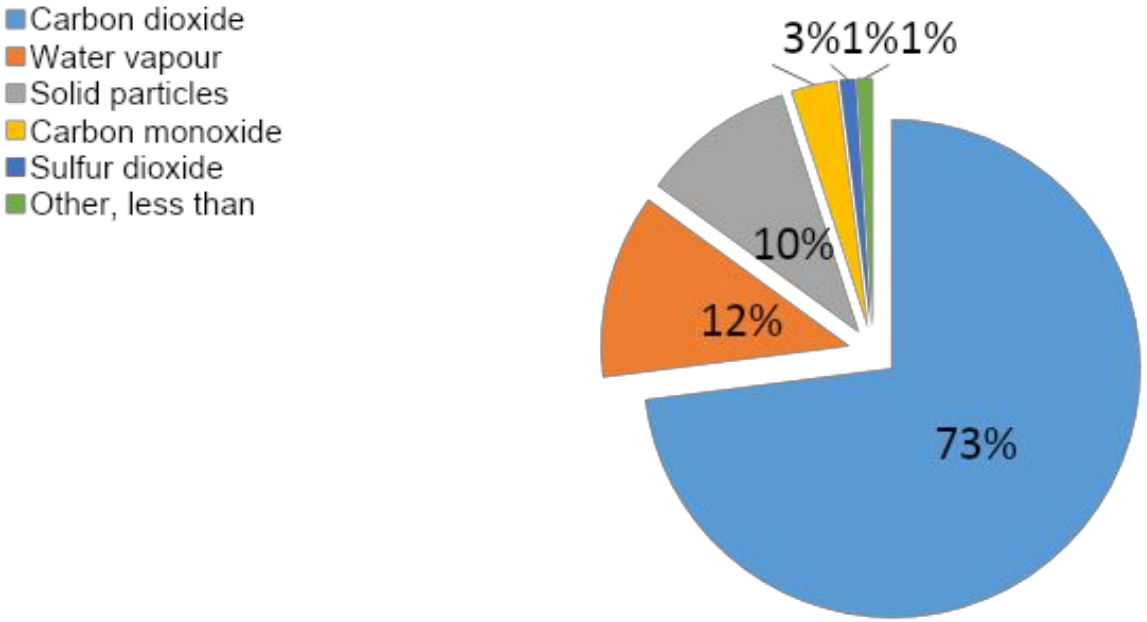
Advantages of laser oil spill elimination

- Safety for personnel, due to remote exposure (in the case of the classical method, when using a flare system, a sufficiently close distance is required).
- The ability to burn off the remains of the spill when using surfactants or sorbents
- The efficiency of oil spill removal is 90-98% (mechanical means allow to collect no more than 20-30% of the spilled oil).
- In the Arctic conditions, it is impossible to use other methods.

Pros and cons of the applied methods

	Mechanical	Physico-chemical	Biological	Thermal	Laser
Pros	High efficiency in carrying out work Ability to collect various oil products All-season use	Use of dispersants in combination with various technical means Minimum storage and transportation costs	Non-toxic Minimal damage to the ecosystem	Rapid response to an emergency oil spill Allows to eliminate up to 98% of oil products in a relatively short period of time Minimum costs	The laser method is safe compared to the thermal one Remote control at a safe distance of up to 150 meters Use in hard-to-reach nearshore areas Elimination of oil spills in the Arctic conditions
Cons	Residual thin film Cannot be used in the Arctic conditions	Toxicity Limited capabilities at the low temperature	Limited capabilities at the low temperature Long term elimination period	Necessity of additional fire safety measures implementation Release of combustion products Cannot be used in Arctic conditions	Release of combustion products

The following combustion products are formed during the combustion of the oil products:



Potential customers

ТРИНИТИ
РОСАТОМ

Oil and gas industries:

- PJSC «Tatneft» n.a. V.D. Shashin
- PJSC «Lukoil»
- PJSC «Gazprom»
- PJSC «Surgutneftegaz»
- PJSC «NK «Rosneft»
- PJSC NK «RussNeft»
- PJSC «Novatek» etc.
- «Arktik LNG-2» Ltd.
- CJSC «Nortgaz»
- «Yamal LNG» Ltd.
- SUE CR Chernomorneftegaz
- «SN-Gazdobycha» Ltd.
- «GDK Lensk-gaz» Ltd.
- JSC “Sakhatransneftegaz"

ТРИНИТИ
РОСАТОМ

3. Mobile laser technological complex for underwater cutting

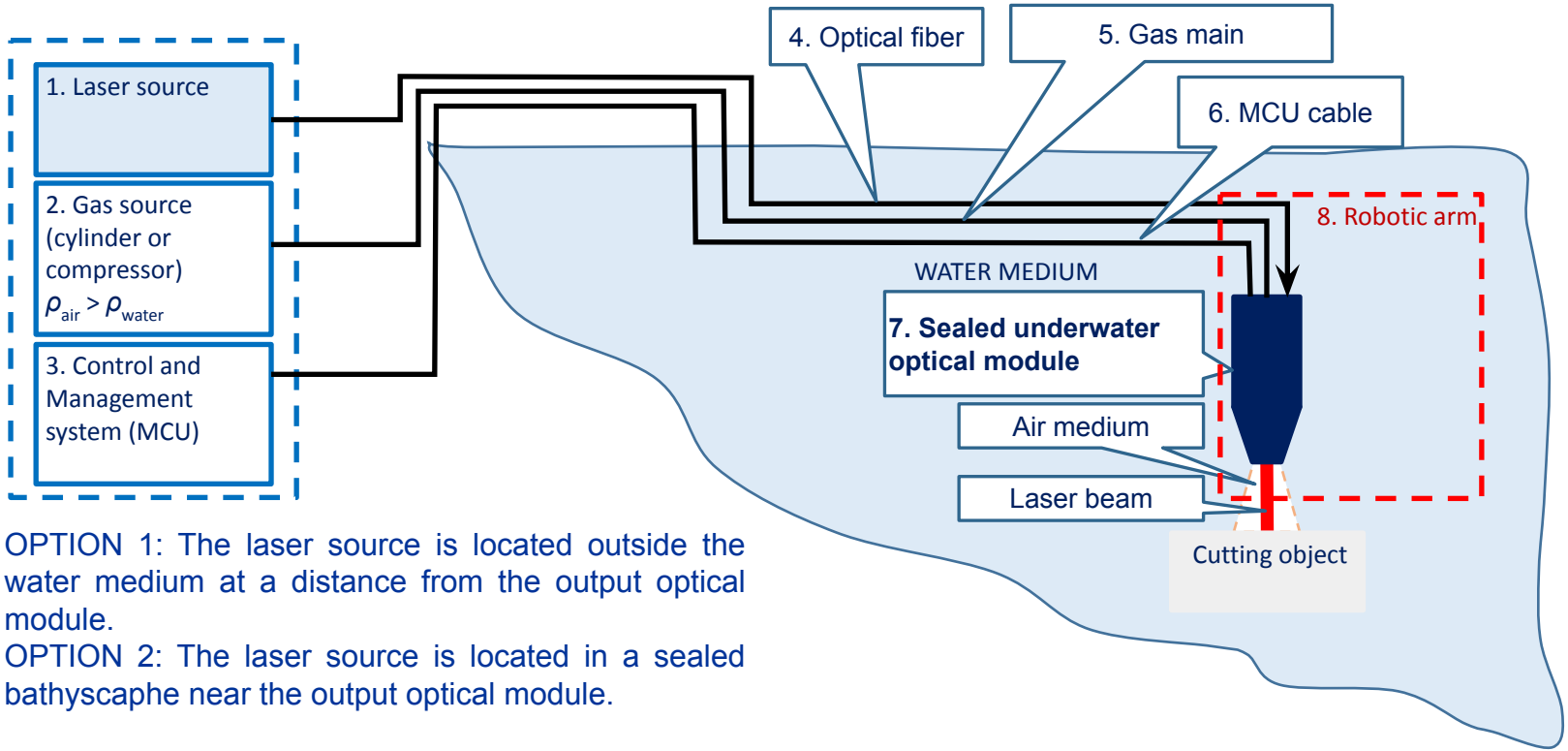
Underwater laser cutting

A Mobile Laser Technology Module (MLTC) has been created in TRINITI JSC. One of the tasks to be solved by means of MLTC is to provide highly efficient and safe underwater cutting of thick-walled and bulky metal and reinforced concrete structures.

MLTC can be used for fragmentation of such objects as:

- radiation-contaminated metal structures of nuclear power plants in the holding basins;
- shipwrecks;
- underwater elements of port facilities;
- offshore platforms for gas and oil production on the sea shelf (including the Arctic one).

Implementation scheme

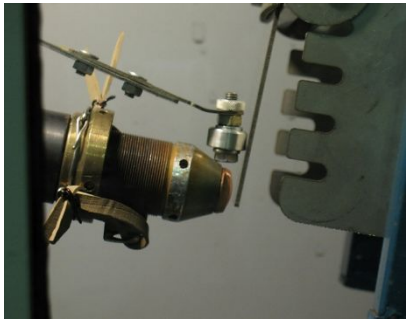


OPTION 1: The laser source is located outside the water medium at a distance from the output optical module.

OPTION 2: The laser source is located in a sealed bathyscaphe near the output optical module.

Technology comparison

Alternative products/ solutions	Key Product/Solution Features				
	Depth	Thickness of the cut metal	Consumable materials	Operating gas	Work safety
MLTC (TRINITI JSC)	**Up to 100 m**	**Up to 100 mm**	**No consumable materials**	**Air**	**No limitations**
«Vanita» LLC. (**plasma cutting**)	Up to 25 m	Up to 30 mm	Regular replacement of the cathode and nozzle	Air	No limitations
«Tetis Pro» JSC (**electro-oxygen cutting**)	Up to 20 m	Up to 35 mm	Regular replacement of the electrode and nozzle	Oxygen	Danger of oxygen detonation
«Svarbi» LLC (**gas-oxygen cutting**)	Up to 40 m	Up to 70 mm	No consumable materials	Oxygen and hydrogen	Danger of detonation of operating gases



Functions of the underwater robotic arm

1) Delivery of the underwater optical module (UOM) to the cutting site and back.

2) The initial positioning of the working elements of the output module in relation to the cutting object.

3) Moving the working elements of the output module during the cutting process.

4) Changing the cutting location or cutting object.

5) Ensuring operation in a wide range of parameters.

The robotic arm is to be developed according to the individual technical specification of the customer.

It is possible to develop a different versions of the robotic arm for different tasks.

The approximate production time is at least 6 months.

THANK YOU FOR YOUR ATTENTION

Alexander Petrovskiy
Project Manager

Tel.: +7 (495) 841-56-95
Cell.: +7 (910) 409 79 58
E-mail: petrovskiy@triniti.ru
www.triniti.ru

Alexander Krasyukov
Head of Innovative and Applied Research Department

Tel.: +7 (495) 851-06-46
Cell: +7 (916) 924 37 75
E-mail: krasukov@triniti.ru
www.triniti.ru