



**“WOLF” Perimeter security system**

**BG-OPTICS LLC is a Russian research and development production company, part of the Complex Systems Group of Companies.** For many years it has been developing, producing and implementing integrated solutions for control and security of area and linear objects. Solutions for control and protection of site and linear objects.

## Main areas:

- "WOLF" perimeter security alarm system;
- "TIGER" video analytics system;
- PHOENIX drone, PHOENIX MINI drone, PHOENIX SPP drone;
- collectorless motors in a wide range of power and supply voltages;
- integrated development, production and testing of assemblies of radio electronic and optical equipment;
- development and design of applied automated control systems for industrial production, security and life support systems for various facilities;
- application and firmware

## Company advantages:

- own scientific, technological and production bases;
- high scientific potential of BG-Optics employees, among which are professors, doctors and candidates of physical, mathematical and technical sciences;
- confirmation of product quality and reliability in joint tests with the Ministry of Defence of the Russian Federation, Federal Security Service of Russia and the Federal Guard Service of Russia

*The WOLF system meets the requirements imposed by Russian Federation Government Decree No. 969 of 26 September 2016 to the functional properties technical means of ensuring transport security, which is confirmed by the Certificate of Conformity of the Ministry of Internal Affairs of Russia No. RF.03.001143*



МИНОБОРОНЫ  
РОССИИ



УВ ФСО РОССИИ



МЧС РОССИИ



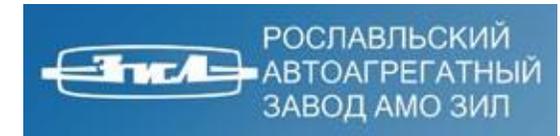
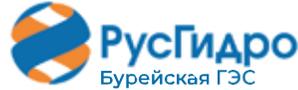
ЦСН ФСБ РОССИИ



ПРАВИТЕЛЬСТВО  
СМОЛЕНСКОЙ  
ОБЛАСТИ



ПРАВИТЕЛЬСТВО  
ЯРОСЛАВСКОЙ  
ОБЛАСТИ





# "WOLF" perimeter alarm system distinctive features



A highly perspective signal armament device designed to enhance the protection of terrain, critical infrastructure facilities and approaches to them.



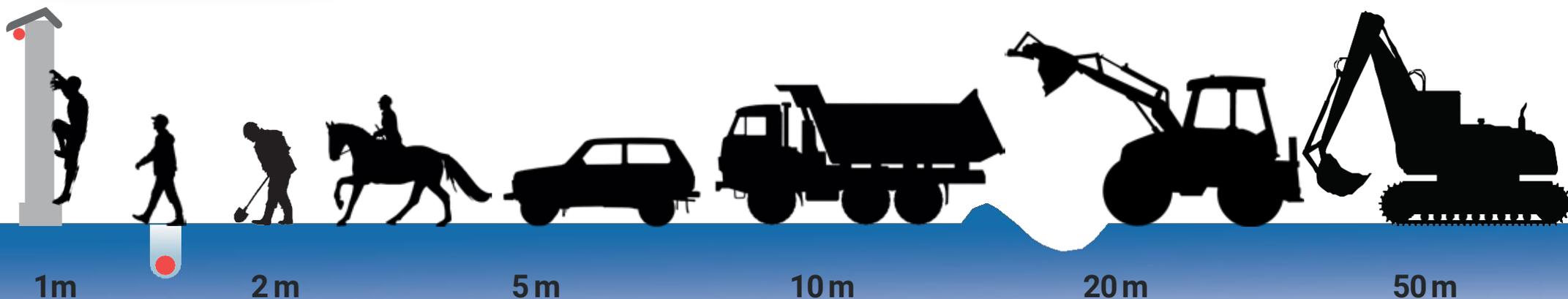
The "WOLF" perimeter alarm system is a reliable, simple and flexible complex solution for the deployment of perimeter security boundaries objects (point, linear, area, including complex configuration), including in the absence of industrial power supply and communication lines.



Allows to detect and classify any activity, causing ground vibrations in the path of the sensor cable, with an accuracy of up to 5 m, classify the type of intruder and determine the direction of its movement on a boundary up to 140 km in distance.



System has no analogues in Russia and exceeds foreign models on a number of basic parameters and provides high reliability of protection with a minimum number of false alarms.



## Detects and recognizes the following types of influences:

- ◆ pedestrian motion crossing security boundary;
- ◆ vehicle movement crossing the security line;
- ◆ working with a shovel – 2 m;
- ◆ movement of light wheeled machinery – 5 m;
- ◆ movement of heavy wheeled equipment – 10 m;
- ◆ operation of earth-moving machinery – 20 m;
- ◆ caterpillar movement.

## Provides a low false alarm rate under the following interference conditions:

- ◆ movement of a person, group of people along the detection zone at a distance of at least 1 m;
- ◆ traffic along the detection zone at a distance of at least 10 m;
- ◆ railway traffic along the detection zone at a distance of at least 200 m;
- ◆ flight, take-off, landing of single (flock) birds in the detection zone;
- ◆ movement of animals weighing up to 20 kg in the area of detection and impact on the engineering barrier.

◆ All events that occur are saved in the archive.



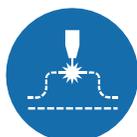
# "WOLF" perimeter alarm security system advantages



Stable operation of the complex at any time of the year under any weather conditions.



Complex independence from the electrical grid and communication lines.



Ease of extension.  
Fiber optic extension or repair in the field.



Integration on software  
Hardware and software integration into any existing security systems as well as engineering barriers.



Potentially dangerous objects accurate detection.



Linear unit concealment.



Unable to be detected by radio-electronic means.



Interference immunity,  
Impossibility of blocking with radio-electronic interference resistance, inability to be blocked by electronic means.



Minimize operating costs – one system replaces many point sensors.  
Does not require frequent maintenance. Fiber optics can be easily extended and can be repaired in the field in case of accidental damage.  
System service life is at least 10 years.



# "WOLF" system economic viability application

## 01 Post-installation system maintenance

Modern technologies applied and quality control of the system allows us to extend the service life of our equipment up to 10 years (in the absence of deliberate actions to disable the system by third parties).

## 02 System installation

The ease of installation comes from the design of the system and does not require special skills of the installation team.

## 03 Post-warranty system maintenance

Savings in power charges, routine maintenance, repairs.

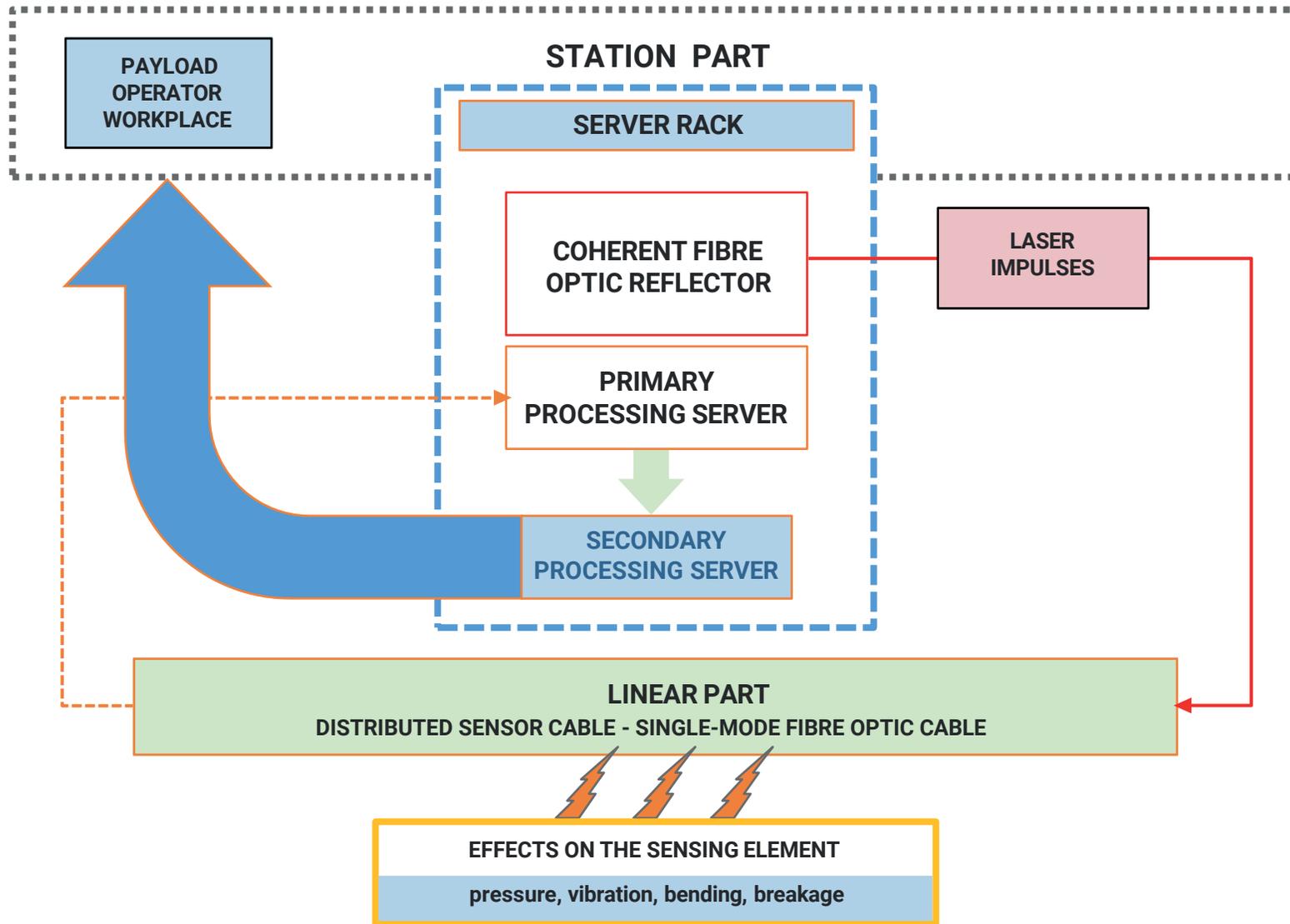
## 04 Additional equipment costs

The scientific and technical potential of the "WOLF" system makes it possible to create several guard lines with the help of a cable sensor without extra detection means and power supply cable networks.

## 05 Operating losses (direct and indirect)

Sensitive element on the basis of single-mode Russian-made single-mode fibre-optic cable (with a service life of up to 25 years), as well as the absence of active equipment at the boundary line – significantly reduces the cost of operating the linear part.

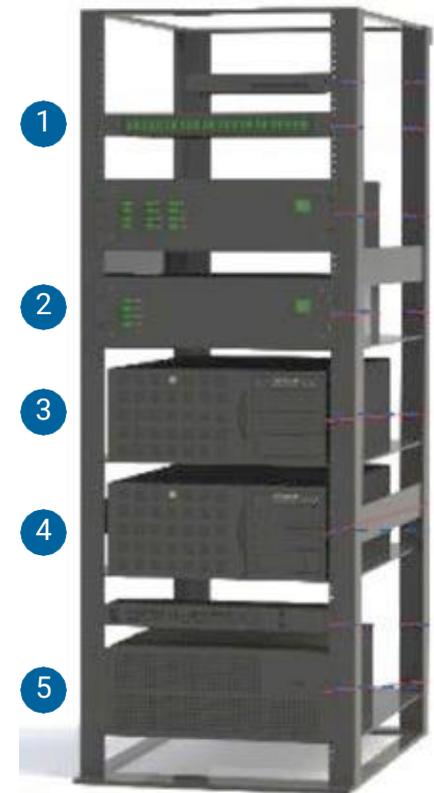




WOLF system architecture is based on a distributed vibroacoustic sensor. Any standard telecom single-mode optical fiber can be used. Optical fiber does not require power and is not a source of electromagnetic radiation that makes difficult to determine its location in ground. The heart of the system is OTDR (Optical Time Domain Reflectometer). WOLF operation utilizes the effect of light scattering in the optical fiber. The optical module beams laser pulses into the optical fiber. As any optical fiber is not uniform by structure it has inhomogeneity of refractive index, that causes dispersion of laser probe pulses. This effect is known as Rayleigh scattering. Coherent reflectograms are formed on basis of backscattered laser signal. The reflectogram does not change in time in the absence of external effects. When pressure on ground occurs the reflectogram is distorted in the place that corresponds to the place of the impact.

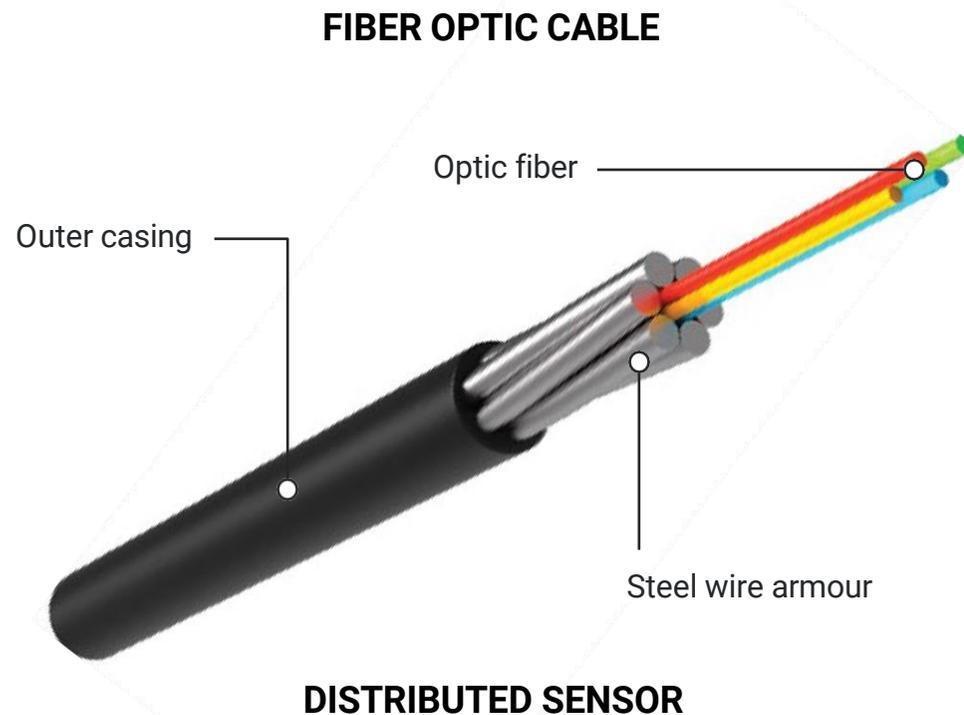
After processing with ADC (analog-digital converter) the system processor determines the useful signal and makes primary channels information an assessment of primary information from channels to focus on preset reference. The user friendly interface will display to the operator information about the exact location of the intruder at the secured perimeter and its type. WOLF system allows to determine and classify activities of any type that cause ground or fence vibrations.

The accuracy of the event location is up to 5 meters through the entire optical fiber length of up to 70 km. Multi-channel modifications of WOLF optical modules designed for connection of several optical fibers to different channels. Along with laying the fibers in the ground or fence towards each other, that enables to extend the controlled perimeter up to 140 km.



- 1 Optic cross
- 2 Coherent fiber optic reflectometer
- 3 Primary processing server
- 4 Secondary processing server
- 5 Uninterruptible power supply

# The principle of operation of the product is based on the effect of Rayleigh dispersion in optical fiber



The useful signal is extracted by an analogue-to-digital converter (ADC), the processor makes an initial evaluation of the signal. An analogue-to-digital converter, the processor performs the initial evaluation of the information on the channels with the allocation of controlled frequencies vibro-acoustic spectrum. Then there is a multi-stage processing of the useful signal on the secondary processing server, after that the alarm signal is displayed on the operator's workstation. The occurring events are stored in the archive.

Coherent fiber optic reflectometer (referred to as reflectometer) generates laser impulses in the fibre optic cable of the distributed cable sensor.

Optical fibres are not homogeneous in their structure and have defects on which the probing pulses are scattered. This effect is called Rayleigh scattering.

The light reflected from inhomogeneities is stacked (interferes) and from each section of the optical fibre returns in the form of a reflectogram reflecting the dependence of the power of backscattered radiation as a function of time.

In the absence of mechanical effects on the fibre, the reflectogram changes insignificantly in time.

When an intruder overcomes the protected boundary by various means.

By various methods leads to the impact on the fibre-optic cable (pressure, vibration, bending, breaking), the trac is distorted in the place corresponding to the impact.

The unused fibres of the fibre optic cable can be used as transmission channels if required.

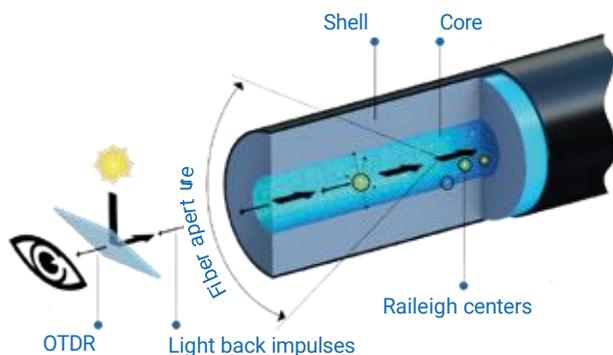
STATION PART	OPERATOR'S WORKSTATION	1	PC
		2	Mobile device (ipad, laptop, etc.)
	SERVER RACK	1	Network switch
		2	Security controller
		3	Optical cross
		4	Optical amplifier unit
		5	Coherent fiber optic reflectometer
		6	Primary processing server
		7	Secondary processing server
		8	Optical coupling
9	Socket unit		
10	Uninterruptable power supply		
LINEAR PART	SENSITIVE ELEMENT	1	Distributed sensor cable - single-mode fibre optic cable
	EXTRA DEVICES	2	Any alarm devices that support protocol, electric locking devices, electric gate openers, etc.

-  All equipment listed above can be purchased locally in the country of installation, except for items 4 (Optical amplifier unit) and 5 (Coherent fiber optic reflectometer)
-  The distributed sensor cable can either be provided by the local supplier or by us



# "WOLF" Composition of security alarm system perimeter

## Linear part



Distributed sensor, additional signalling sensors, electric actuators, electric locks and other products

## Stationary part

(equipment located in a telecommuting cabinet)



## Automated workplace operator workstation



## More options



### Video cameras

The "WOLF" system allows to integrate video surveillance systems of any scale, regardless of territorial distribution, number of cameras, system users and time data storage time



### "TIGER" situational analytics package

Allows to create surveillance zones and rules for alarm generation, detect perimeter violations, track up to 100 objects at the same time.

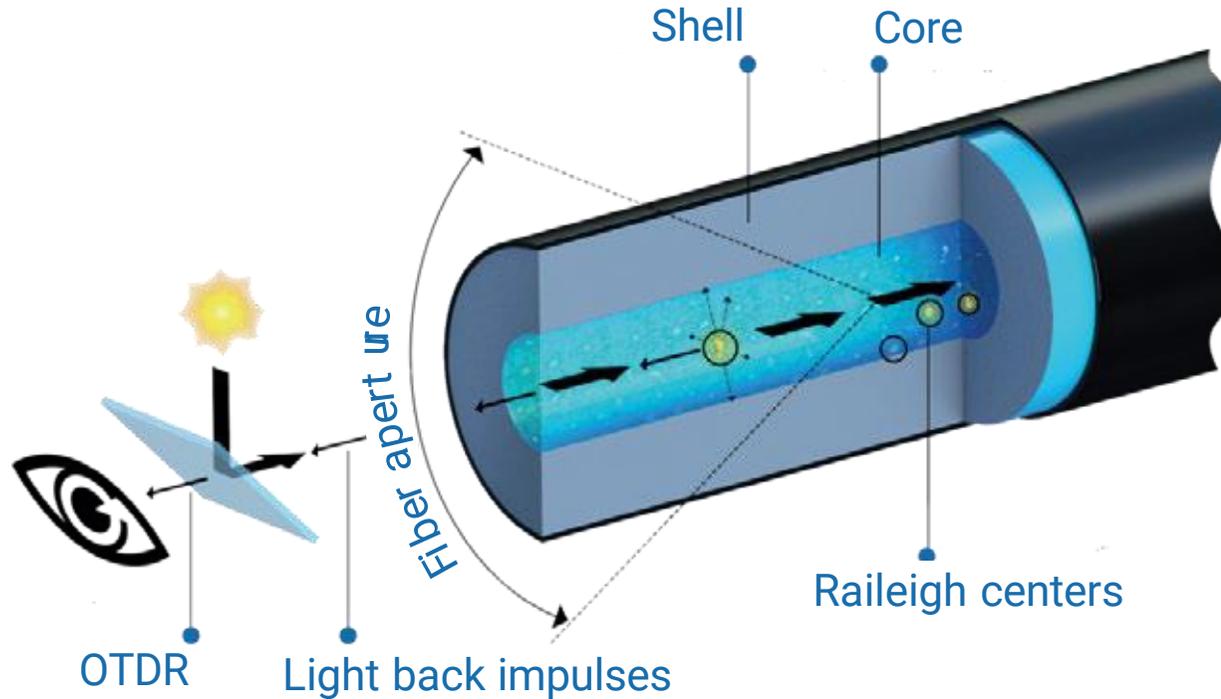


### Security lighting and alarm system

Allows to create a light curtain in the direction of security boundary violation.



## Linear part



### Distributed sensor cable

A distributed sensor cable based on a single-mode fiber optic cable is used as a sensing element equipped with a single-mode optical fiber with an extended operating waveband.

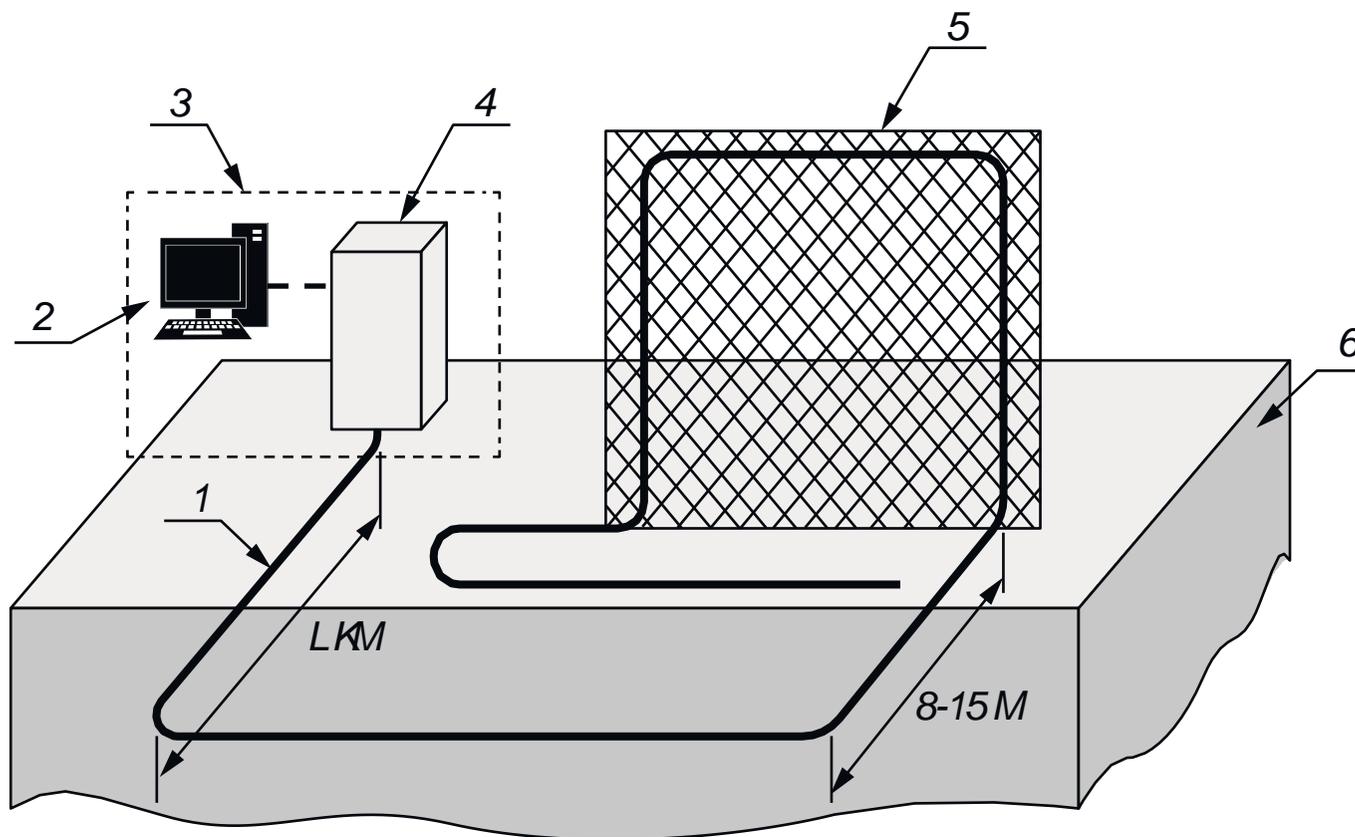
Opening gates sensors (wickets, etc.)



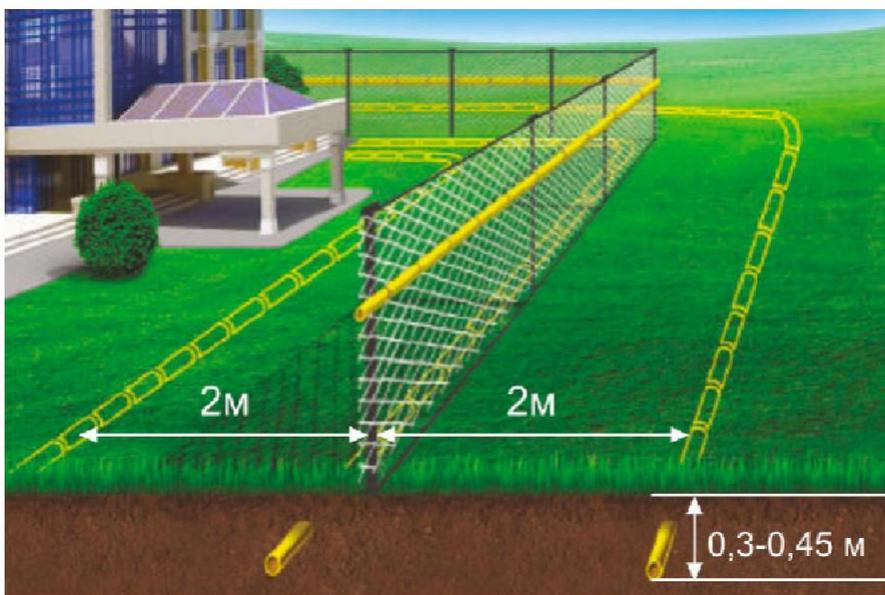
Locking devices electric actuators



## Combined fiber optic system

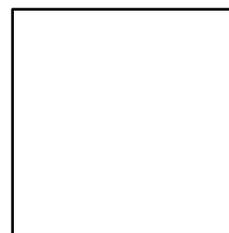


- 1 – Sensitive element
- 2 – Operator's workstation
- 3 – "WOLF" system
- 4 – Telecommunication cabinet
- 5 – Barrier
- 6 – Soil



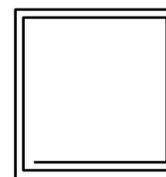
## Building in 1 boundary (single-circuit).

Ensuring that the proximity detection of violators ("single person", "group of intruders", "vehicle") to the protected area until the moment of crossing the line cable-sensor laying line along the entire throughout the entire length of the monitored area. The accuracy of determining the place of violation – not more than 5 m.



## Building in 2 lines (multi-circuit).

Providing detection and classification of intruders by type with determination direction of movement.



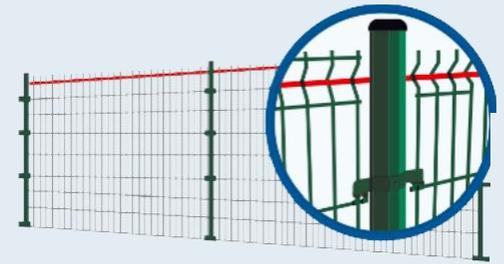
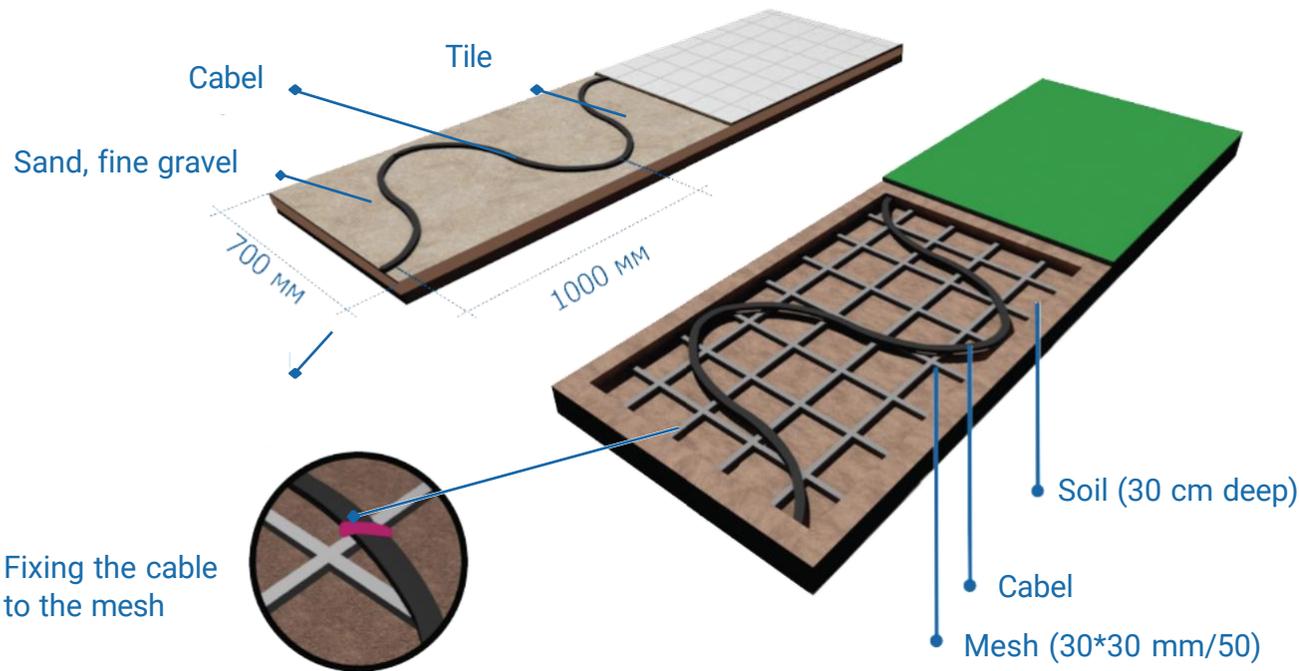
## Special construction.

To detect the position of objects.

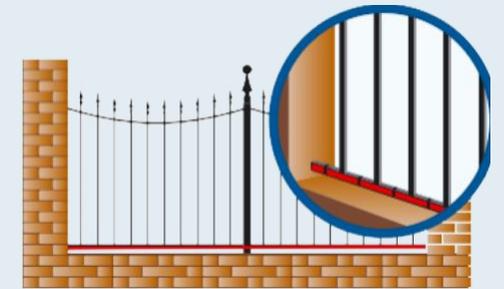


Depending on the tasks to be performed and the specifics of the monitored object the cable sensor can be laid in the ground, as well as at different depths in other types of coatings of the controlled area: asphalt, concrete, tiles.  
At the same time it is possible to install the cable sensor on/into various types of perimeter fences and engineering barriers.

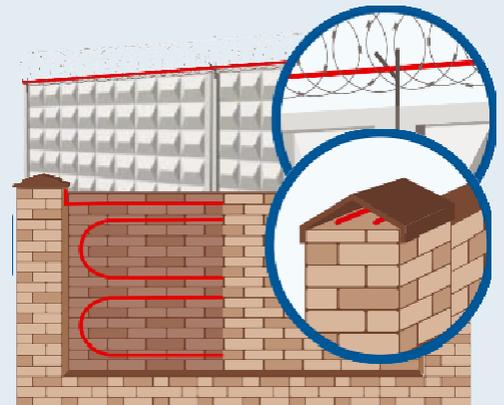
The method of installation implies careful attention to the landscape near the limit, no need to remove plants to create a estrangement.



Wire netting

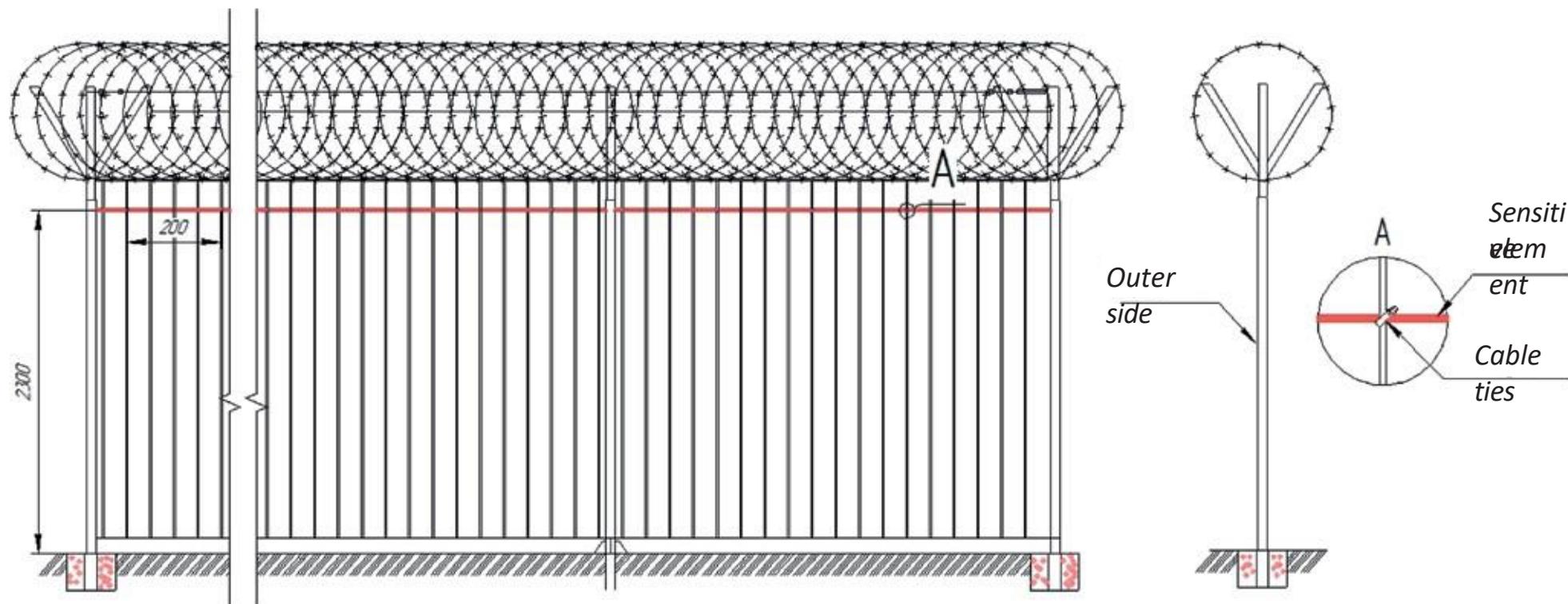


Designed welded fence



Integral barrier

Option of mounting the linear part on a fence made of welded metal mesh with a protective canopy with reinforced barbed wire.



**Symbols:**

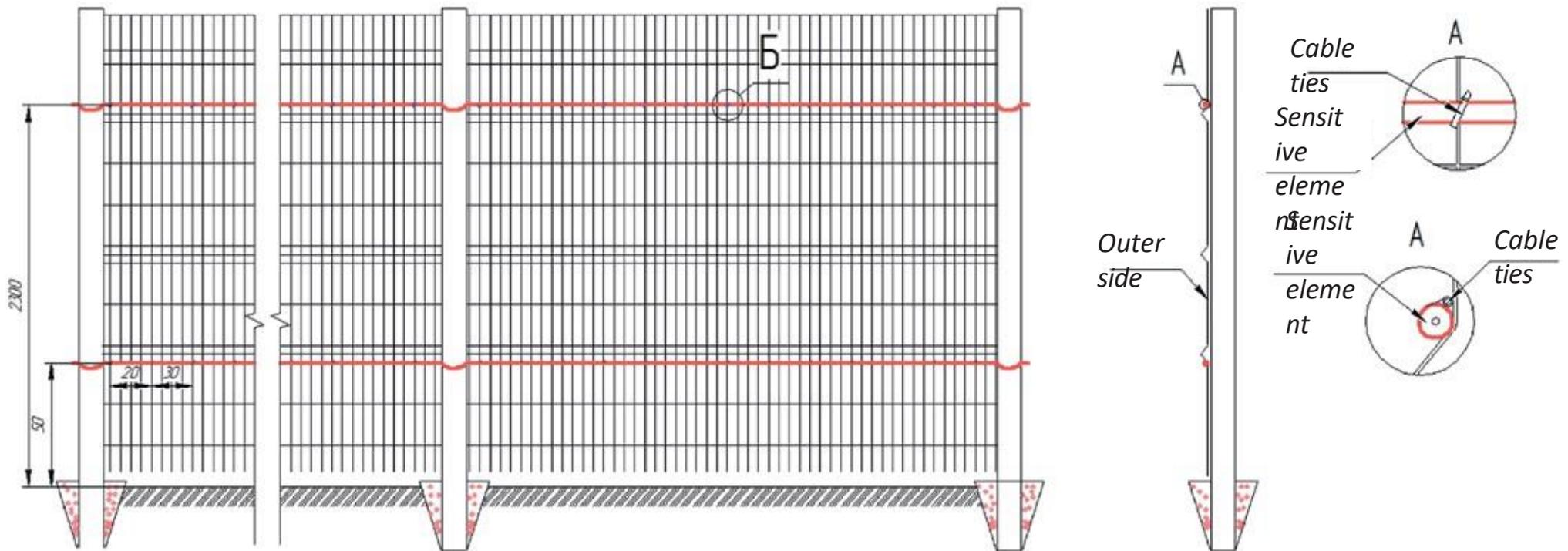
— Sensitive element: cable СЛ-ОКМБ\_ОЗНУ-8Е2-5.2

1 Max length of the connected cable depends on the type of "WOLF" fiber reflectometer

2 Sensor element is routed in accordance with the specifications

3 Fixing points should be created using all-weather cable clamps at a distance of 200-300 mm from each other

Option of mounting the linear part on a welded metal mesh fence.



**Symbols:**

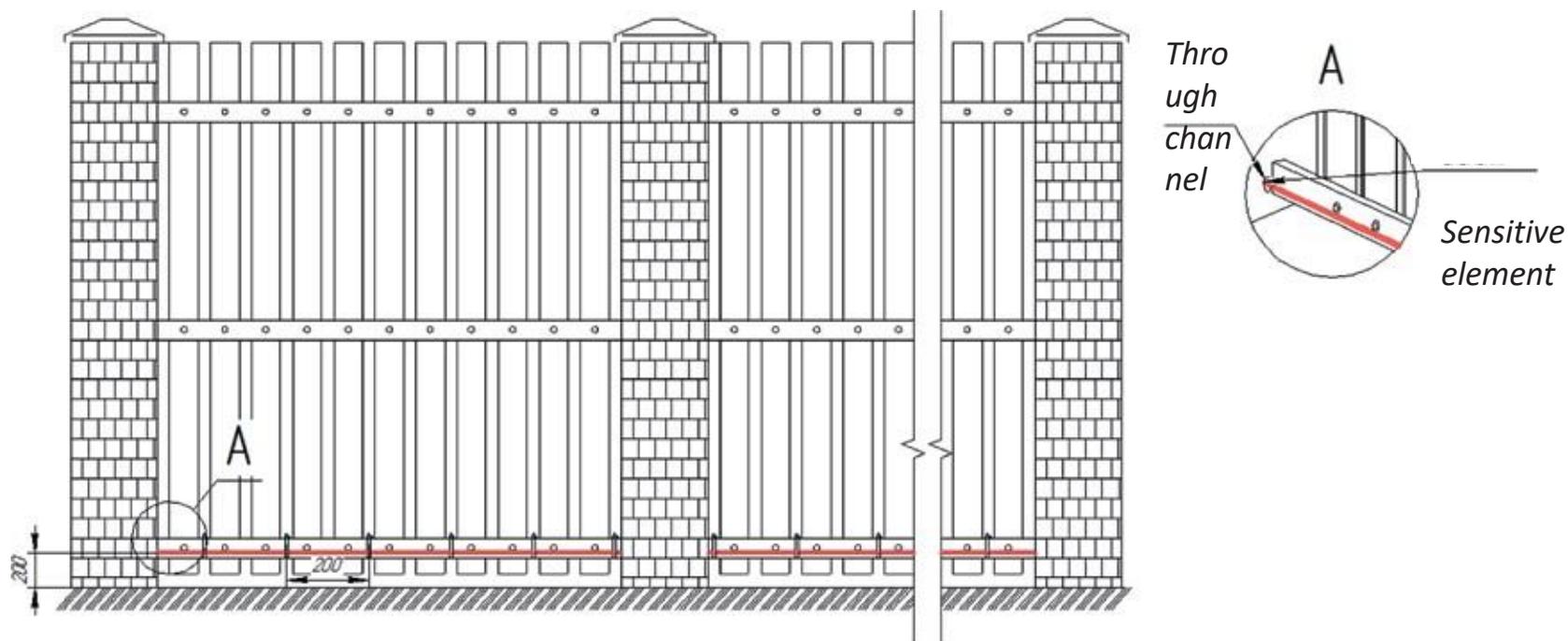
— Sensitive element: cable СЛ-ОКМБ\_03НУ-8Е2-5.2

1 Max length of the connected cable depends on the type of "WOLF" fiber reflectometer

2 Sensor element is routed in accordance with the specifications

3 Fixing points should be created using all-weather cable clamps at a distance of 200-300 mm from each other

Mounting linear part option on a decorative welded fence.



**Symbols:**

 Sensitive element cable СЛ-ОКМБ-ОЗНУ-8У2-5.2

1 Maximum length of the connected cable depends on the

type of wire fit for welded fence

2 Create fixing the sensitive element weather cable clamps at a distance of 200-300 mm from each other

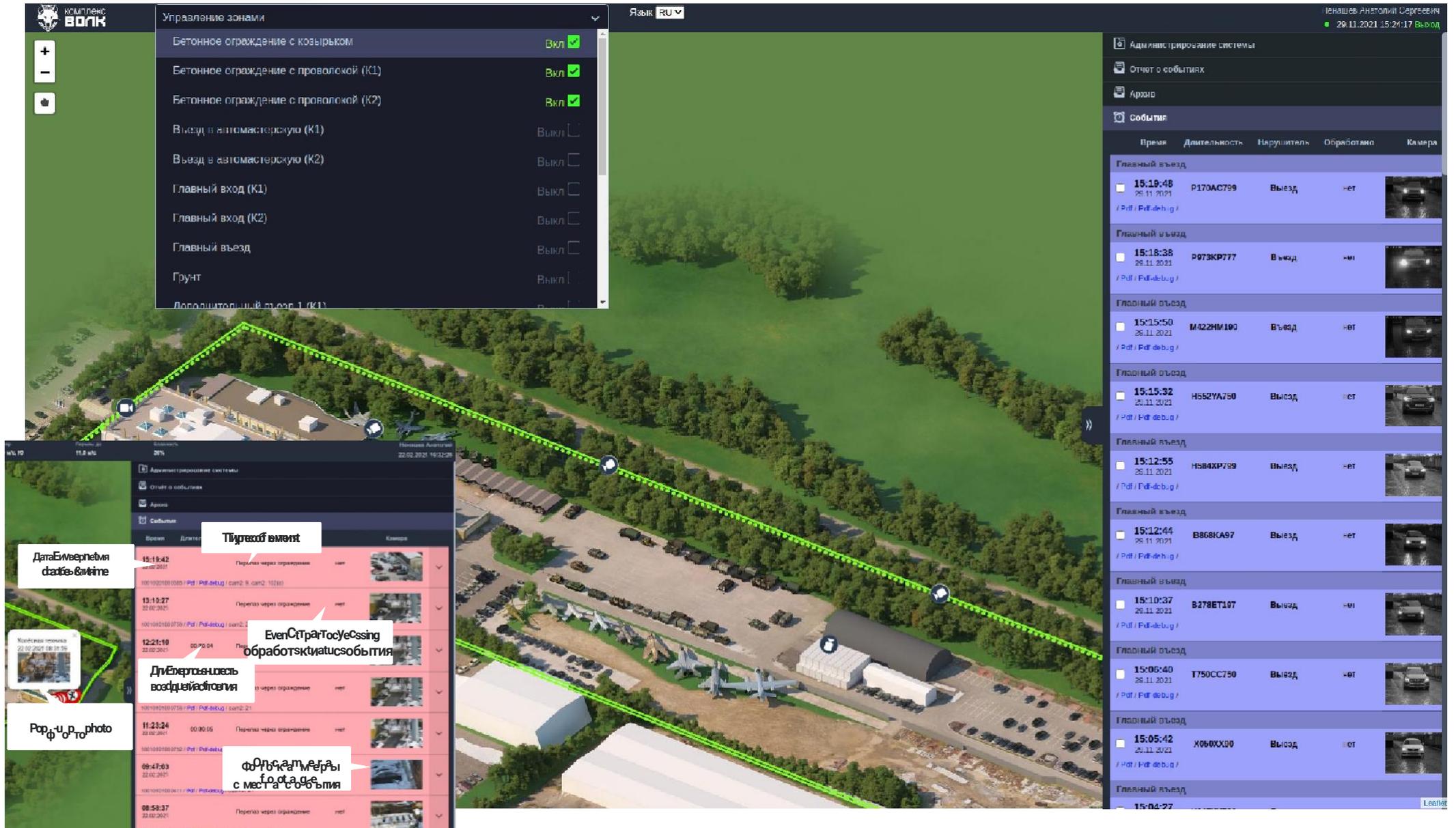
4 For cable routing through brick pillars, it is necessary to make a through channel

## "WOLF" system operator automated workplace



### Opportunities:

- Manage the devices placed on the graphic layout:
  - start emergency recording on the required camera;
  - switch on audio broadcasting from the microphone;
  - arm or disarm the device;
  - close/open the relay of the control unit;
  - accept/reset an alarm;
  - control to Access Control and Management System devices;
  - broadcast on the selected camera.
- Access control to the object:
  - use of the integrated access control and management system;
  - face recognition module;
  - license plate recognition module.



**Управление зонами**

- Бетонное ограждение с козырьком
- Бетонное ограждение с проволокой (К1)
- Бетонное ограждение с проволокой (К2)
- Въезд в автомастерскую (К1)
- Въезд в автомастерскую (К2)
- Главный вход (К1)
- Главный вход (К2)
- Главный въезд
- Грунт
- Дорожительно-технический проезд 1 (К1)

**События**

Время	Длительность	Нарушитель	Обработано	Камера
15:19:48 28.11.2021	P170AC709	Выезд	нет	
15:18:38 28.11.2021	P073KP777	Выезд	нет	
15:15:50 28.11.2021	M422HM100	Выезд	нет	
15:15:32 28.11.2021	H562YA750	Выезд	нет	
15:12:55 28.11.2021	H584XP709	Выезд	нет	
15:12:44 28.11.2021	B868KA97	Выезд	нет	
15:10:37 28.11.2021	B278ET107	Выезд	нет	
15:06:40 28.11.2021	T750CC750	Выезд	нет	
15:05:42 28.11.2021	X060XX00	Выезд	нет	
15:04:27				

**Database events data & time**

**Event processing**

**Photo**

**Order metrics**

The system operator's workplace is designed for displaying the results of monitoring of the guarded boundary, visualization of events against the background of a map or terrain scheme and saving them in the archive.

The software allows you to divide the guard line into flanks and sections without installing additional equipment on the ground.

Besides that, the software allows other third-party systems can be connected to the complex, such as access control and management systems, continuous radiation monitoring systems and other modules based on the specific requirements of the customer.

The software of the complex supports web interface, so the operator can control the complex's operation remotely from a tablet or smartphone.

Tablets and smartphones can also be used as emergency response team, to receive information from the complex from the scene of an alarm online.





# "WOLF" system technical characteristics

The complex performs its functions with preservation of parameters and characteristics at power supply from industrial AC power grid 50±3 Hz, voltage 220±20 V, with automatic transition to power supply from uninterruptible power supply when the voltage goes beyond the specified limits.

The 'WOLF' system, provided that the sensing element is placed in two boundaries, provides:

- **detecting objects of unlawful**  
"Single person" intruder,  
"group intruder", "transport" –  
with a probability of at least **0.95**
- **classification of illegal intrusion to the protected object** by types "single person", "group intruder", "transport" with probability from **0.8 to 0.9**
- **determining the correct direction of the objects of unlawful**  
of a single person,  
"group intruder", "transport" –  
with a probability of at least **0.9**

Characteristics	Meaning
System availability time after power-up, taking into account the operating system boot time	No more than 10 min
Response time (delay time of intruder intrusion notification)	No more than 2 sec
Possibilities of the system for detection range of various objects when the sensitive element is laid in the ground at a depth of 0.3 - 0.45m:	
movement of the intruder or object along the detection zone weighing more than 50kg - working with a shovel (spade) - excavation work - caterpillar movement - heavy-duty wheeled machinery - light wheeled vehicle traffic - fibre optic cable break	No less than 1 m  at least 1-1.5 m at least 10-20 m at least 20-50 m at least 10-20 m at least 5-10 m All the way
The range of detectable speeds of the intruder's movement:	
- pace - jog - vehicle	0.8 - 2.5 m/s 2.5 - 7 m/s 2.8 - 16.7 m/s
Service life	No less than 10 years





# "WOLF" system technical characteristics

**Average false alarm operating time with the length of the linear part of the "WOLF" system of 1 km is as follows**

- with the usage of linear part of the barrier type not less than **700 hours**;
- with the use of non-barrier type linear part not less than **400 hours**;
- with application of linear part of combined type not less than **1500 hours**.

**With a natural combination of the following destabilising factors:**

- precipitation in the form of rain with an intensity **not exceeding 40 mm/hour**;
- of snow with intensity in terms of in terms of water **not exceeding 10 mm/h**;
- the speed of the wind is **not more than 15 metres per second**, with gusts **not exceeding 25 metres per second**;
- grass and snow cover **not more than 1 m high**;
- presence of frost, dew, ice of **not more than 5 mm thickness**.

Characteristics	Meaning
Time to restore the standby mode after the end of the 'ALARM' signal	No more than 20 s
Operating time from autonomous power supply with battery power supply	No more than 2 h (optional)
Length range of the linear part of the product on one boundary (one channel)	1,5 – 70 km
Length range of the linear part of the product for two boundaries (two way)	3 – 140 km
Length of the virtual sensor (resolution disturbance detection capability)	not more than 5 m along the length of the section
Availability of output/input signals:	
- normally open relay contact (activation of the alarm signal)	4
- electronic key type (24V, 0.5A, with short-circuit protection)	12
- input signals with group galvanic isolation	16
Availability of communication protocols with the upper level	HTTP API, OPC UA
Availability of interfaces and communication protocols with controllers	RS485/232
Average operating time per failure of the server part	at least 30 000 hours
Average MTBF of the linear part in the absence of mechanical damage	at least 100 000 hours
Recovery time (excluding spare parts delivery time)	max. 30 min

## BG-Optics develops and manufactures all important components of the WOLF signalling system

● “WOLF” software

● Production:  
control modules for pump lasers,  
highly coherent laser sources  
optical modulators,  
optical receivers

● Design:  
circuit diagrams, printed circuit boards,  
embedded software for the ‘VOLK’ module

● Production:  
fibre optic amplifiers, synchronisation modules,  
tunable filter modules based on fibre Bragg gratings,  
analogue-digital educator

### “WOLF” system additional services and system maintenance

- Identification of System devices having deviations of technical parameters, which may lead to failure or reduction of functional reliability of the system.
- Repair or replace failed devices, including power supplies.
- Detection of cases of incorrect setting, installation and application of the System equipment in inadmissible operating conditions and subsequent correction of modes.
- On-site resolution of disputable issues of technical claims (customer's complaints).
- Training of the customer's personnel, consultations and provision of methodical assistance in practical operation of the System.