Modern innovative informational computer technologies have a considerable influence on industrial development. There are great changes also in fire automatics, the integral part of which are fire robots.

Necessary to mention, that Russia is the first country in the world, where legally and normatively appeared a new type of automatic fire suppression systems – the robotic fire suppression systems. They are included in the federal law of the country about fire safety #123-FZ, the design norms of extinguishing system SP5.15130.2009 and the state standard SP5.15130.2009 for robotic fire suppression systems.

Fire robots have passed through a considerable way of evolution development. This year the first fire robot, created for protection of Kizhi, has a 30th anniversary. The robot was a start of the new direction of fire science – robotic fire suppression technology.

Technological disasters intensified elaborating of fire robots for extreme conditions.

After practical experience of using fire robots, new technologies of fire suppression were researched in Russian Scientific Research Institute of fire defense and Institute of physical-technical problems in Moscow, in State Project Institute “Spezavtomatika” in Leningrad and Laboratory of fire robots in Petrozavodsk.

In these works the new indexes for fire robots were determined, new terms and definitions were invented, practical researches of the stream ballistic were held to make recommendations for use.

The first robotic fire suppression system for protection of machinery halls of Leningrad APS and Petrozavodsk HPP were elaborated and implemented.

Nowadays fire robots and new technologies of fire suppression on their base are used almost in all fields of human activity, connected with fire danger.

Fire robot responds firemen dreams about firefighting much – it monitors deputed protected area and in case of ignition it will direct quickly and accurately a powerful load of water or foam.

Possibility of fire robot, on one side, to replace a human in hazardous conditions, and on other side – to collaborate with him, allows more effective and safe fire extinguishing.

High capacity, address delivery of extinguishing solution, its concentrate feeding onto local place of ignition, flexible system of control, self-testing – this is not full list of technical characteristics of fire robots, that considerably enlarge technical possibilities of fire automatics and increase safety of units in the whole.

Having experience of application of universal monitors with dispersed streams as a part of fire robots and taking into account necessity of these product in the country, «FR» Engineering Centre of Fire Robots Technology had a task to elaborate native modern fire suppression technology in accordance with Russian standards with organizing of its serial production on the specialized factory.

Elaboration of new articles had been held for several years with carrying out of different tests and certification.

Nowadays FR Engineering Centre of Fire Robots Technology is an innovative enterprise and takes a leading position in Russia and CIS in elaboration and manufacturing of fire robots and robotic fire suppression system in accordance with standard GOST R 53326-2009, fire monitors in accordance with GOST R 51115-97 and handline nozzles in accordance with GOST R 53331- 2009.

The range of manufactured production in different modification is more than 200 articles.

The products are certified in accordance with Russian fire safety standards, the requirements of maritime register of shipping and explosion protection.

The products are produced up to the world standards. The novelty of technical decisions is proved by patents.

Among the newly-designed products a whole line of fire monitors with ball socket, water mist mini fire robots and water mist handline nozzles, matrix TV-IR scanners, fire robots on the bolides should be noted.

In the catalogue one can find a wide range of fire robots and robotic fire suppression systems made by «FR». Technical characteristics are given with photos of general view of the articles.

There is detailed information for application of robotic fire suppression system, fire robots and fire monitors for protection of hazardous units, including information necessary for design and construction engineers.
“FR” Engineering Centre of Fire Robots Technology

Certificates, patents, prizes

Certificate of self-regulated organization

«FR» Engineering Centre of Fire Robots Technology LLC is a member of Self-regulated organization “Multiregional building union of designers of fire preventive defense” and has a certificate № P-150-AB-68 dated 26.06.2015, which allows determined type or types of work, that influence on safety of capital projects. Types of work: works on preparing of measures of fire safety.


«FR» Engineering Centre of Fire Robots Technology is certified in the system of international quality standard ISO 9001-2015:

Membership in National Science Academy of Fire Defense

«FR» Engineering Centre of Fire Robots Technology has been a member of Non-Profit Partnership "National Science Academy of Fire Defense" since 2008.

Since 2012 «FR» Engineering Centre of Fire Robots Technology has been a member of methodic committee of technical regulation in the field of fire safety in the National Science Academy of Fire Defense, which was established according to decision of enlarged presidium meeting, academic board and member society of the National Science Academy of Fire Defense.

Patents

At the year-end of 2017 «FR» Engineering Centre of Fire Robots Technology has 19 valid patents of the Russian Federation for its production and 2 international patents.

Diplomas and prizes

The articles of FR Engineering Centre are awarded with gold medal of Exhibition of Economic Achievements, honorary diplomas of international exhibitions and forums.

In 2014 the leading specialists of «FR» Engineering Centre were also awarded a prize of the NANPB in the nominated category “Research and Technological Development” for the range of works with robotic fire suppression system, in 2016 - for the work “Handline nozzles for completing of fire apparatus with automatic adjustment of flow rate and changing spray angle”.

Certificates

Certificates for fire monitors:
- Russian maritime register of shipping type approval certificate № 17.11455.120, date of issue 31.07.2017, is valid until 31.07.2022.
- Certificate № TS RU S-RU.MSH06.V.00102 of conformity for fire monitors of explosion-proof modification, date of issue 20.08.2015 , is valid until 20.08.2020.

Certificates for handline nozzles
- Russian maritime register of shipping type approval certificate №17.11453.120, date of issue 31.07.2017, is valid until 31.07.2022.

Certificates for robotic fire suppression system
- Russian maritime register of shipping type approval certificate №17.11469.120, date of issue 29.08.2017, is valid until 29.08.2022.

Certificates for control box for fire monitors and for drives of explosion-proof modification
- Certificate № TS RU S-RU.MSH06.V.00093 of conformity for control box, date of issue 11.08.2015 r., is valid until 11.08.2020.
- Certificate № TS RU S-RU.MSH06.V.00093 of conformity for electric drives ED.32, ED.33, ED36, date of issue 03.08.2015, is valid until 13.08.2020.
Classification of firefighting equipment

1. Fire monitors

The fire monitors meet the requirements of GOST R 51115-97 and TU 4854-003-16820082-2008; they classified in accordance with GOST R 51115-97:

- LS – fire monitor
- S – fixed
- V – vehicle-mounted
- P – portable, mobile
- U – universal, forming straight and dispersed water or foam stream
- without index "U" - forming the straight stream of water and foam
- D – remote-controlled
- without index "D" - manually-operated
- 10-330 - flow rate of water and foam former solution, l/sec.

An example of description for a water/foam universal fixed remote-controlled fire monitor with the flow rate of 100 l/sec is given: LSD-S100U.

For articles made by «FR» Engineering Centre of Fire Robots Technology in accordance with TU 4854-003-16820082 -2008 the additional index in the article type definition is given, which should be in the end of the article type definition in accordance with GOST, after index U to classify:

1. Constructive modification of fire monitor:
   - U – tube construction
   - Ul – with lower installation of monitor
   - Uul – with upper and lower (variable) installation of monitor
   - without index «D» - with upper installation of monitor
   - Ub – with ball-socket

2. Types of nozzles:
   - U – with dispersed stream, universal (main modification)
   - without index U - with straight stream, conic
   - Ui – impact
   - Ue – with self-educting foam nozzle
   - Ua – with automatic nozzle
   - Ud – with deflector

3. Additional devices:
   - U – without additional devices
   - Uss – with shielding screen device
   - Uo – with oscillator

4. Extinguishing solution:
   - U – water/foam (combined monitor)
   - Up – powder (powder monitor)
   - Usk - for formation of medium expansion foam ratio streams

After definition of monitor type the information of equipment modification for the conditions of environment is given:

1. Climatic modification:
   - TC, T, U1M - fire robots are produced in general industrial and marine modification

2. Protection type:
   - Ex – explosion-proof, 1ExdIICT4 – type of 1ExdIICT4 explosion proof

IP55, IP65, IP66, IP67 - dust and moisture proof

2. Handline nozzles

Handline nozzles meet the requirements of GOST R 53331-2009 and TU 4854-004-16820082-2008 and are classified in accordance with GOST P 53331-2009:

- RSKU - combined universal handline nozzles,
- 20, 50, 70 - swivel base,
- HP - high pressure,
- without HP index - normal pressure,
- WM - for formation of water mist stream.

The following types of «FR» handline nozzles are produced:

- RSKU-50A, RSKU-70A - combined (water-foam) universal handline nozzles with adjusting of flow rate and angle of a dispersed stream, with swivel base 50 and 70.
- RSKU-50B - handline nozzle with constant flow rate of 4 l/s.
- RSKU-50e, RSKU-70e - the same, with educting of foam from backpack, with possibility of immediate switching from water to foam and back, with swivel base 50 and 70.
- RSKU-50A, RSKU-70A FIREMAN'S AUTOMAT® – automatic combined, universal handline nozzle, with automatic control of the pressure in the set range, with adjustable stream spray angle, with swivel base 50 and 70, with flow rate from 2 up to 8 l/sec and from 4 up to 15 l/sec.
- RSKU-50A «FLUSH» – automatic, combined, universal handline nozzle, with automatic control of the pressure in the set range, with adjustable stream spray angle, with swivel base 50, with flow rate from 2 up to 9 l/sec.
- RSKU-20HP – high pressure universal handline nozzle with adjustable flow rate and stream angle, with shielding screen 120°.
- RSKU-20WM - water mist handline nozzle of normal pressure for formation of water mist streams.

Note: Upon customer’s request the handline nozzles are completed with foam generators.

3. Robotic fire suppression system

Robotic fire suppression systems meet the requirement of GOST R 53326-2009 and TU 4854-005-16820082-2005, and are designated as follows:

- RFSS - robotic fire suppression system
- 2(128)FR - fire robots (FR) and as a component of RFSS,
- LSD-S20(100)U - type of fire monitor, included in FR,
- IR- with ignition detector device in IR-range,
- IR-TV - with ignition detector device in IR-range and TV-camera,
- WM - for formation of water mist stream.

Example of the designation of the RFSS with 6 FR with fire monitors (LSD) with flow rate 20 l/s with ignition detector device in IR-range (IR), TV-cameras (TV) in accordance with GOST 53326-2009: RFSS-6FR-LSD-S20U-IR-TV.
# Product range

## 1. Fire monitors

<table>
<thead>
<tr>
<th>Modifications</th>
<th>Flow rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20 l/sec</td>
</tr>
<tr>
<td>Fixed manually-operated fire monitors</td>
<td></td>
</tr>
<tr>
<td>With conic nozzle</td>
<td>LS-S20</td>
</tr>
<tr>
<td>Universal piped</td>
<td>LS-S20(15,25)U</td>
</tr>
<tr>
<td>With automatic nozzle</td>
<td>LS-S20Ua</td>
</tr>
<tr>
<td>With oscillator</td>
<td>LS-S20(15,25)Uo</td>
</tr>
<tr>
<td>With foam eductor</td>
<td>LS-S20Ue</td>
</tr>
<tr>
<td>For formation of medium expansion foam ratio streams</td>
<td>LS-S20(15,25)Usk</td>
</tr>
<tr>
<td>With deflector</td>
<td>LS-S20Ud</td>
</tr>
<tr>
<td>With ball socket*</td>
<td>LS-S20(15,25)Ub</td>
</tr>
<tr>
<td>Fixed remote-controlled fire monitors</td>
<td></td>
</tr>
<tr>
<td>Universal piped</td>
<td>LSD-S20(15,25)U</td>
</tr>
<tr>
<td>With automatic nozzle</td>
<td>LSD-S20Ua</td>
</tr>
<tr>
<td>With foam eductor</td>
<td>LSD-S20Ue</td>
</tr>
<tr>
<td>For formation of medium expansion foam ratio streams</td>
<td>LSD-S20(15,25)Usk</td>
</tr>
<tr>
<td>Impact</td>
<td>LSD-S20(15,25)Uul</td>
</tr>
<tr>
<td>With ball socket</td>
<td>LSD-S20(15,25)Ub</td>
</tr>
<tr>
<td>Portable remotely-operated fire monitors</td>
<td></td>
</tr>
<tr>
<td>Universal piped</td>
<td>LS-P20(15,25)U</td>
</tr>
<tr>
<td>With oscillator</td>
<td>LS-P20(15,25)Uo</td>
</tr>
<tr>
<td>With foam eductor</td>
<td>LS-P20Ue</td>
</tr>
<tr>
<td>With ball socket</td>
<td>LS-P20(15,25)Ub</td>
</tr>
<tr>
<td>Portable remote-controlled fire monitors</td>
<td></td>
</tr>
<tr>
<td>Universal piped</td>
<td>LSD-P20(15,25)U</td>
</tr>
<tr>
<td>With ball socket</td>
<td>LSD-P20(15,25)Ub</td>
</tr>
<tr>
<td>Fire monitors with quick-release connection*</td>
<td></td>
</tr>
<tr>
<td>Quick-release</td>
<td>LS-P/S20(15,25)U</td>
</tr>
<tr>
<td>Fixed powder fire monitors</td>
<td></td>
</tr>
<tr>
<td>Manually-controlled</td>
<td>LS-S20Up</td>
</tr>
<tr>
<td>Remote-controlled</td>
<td>LSD-S20Up</td>
</tr>
<tr>
<td>Fixed remotely-controlled explosion-proof fire monitors</td>
<td></td>
</tr>
<tr>
<td>With induction motor</td>
<td>LSD-S20(15,25)U-Ex</td>
</tr>
<tr>
<td>With direct current motor</td>
<td>LSD-S20(15,25)U-Ex</td>
</tr>
<tr>
<td>Vehicle-mounted fire monitors</td>
<td></td>
</tr>
<tr>
<td>For dispersed streams</td>
<td>LS-V60(50,70,80)U</td>
</tr>
<tr>
<td>With foam eductor</td>
<td>LS-V60(50,70,80)U</td>
</tr>
</tbody>
</table>

**Note:**

* - fire monitors may have additional options a, e, d, ss, o in different combinations according to accepted classification.
1.1. Component parts to add to a complete fire monitor set

<table>
<thead>
<tr>
<th>Modifications</th>
<th>Name</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completeness</td>
<td>of the LSD with DC electric drives in</td>
<td>of the LSD in explosion-proof modification:</td>
</tr>
<tr>
<td>in general</td>
<td>general industrial modification:</td>
<td>BVE-80-Ex, BVE-100-Ex - butterfly valve</td>
</tr>
<tr>
<td></td>
<td>BVE-80, BVE-100 - butterfly valve with</td>
<td>with electric drive in explosion-proof</td>
</tr>
<tr>
<td></td>
<td>electric drive</td>
<td>modification</td>
</tr>
<tr>
<td></td>
<td>RCC – remote control console</td>
<td>CB-1B4 - control box for LSD-Ex 380/220 V</td>
</tr>
<tr>
<td></td>
<td>BP-2R-P – power supply unit for fire</td>
<td>in general industrial modification</td>
</tr>
<tr>
<td></td>
<td>robots</td>
<td>CB-1B7 - control box for LSD-Ex 220 V</td>
</tr>
<tr>
<td>Extra</td>
<td>for the LS and LSD:</td>
<td>in general industrial modification</td>
</tr>
<tr>
<td></td>
<td>equipment</td>
<td>CB-Ex EDA.5 (EDA.3) - control box for</td>
</tr>
<tr>
<td></td>
<td></td>
<td>asynchronous AC electric drives fire</td>
</tr>
<tr>
<td></td>
<td>SS – shielding screen device</td>
<td>monitors in explosion-proof modification</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CB-Ex EDD.2 - control box for DC electric</td>
</tr>
<tr>
<td></td>
<td></td>
<td>drives in explosion-proof modification</td>
</tr>
</tbody>
</table>

2. Handline nozzles

<table>
<thead>
<tr>
<th>Modifications</th>
<th>Du-20</th>
<th>Du-50</th>
<th>Du-70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universal</td>
<td>RSKU-50A</td>
<td>RSKU-70A</td>
<td></td>
</tr>
<tr>
<td>With foam eductor</td>
<td>RSKU-50e</td>
<td>RSKU-70e</td>
<td></td>
</tr>
<tr>
<td>Automatic</td>
<td>RSKU-50A-FA</td>
<td>RSKU-70A-FA</td>
<td></td>
</tr>
<tr>
<td>Automatic «Flush»</td>
<td>RSKU-50A-FA «Flush»</td>
<td></td>
<td></td>
</tr>
<tr>
<td>With constant flow rate of 4 l/s</td>
<td>RSKU-50B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water mist of high pressure</td>
<td>RSKU-20HP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water mist of normal pressure</td>
<td>RSKU-20WM</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Upon customer’s request the handline nozzles are completed with foam generators.

3. Fire robots (FR) and robotic fire suppression system (RFSS)

<table>
<thead>
<tr>
<th>Modifications</th>
<th>4 l/sec</th>
<th>5,10 l/sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water mist mini fire robots (installed on the ceiling)</td>
<td>FR-LSD-S4Ub-IR</td>
<td></td>
</tr>
<tr>
<td>With dispersed streams</td>
<td>FR-LSD-S4Ub-IR</td>
<td></td>
</tr>
<tr>
<td>With water mist streams</td>
<td>FR-LSD-S4Ub-IR</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modifications</th>
<th>20 l/sec</th>
<th>40 l/sec</th>
<th>60 l/sec</th>
<th>100 l/sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program-controlled</td>
<td>FR-LSD-S20(15,25)U</td>
<td>FR-LSD-S40(20,30)U</td>
<td>FR-LSD-S60(50,70,80)U</td>
<td>FR-LSD-S100(70,80,90,125)U</td>
</tr>
<tr>
<td>With IR scanner</td>
<td>FR-LSD-S20(15,25)U-IR</td>
<td>FR-LSD-S40(20,30)U-IR</td>
<td>FR-LSD-S60(50,70,80)U-IR</td>
<td>FR-LSD-S100(70,80,90,125)U-IR</td>
</tr>
<tr>
<td>With IR scanner and TV</td>
<td>FR-LSD-S20(15,25)U-IR-TV</td>
<td>FR-LSD-S40(20,30)U-IR-TV</td>
<td>FR-LSD-S60(50,70,80)U-IR-TV</td>
<td>FR-LSD-S100(70,80,90,125)U-IR-TV</td>
</tr>
<tr>
<td>Program-controlled with radio channel</td>
<td>FR-LSD-P20(15,25)U</td>
<td>FR-LSD-P40(20,30)U</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed fire robots of general industrial modification*</td>
<td>FR-LSD-S100(70,80,90,125)U</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modifications</th>
<th>4 l/sec</th>
<th>5,10 l/sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed fire robots of explosion-proof modification</td>
<td>FR-LSD-S100(70,80,90,125)U</td>
<td></td>
</tr>
<tr>
<td>With IR scanner and/or TV-camera</td>
<td>FR-LSD-S20(15,25)U-Ex-IR-(TV)</td>
<td>FR-LSD-S40(20,30)U-Ex-IR-(TV)</td>
</tr>
<tr>
<td>Robotic fire suppression system of general industri* and explosion-proof modification</td>
<td>FR-LSD-S100(70,80,90,125)U-Ex-IR-(TV)</td>
<td></td>
</tr>
<tr>
<td>Program-controlled</td>
<td>RFSS-2(128)FR-LSD-S20(100)U(b)-(Ex)</td>
<td></td>
</tr>
<tr>
<td>With IR scanner and/or TV-camera</td>
<td>RFSS-2(128)FR-LSD-S20(100)U(b)-(Ex)-IR-(TV)</td>
<td></td>
</tr>
</tbody>
</table>

*Note: are produced in pipe and ball socket construction

4. Fire towers

<table>
<thead>
<tr>
<th>Name</th>
<th>Description and characteristics of fire monitors, handline nozzles, fire towers and components parts (items 1, 2, 4, 5 of product range can be found in additional catalogue)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FT-2, FT-2.5, FT-3, FT-4, FT-5, FT-6, FT-9, FT-10...</td>
<td>- Fire tower with site for LS work of 2, 2.5, 3, 4, 5, 6, 9, 10... m</td>
</tr>
</tbody>
</table>

*Note: Upon customer’s request the fire towers are produced up to 30 m in height

Note: Description and characteristics of fire monitors, handline nozzles, fire towers and components parts (items 1, 2, 4, 5 of product range can be found in additional catalogue)
Fire robots.
General types

FR-LSD-S20(15,25)U
FR-LSD-S20(15,25)U-IR
FR-LSD-S20(15,25)Ub-IR
FR-LSD-S20(15,25)Ub-IR in vandal-proof modification
FR-LSD-S10Ub-IR mini fire robot
FR-LSD-S40(20,30)U
FR-LSD-S40(20,30)U-IR
FR-LSD-S40(20,30)U-IR with foam eductor
FR-LSD-S40(20,30)U-Ех
FR-LSD-S40(20,30)U-Ех-IR-TV
FR-LSD-S60(50,70,80)U
FR-LSD-S60(50,70,80)U-Ex-IR-TV
Fire robots
Specifications

General information, purpose and application
Fire robots are produced in accordance to Russian national standard GOST R 53326-2009 and TU 4854-005-16820082-2005. They are applied for formation of extinguishing solution stream with adjustable stream spray angle from a straight stream to a dispersed stream with 90 degree spray angle, automatic extinguishing as a component of the robotic fire suppression system.

Fire robot is used for fire extinguishing, cooling of building and technological structures, suppression of clouds of toxic or radioactive gases, fume and dust.

Fire robots are produced in general industrial, marine and explosion-proof modification.

Fire robots are produced on the basis of remote-controlled fire monitors and are divided into three types:
- **FR without IR scanners** – carry out extinguishing and cooling of the protected objects within the area according to the program after receiving of an external signal to start the operation.
- **FR with IR scanners** – deliver a fire-extinguishing agent directly to the source of fire after receiving of an external signal to start the operation and defining of the ignition coordinates.
- **FR with IR-TV** - FR with IR-TV - with the device of detection of fire in the IR range and a television camera.

FR are equipped with three DC electric drives (control of the monitor rotation vertically and horizontally, control of the stream spray angle).

Specifications

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>FR-LSD-S20</th>
<th>FR-LSD-S40(20,30)U-IR-TV</th>
<th>FR-LSD-S60(50,70,80)U-IR-TV</th>
<th>FR-LSD-S100(70,80,90,125)U-IR-TV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Coordinate system</td>
<td>Spherical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Movable operating element</td>
<td>Monitor with nozzle, forming a dispersed water stream</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Motion speed, °/sec</td>
<td>3 - 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Nominal pressure, MPa</td>
<td>0,6</td>
<td>0,6</td>
<td>0,6</td>
<td>0,8</td>
</tr>
<tr>
<td>5. Operating pressure range, MPa</td>
<td>0,4-1,0</td>
<td>0,4-1,0</td>
<td>0,4-1,0</td>
<td>0,4-1,0</td>
</tr>
<tr>
<td>6. Water flow rate, l/sec</td>
<td>15 20 25</td>
<td>20 30 40</td>
<td>50 60 70 80</td>
<td>70 80 90 100 125</td>
</tr>
<tr>
<td>7. Water foam solution flow rate, l/s</td>
<td>15 20 25</td>
<td>20 30 40</td>
<td>50 60 70 80</td>
<td>70 80 90 100 125</td>
</tr>
<tr>
<td>8. Range at nominal pressure, m, of:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- straight water stream</td>
<td>50 55 59</td>
<td>55 62 65</td>
<td>70 72 75 78</td>
<td>83 87 95 100 105</td>
</tr>
<tr>
<td>- dispersed stream (at a 30° angle)</td>
<td>31 34 35</td>
<td>34 38 42</td>
<td>43 44 46 50</td>
<td>51 53 58 61 65</td>
</tr>
<tr>
<td>- straight foam stream</td>
<td>44 47 49</td>
<td>47 53 55</td>
<td>60 63 65 70</td>
<td>70 74 81 85 87</td>
</tr>
<tr>
<td>9. Monitor rotation, °</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- in a vertical plane</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- in a horizontal plane</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Variation range of stream angle, °</td>
<td></td>
<td></td>
<td></td>
<td>0-90</td>
</tr>
<tr>
<td>11. Foam expansion ratio, not less than</td>
<td></td>
<td></td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>12. Ignition detection device</td>
<td>IR scanner, IR scanner and a television camera</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Connection with external devices</td>
<td></td>
<td></td>
<td></td>
<td>with the interface RS-485</td>
</tr>
<tr>
<td>14. Operating life, years</td>
<td></td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>15. Weight, kg, not more than</td>
<td>42</td>
<td>43</td>
<td>45</td>
<td>60</td>
</tr>
</tbody>
</table>

Notes:
1) Streams range capacities are given under the conditions that maximum discharge of fire-extinguishing liquid is used, with the angle of slope of monitor to the horizon of 30 degrees, which is fixed in operating position.
2) Foam ratio is given under the condition that general-purpose foam former solution TEAC TU-2481-005-45811049-01 is used.
3) Modifications of fire robots (FR) concerning discharge, installation methods (portable, vehicle-mounted, on platform, on lifting gear), types of explosion protection, dust and damp proof, use of eductor for supply of foam former solution, impulse nozzles and video monitoring are made at the request of customer.
Robotic fire suppression system (RFSS)

General information, purpose and application

Robotic fire suppression systems are produced in accordance with the requirements of GOST R 53326-2009 and TU 4854-005-16820082-2005.

Robotic fire suppression system (RFSS) is designed:
- for fire containment and fire suppression;
- for cooling of the load-bearing structures of the building cover and protected facilities located in a close proximity to the seat of the fire.

RFSSs are used to protect industrial and public buildings, high-floored structures and outdoor installations (hangars for aircrafts and helicopters, production facilities, machinery halls of nuclear power plants and thermal power plants, storage facilities, including rack storage facilities, timber storages, oil tank farms, railcar loading and unloading racks, berths and berth complexes, railway and road tunnels, long-distance ships, including tankers, bulk carriers, container bulker, offshore platforms, multifunctional buildings, buildings for sports and entertainment events, monuments of wooden architecture.

RFSS includes two or more fixed fire robots (robotic monitors), control system, shut-off devices with electric drive.

The composition and quantity of technical means of RFSS is determined by its purpose and application at a particular facility.

The technical equipment (TE) of RFSS are given in Table 1.

An example of the designation of the RFSS for eight fire robots with a flow rate of 60 l/s with an detection device in the IR range: RFSS-8FR-LSD-S60 (50,70,80)U-IR, in accordance with TU 4854-005-16820082-2005

RFSS technical equipment:

<table>
<thead>
<tr>
<th>Name</th>
<th>Composition</th>
</tr>
</thead>
</table>
| Technical equipment for fire hazardous areas (is installed on the protected object) | Fire robot  
IR scanners  
Butterfly valve with electric drive BVE  
Power supply unit BP-2R / BP-2R-P / BP-2R-T /BP-2R-T-P  
Foam solution level controller KUP-1  
Liquid level controller device UKU-1  
Foam solutions tanks (for 200, 400, 600 l)  
Normally closed butterfly valves EVZZ0V-40V |
| Technical equipment for explosion and fire-hazardous areas (is installed on the protected object) | Fire robot in explosion-proof modification 1ExdIICT4  
IR scanners in explosion-proof modification 1ExdIICT4  
Butterfly valve with electric drive in explosion-proof modification BVE 1ExdIIIBT6  
Control box for DC electric drives in explosion-proof modification CB-Ex EDD 1ExdIIIBT4 |
| Technical control equipment (is installed in the constantly attended location) | Central control device control box CB-CCD  
Personal computer  
UPS for computer  
Network controller control box CB-NC  
Control unit for connection of 2 wire-connected remote control consoles PDU-P  
Radio channel unit BRK  
Radio remote control console PDU-R  
Switch unit BK-16 for 16 input/ 16 output  
Dispatch system |

Software

“Configuration of the robotic fire suppression system RFSS”  
“Monitoring of the RFSS”

CB-NC is designed for the organization of the RS-485 control bus between CB-CCD and other technical equipment of RFSS:
- control unit with connectors for two remote control consoles PDU-P;
- radio channel unit BRK;
- FR in general industrial modification;
- butterfly valves with electric drive BVE;
- controllers of the level of foaming agent KUP-1;
- Control boxes CB-Ex EDD.

Number of the connected devices:
- central control device control box CB-CCD - 1 pc.;
- remote control consoles PDU-P together with BRK - up to 4 units;
- butterfly valves with electric drive BVE - up to 32 pcs.;
- foam solution level controller KUP-1 - is determined depending of the number of foam solution tanks;
- FR in general industrial modification - up to 32 pcs.;
- control boxes CB-1B7-UI, CB-Ex EDD - up to 32 pieces.

The number of connected units could be increased if it is required for the protection of the object.

FR in explosion-proof modification and butterfly valves in explosion-proof modification with electric drive are connected to the internal control bus of the control boxes CB-Ex EDD.

The RFSS is used together with the automatic installation of fire alarm and video surveillance system which are designed to
detect a fire at an early stage, transmit a fire signal to the security room (fire station) and generate a signal for the start-up of the fire extinguishing system, as also to promptly monitor the situation in the fire zone.

In addition, the services for remote monitoring of RFSS by specialists of the service organization via Internet or GSM communication channels are provided. The monitoring allows to obtain information about the state of the RFSS in real time, that increases the efficiency of RFSS services.

**Operation of robotic fire suppression system**

If addressable flame detectors start signaling, the control console gives light alarm with a number of stub and voice alarm. Multiple interface unit transmits a fire signal to central control device (CCD) of the robotic fire suppression system and the program of fire extinguishing starts.

There are 4 possible operating modes of the RFSS:
- automatic,
- start lockout,
- remote,
- manual.

**Automatic operating mode of RFSS**

The initiator of the RFSS operation in automatic mode is the automatic fire alarm system (AFAS).

To reduce the inertia of operation of the installation and to increase the accuracy of registration of the source of fire, it is recommended to use addressable flame detectors as general or zone vision detectors or to output each non-addressable flame detector to its circuit on the fire alarm control panel. Fire alarm control panels should be installed in constantly attended location with the presence of duty personnel.

The location of the automatic general or zone vision fire detectors should be selected taking into account their technical parameters, fire factors, architectural and planning features of the protected areas, design features of the processing equipment, and the requirements of SP 5.13130.

Each automatic zone vision fire detector or group of detectors that control one zone must identify only the zone controlled by them.

Generation of commands for the fire-extinguishing agent supply to a specific scanning zone for the FRs that are not equipped with IR scanners should be performed at activating of two general vision detectors or two zone vision detectors triggered by the "AND" logic circuit in accordance with SP 5.13130.

Generation of a command to move the FR, equipped with IR scanners, in order to specify the coordinates of the source of fire should be performed at activating one of the general vision detectors or one of the zone vision detectors triggered by the "OR" logic circuit in accordance with SP 5.13130.

Generation of a control command for the fire-extinguishing agent supply should be performed at fire detection by the two FR scanners installed on two FRs.

**Option 1. Irrigation of the extinguishing zone without specifying the ignition coordinates.** The FRs are not equipped with IR scanners.

The operation algorithm of the installation:
- the automatic fire alarm system (AFAS) transfers a fire signal ("AND" logic circuit) from a certain zone of the protected object to the switching unit BK-16 with subsequent transmission to the CB-CCD;
- the control box CB-CCD transfers a signal to two FRs located in the specified zone of the protected object to open their butterfly valves for fire-extinguishing agent supply and to carry out extinguishing due to the program (the program of operation of the RFSS by the fire alarm system signals is determined at the design stage and is put into the software of the complex during production).

**Option 2. Irrigation of the extinguishing zone with defining of the ignition coordinates.** FRs are equipped with IR scanners.

The operation algorithm of the installation:
- the automatic fire alarm system (AFAS) transfers a fire signal ("AND" logic circuit) from a certain zone of the protected object to the switching unit BK-16 with subsequent transmission to the CB-CCD;
- the control box CB-CCD transfers a signal to two FRs located in the specified zone of the protected object to search of the seat of the fire;
- the IR scanners installed on the FR begin to search for the seat of the fire site with the subsequent transfer to the CB-CCD;
- the CB-CCD after defining of the coordinates of the seat of the fire gives a signal to the two optimally close located FRs to start extinguishing (to open the butterfly valves and operating due to the program).

When starting the RFSS for fire-extinguishing the control box CB-CCD creates the following commands:
- disconnection of operational and electrical equipment (if necessary), of ventilation;
- start-up of the public fire alarm system;
- start-up of the pumps and the pumps shutdown.

Each point of the fire ignition should be within the range of the two FRs. At short distances, up to 15 m, fire extinguishing is carried out at adjusted spray angle, at large distances, fire extinguishing is carried out over the area with straight streams.

**Start lockout mode**

The start lockout mode is turned on and off by the operator. Wherein:
- fire monitors are being stopped and locked
- butterfly valves are being closed and locked
- input / output devices are being turned off and locked

In the start lockout mode:
- control of the fire monitors and butterfly valves is disabled
- fire suppression is not carried out.

All the devices that were locked while starting the mode are being unlocked when you exit the mode.

**Remote operating mode of RFSS**

The remote mode is used during start-up and commissioning works and direct visual control at site.

In this mode the control is carried out through the remote control console (PDU connected to the FR junction box or to the CCD connector, or carried out through the radio remote control console (PDU-R2) in the radio signal coverage area. It is possible to execute the following commands:
- selection of FR for control;
- opening / closing of the butterfly valve and solenoid valve;
- targeting of the FR (rotation in the horizontal and vertical planes);
- setting of the FR rotation speed - 8 speeds;
- adjusting of the stream angle;
- setting of operational control (inline scanning of a spherical
square) and recording of the operative program parameters in non-volatile memory of FR - 8 programs;
- start / stop of the operative program;
- setting of the limits of FR rotation in the vertical and horizontal planes.
The output of the information on the state of the controlled FR is provided on the display of the remote control consoles PDU or PDU-R2:
- level of the PRs set speed;
- information on the operation of electric drives;
- value of the active electric drive current;
- value of water pressure;
- state of the butterfly valve ("open" / "closed");

- information on the alarm status.

**Manual mode of robotic fire suppression system**
Manual mode is applied in case of emergency switch off of power supply network. In this mode the following actions could be carried out:
a) moving of fire robot “Left”, “Right”, “Up”, “Down” by handle for manual control;
b) control of stream spray angle “Wide”, “Narrow” by rotating of outer race of nozzle by using of handles on the nozzle’s base;
c) control of butterfly valve “Open”, “Close” by handle for manual control.
Self-targeting spraying mini fire robots

General information, purpose and application
The fire robots are water-foam, universal, with program (remote) control, fixed, with IR scanners. The fire robots are manufactured in two modifications:
- with flow rates 5, 10 l/sec – for formation of dispersed streams,
- with flow rates 4 l/sec – for formation of water mist stream.
They are applied for formation of a stream of extinguishing solution with the option to change the stream spray angle from a straight stream to a dispersed stream with 120 degree spray angle as a component of the automatic robotic fire suppression system.

Features:
- mini fire robots are controlled by infrared detection device targeting on the fire location;
- IR scanner sensitivity is 0,1 m² at a distance of 20 m;
- mini fire robots are installed on the ceiling of the protected facility.

Advantages:
- large protected areas;
- damage reduction;
- economic efficiency;
- easy installation.

Field of application:
- trade, exhibition, sports complexes and administrative buildings, museums, libraries, books stacks hotels, hospitals etc. (water extinguishing);
- production and storage facilities (woodworking industry, textile, knitwear, pulp and paper, printing manufactures etc.), parking areas (foam extinguishing).

Water mist fire robots are effective for protection of buildings and objects, where it is necessary to minimize the volume of the supplied water during fire extinguishing because of the shortage of water or inadmissibility of hit on objects of excessive amount of liquid, for example, the museums, libraries.

Technical data:

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>FR-LSD-S4Ub-WM-IR</th>
<th>FR-LSD-S10Ub-IR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordinate system</td>
<td>Spherical</td>
<td></td>
</tr>
<tr>
<td>Movable operating element</td>
<td>Monitor with nozzle</td>
<td></td>
</tr>
<tr>
<td>Angle rotation speed, °/sec</td>
<td>3 - 12</td>
<td></td>
</tr>
<tr>
<td>Operating pressure range, MPa</td>
<td>0,4-1,7</td>
<td>0,3 - 0,6</td>
</tr>
<tr>
<td>Nominal pressure, MPa</td>
<td>0,5</td>
<td>0,6</td>
</tr>
<tr>
<td>Flow rate of water (foam agent solution) under nominal pressure, l/s, not less than</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Range at nominal pressure, m, of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- straight water stream</td>
<td>25</td>
<td>26</td>
</tr>
<tr>
<td>- dispersed stream (at a 30° angle)</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>- straight foam stream</td>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td>Average mean droplet diameter, micrometer, not more than</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>Monitor rotation, a°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- in a vertical plane</td>
<td>420</td>
<td>360</td>
</tr>
<tr>
<td>- in a horizontal plane</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Variation range of stream angle, a°</td>
<td>0-120</td>
<td>0-120</td>
</tr>
<tr>
<td>Foam expansion ratio, not less than</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Ignition detection device</td>
<td>1. IR scanner, 2. IR matrix</td>
<td>3. IR matrix with the detection device of fire ignition in visible range.</td>
</tr>
<tr>
<td>Connection with external devices</td>
<td>with the interface RS-485</td>
<td></td>
</tr>
<tr>
<td>Weight, kg, not more than</td>
<td>6,5</td>
<td>7,5</td>
</tr>
</tbody>
</table>
Robotic fire suppression system (RFSS) based on mini fire robots

Purpose:
- fire extinguishing and fire containment,
- cooling of roof framing of buildings and protected objects, located very close to the source of fire.

RFSS configuration:
- two or more fire robots (FR)
- solenoïd valves DN 50
- control system (CS)

Note: RFSS configuration is completed by the designer in accordance with the specific object of application.

Operating procedure:
- The fire alarm system issues a fire signal to the RFSS control system.
- IR scanners installed on the fire robot, start searching for a source of fire. The coordinates of the source of fire are transferred to the control system.
- After detection of the coordinates of the source of fire the control system transmits a signal to the fire robot, optimally located to the source of fire, to open the valve/valves for supply of the extinguishing agent.

Note: *general or zone signals from the system could be transferred into the RFSS control system (it is specified at the design stage). There is a possibility of remote control with the remote control console RCC.

Spraying diagram depending on the elevation angle of the fire robot

Fire extinguishing is carried out within the burning area up to 120 m² by stream scanning.
Automatic fire-extinguishing system based on fire monitors with oscillators

General information, purpose, application
Automatic fire-extinguishing system based on fire monitors with oscillators (the automatic system) belong to automatic fire-extinguishing system and are used for water and foam fire extinguishing by straight and adjustable spray angle and for protection of industrial and civil facilities. Automatic systems are able to provide high intensity of watering and are an effective option instead of drencher automatic systems of fire suppression. One fire monitor can replace hundred irrigators and a tube network is limited only by a main tube line. Automatic systems are used for reservoirs of oil products cooling, protection of shelving storages, energetic units and for making of water shields. Fire monitors with oscillators are produced with butterfly valve, with foam eductor and deflector nozzles under GOST R 51115-97 and Technical requirements of “FR”: Fire monitors with oscillators – TU 4854-003-16820082-2008, butterfly valve, foam eductor and deflector nozzles -TU 4854-003-16820082-2008.

Automatic system design
Choice and location of fire monitors with oscillators, angles of oscillation and number of fire monitors operating at the same time should be determined when designing taking into account features of the specific facility. Automatic system location should include extended nonutilizable for extinguishing solution areas. It is allowed to use sprinkler, drencher or other local systems of fire suppression in these areas. The average intensity of watering should be determined as a ratio of the total flow rate of active firefighting monitors (l/sec) to watering area (m2) during the cycle (sec) and it should be less than normal intensity of watering set for drencher systems. The automatic system operates:
- in the mode of automatic watering the area of extinguishing;
- in the remote mode to control a butterfly valve by a control console;

The automatic system makes signals for switching on a fire hose, closing devices with electric drives, start of an acoustic and light alarm giving signals to a fire station, giving “Fire”-signal to a duty room and giving signals to control technological and ventilation systems etc. After gates opening water or a foam solution are supplied to the automatic system from a main pipeline and it starts irrigating a protected area oscillating a stream along a preset area.

Peculiarities of automatic system engineering design
Choice and location of fire monitors with oscillators, angles of oscillation and number of fire monitors operating at the same time should be determined when designing taking into account features of the specific facility. Automatic system location should include extended nonutilizable for extinguishing solution areas. It is allowed to use sprinkler, drencher or other local systems of fire suppression in these areas. The average intensity of watering should be determined as a ratio of the total flow rate of active firefighting monitors (l/sec) to watering area (m2) during the cycle (sec) and it should be less than normal intensity of watering set for drencher systems. The automatic system operates:
- in the mode of automatic watering the area of extinguishing;
- in the remote mode to control a butterfly valve by a control console;

The automatic system makes signals for switching on a fire hose, closing devices with electric drives, start of an acoustic and light alarm giving signals to a fire station, giving “Fire”-signal to a duty room and giving signals to control technological and ventilation systems after registration of fire signal received from an automatic system of fire alarm and other devices which initialize start of the automatic fire-extinguishing system based on fire monitors with oscillators.

Automatic system elements
The automatic system consists of fire monitors with oscillators of LS-S20Uо, LS-S40Uо, LS-S60Uо, LS-S100Uо type (see pic. 1) and fire monitors with circular rotation oscillator of LS-S20Uоc, LS-S40Uоc, LS-S60Uоc, LS-S100UоC type (see fig.2). The fire monitors with oscillators are connected to a main feeding pipeline with usage of DGE-80, DGE-100 or DGE-80Ex, DGE-100Ex butterfly valve in explosion proof modification. The fire monitors can be equipped with foam eductor to supply foam solution in the systems of foam extinguishing and deflector nozzles to form a narrow stream when water shields are made.

The functional principle of the automatic system
In case of fire a device of receiving control equipment (a control device) of fire alarm system included into the automatic system gives a signal to a control box for opening gates in the area where fire alarm gives signals. At the same time the control device gives control signals to open a fire pump, to start an acoustic and light fire alarm and to control technological and ventilation systems etc.
Automatic water extinguishing system based on fire monitors applied in oil-filled power autotransformers: Engineering solution

The following engineering solutions “Automatic water extinguishing system based on fire monitors with oscillators applied for protection of oil-filled power autotransformers in Russian power engineering facilities” has been designed by «FR Engineering Centre of Fire Robots Technology».

The system includes fire monitors with oscillators LS-S40(20)U o. These fire monitors meet the requirements of Federal Grid Company of Unified Energy System JSC “FSK EES UES” (the Russian national power distributor) recommended for application on its facilities by Decision № 29-12 dated 21.05.2012 and included into the list “Equipment, technologies and materials”, valid for application on the facilities of JSC Russian Grids up to the year of 2017.

This system has several advantages:

- a loop pipeline with installed fire monitors is applied and a conventional piping with a distributing network of irrigators is excluded;
- location of fire monitors on an accessible height makes it easier to serve them as well as transformers and high-voltage equipment because in this case it is not necessary to apply lifting mechanisms and switch off transformer. Moreover the probability of extinguishing system’s breakdown in case of ignition is reduced;
- fire monitors have adjustment of stream direction horizontally and vertically as well as possibility to change flame angle of dispersed stream, that can increase effectiveness of extinguishing of local ignitions on autotransformer and surrounding grounds;
- considerable reduction of weight and dimensional indexes of the installation, possibility to use an existing water supply system (pipelines, extinguishing pump station) while keeping an adjusted intensity of irrigating reduce price and exploitation costs when replacing existing automatic fire-extinguishing with drencher irrigators with oscillator fire monitors;
- application of fire monitors with oscillators reduces negative influence of the wind causing stream’s drifting, because an angle of water supply can be changed relative to a wind direction in order to choose optimal;
- position of fire monitors and their elements is identified by special devices fixed on fire monitors it allows to get back to initial settings if necessary, for instance, after fire monitor technical service.

The fig. 2,3 show the scheme of protection of the power oil-filled former by the automatic water fire-extinguishing system based on fire monitors with oscillators.

The fire monitors are installed on loop firefighting pipeline Du 200 along the perimeter of the transformer.

The location of fire monitors provides the irrigation of every autotransformer’s part by two streams at least giving “Fire”-signal to a fire post (to a duty room) and giving signals for control of technical systems, systems of ventilation and others.

Fig.1 The scheme of protection of the power oil-filled former with application of oscillating fire monitors

Fig.2. The scheme of installation of fire robots on the unit’s plan
Robotic fire suppression and security system on the overseas ships

The robotic fire suppression system, completed with systems of detection of unauthorized access and surrounding area (systems of TV-observation with motion sensors and others, in accordance with customer’s request), can be used on the overseas ships as a robotic fire suppression system for extinguishing and for protection against attacks.

The robotic fire suppression system with using of robots of double function protects the ship from attacks and to fling off pursuers on fast motor boats, misguiding them by powerful water stream, and to localize and extinguish fire on ships.

The system of the TV-observation, included into the robotic fire suppression system, means to observe a ship’s water area, to detect the location of a fire source and to observe the situation.

The robotic fire suppression system includes a control device for fire complex CD, a video control device VCD, up to 32-x security fire robots sFR-LSD-S40U and a water supply system.

The fire robot sFR-LSD-S40U in marine modification, with a flow rate 40 l/sec provides the reach of stream of 70 m under the pressure of 0.8 MPa in a water supply network.

If the fire-extinguishing security robot is supplied with an around-the-clock observing TV-camera with motion sensors, the system of TV-observation makes it possible to detect moving units on water and their position in a surrounding water area.

The location of fire monitors provides the irrigation of every autotransformer’s part by two streams at least giving “Fire”-signal to a fire post (to a duty room) and giving signals for control of technical systems, systems of ventilation and others.

The robot directs automatically onto given coordinates and shoots the aim by a water stream within a command. The aim coordinates can be corrected in remote mode. The monitor with TV-cameras is stabilized for a given angle within ship motions.

For a stream’s directing the manual, remote and automatic control modes are provided.
Protection of tunnels and rack storage facilities with fire robots on the bolides

In tunnels and rack storage facilities it is more efficient to use robotic fire suppression systems based on fire robots with a mobile unit in accordance with GOST R 53326-2009. According to the utility model patent No. 93284 "Mobile robotized fire complex" it is suggested a solution with the installation of fire robots on the bolides moving along the monorail along the fire main piping, with automatic connection to it in the nearest to the place of ignition assembly sites of extinguishing agent.

**Operation of robotic fire suppression system (RFSS)**

RFSS works as follows. Upon activation of fire alarm units and receipt of a fire alarm a robot on the bolide control device transmits a command to a fire robot via radio channel to move along the guideway to fire area address. Upon approaching the fire area a low-speed command is produced, and then the robot stops by the hydraulic valve on the fire main. Fire detection device determines the coordinates of fire area and generates control commands for directing of the robot to the fire area. Then a connecting mechanism of hydraulic valve and power connector is activated. The water is piped from the fire main, and the electric power is supplied through the power connector from the electrical network. Fire extinguishing is carried out in automatic mode due to the program by line scanning with jets covering the fire area. Moving of the bolides and fire-extinguishing could also be carried out in remote control mode from the remote control console. Using of the mobile unit extends the working areas of fire robots with decrease of their number at the protected object that is especially important for long objects, such as tunnels. Fig. 2 shows general view of fire robots on the bolides in the road tunnel moving along the fire main.
Applying traditional sprinkler and deluge systems while protecting rack storage facilities, which require high-intensity irrigation, causes big problems. To protect one rack storage facility requires hundreds of sprinklers with the branched water supply network. Especially the disadvantages are noticeable in the operation of such systems. During a fire, the light wire local networks which are within the area of the fire could be put out of action.

Figure 2 shows a general view of the RFSS based on fire robots on the bolides, and Figure 3 shows the RFSS layout from the technical project for protection of a rack storage facility. In case of a fire, 2 fire robots within 10 seconds can reach the most distant point of the fire, connect to the fire main and carry out fire extinguishing with two streams at a water rate of up to 60 l/s each.

Fig. 3. General view of RFSS based on fire robots on the bolides in a rack storage facility

Fig. 4. Layout of protection of a rack storage facility with RFSS based on fire robots on the bolides
Design work

"Engineering centre "FR" LLC performs design work on fire protection systems of buildings and structures with the use of fire monitors and fire robots.

Executed design works:
- Development of design and estimate documentation for automatic fire-extinguishing systems for high-floored and air-supported structures, fuel and lubricant and highly flammable liquid storages and with application of robotic complexes RFSS, fire extinguishing systems for loading and unloading racks and berth complexes using remote-controlled monitors LSD or monitors with oscillating devices.
- Design works on the other types of automatic fire-extinguishing systems, including modular and automatic fire alarm systems.

In addition to the main activities, the Engineering centre "FR" LLC renders the following services:
- for project organizations - selection of the best option for application of the equipment produced by the Engineering centre "FR" LLC and projects support;
- for direct customers – assistance during selection and recommendations on the installation of fire monitors for the facility protection.

Below are the examples of implemented projects in recent years, as well as individual design solutions for the protection of various objects.

Implemented projects:

Protection of aircraft and helicopter hangars:
- Hangar for technical maintenance of the BOEING 737 NG aircrafts at the international airport n.a. Yu. A.Gagarin, Orenburg
- Hangar for aircraft at the Minsk National Airport
- Ostafyevo-airport, Podolsk:
  - the hangar for storage and maintenance of aircraft (5 aircraft) with the hangar apron and the taxiway;
  - center for Business and Small Cargo Aircraft (CBSCA) in Ostafyevo International Airport. Hangar for 8 Boeing 737-BBJ
- The building of hangar No. 2 and aircraft service station Sheremetyevo-1-airport, Moscow
- Vnukovo airport, hangar complex of Rossiya State Transportation Company, Moscow

Protection of sports facilities:
- Big Sports arena “Luzhniki”, Moscow
- Stadium "Zenit Arena", St. Petersburg
- Sport complex “Orenburgye”, Orenburg
- Athletic Complex, St. Petersburg, Moskovsky District, quarter No. 3, to the east of Yuri Gagarin Avenue

Protection of the public assembly and entertainment facilities:
- "VEGAS-CITY", Shopping and Entertainment Center, concert hall with 1500 seats, Moscow

Protection of industrial facilities:
- Nizhny Novgorod Machine-building Plant, buildings №5 and № 3, Nizhny Novgorod
- "GOZ Obukhovsky plant", reconstruction of production shops, Saint-Petersburg

Protection of wood-working industry:
- Outdoor wood storage, Tatarstan, Yelabuga

Protection of highly explosive manufactures and facilities:
- Cosmodrome Vostochny, launching complex, operation and checkout buildings
- Cosmodrome Plesetsk- launching complex "Angara"

Protection of machinery halls in the heat and power plants:
- Power houses of Petrozavodsk Heat and Power Plant (HPP)
- Lugansk HPP (Donetsk region), energy units of heat energy station
- Kurakhovskaya HPP (Donetsk region), energy units of heat electric station

Protection of the units of oil and gas industry:
- Baltic Pipeline System, Primorski – oil terminals
- Specialized seaport “Vitino”, Kandalaksha, the Murmansk Region – berth complex for reloading of the oil and oil products
- Oil terminals “Lukoil 2”, Vysotsk, the Vyborg district, the Leningrad Region
- Yaroslavsky refinery (OAO “NGK Slavneft”) – production facilities
- Transformers production plant “Power Machines – Toshiba. High-Voltage Transformers”, LLC

Protection of the chemical industry units:
- PC “European sulfur terminal” Commercial port, Leningrad region, Ust-Luga

Protection of alcohol storage facilities:
- Alcohol storage facility of Khabspiprom, LLC, Khabarovsk

Protection of metal industry facilities:
- Ilyich Iron and Steel Works of Mariupol
Protection of aircraft and helicopter hangars

Hangar complexes for aircraft parking and maintenance work are fire-hazardous facilities of B1 class according to SP 12.13130-2009, fire danger class P-1 according to PBU, with a degree of fire resistance II. Hangar complexes are recommended to be equipped with robotic fire suppression system. The robotic fire suppression system should be applied as a fire-extinguishing system subject to requirements for hangar complex, laid down by Russian Scientific Research Institute of Fire Defense and Russian EMERCOM. Application of robotic fire suppression system is proved by this extinguishing method effectiveness, impossibility to use sprinkler or drencher automatic fire extinguishing system for protection of buildings which are more than 20 m in height.

Taking into account a specific character of a unit needed to be protected aviation fuel spill is considered to be the main fire danger (kerosene oil ТС-1, temperature of ignition more than 28°C, for airplane Boing-737-BBJ the rest is 70 kg), that’s why as a fire extinguishing agent it is recommended to take:
- foam of low ratio based on water solution of fluorinated foam former for liquidation of possible seats of fire;
- water dispersed by fire monitor for supporting constructions and equipment irrigation;
- flame detectors as devices for fire detection;
- thermo cable as a device of girders’ thermal overload.

Seat of fire extinguishing is provided by two fire robots (FR) with foam eductor which supply foam solution simultaneously.

Cooling of building constructions and airplanes near a seat of fire is recommended to be provided by water supply from 2 fire robots in manual and remote modes. Working time of system of girders’ cooling is considered taking in account working time of fire extinguishing system and time for precipitation of smoke.

For providing of possibility of fast disclosure and extinguishing of seat of fire along the square of hangar, including surface under airplane’s body, fire robots and flame detectors are located in 2 levels.

Height of fire robots’ location is determined by their characteristics, height of hangar and sizes of airplane. Such arrangement provides watering of every point of protected surface by two robots.

In huge hangars it is possible to use a system of forward coming fire robots from automatically opening doors in a floor or such an installation may be applied on the grounds under a lower chord of supporting girder.

Feeding water pipe of automatic fire suppression system – robotic fire suppression system is circular, water-filled (up to disk gates); pressure in a duty mode is maintained by automatic water filler installed in a pumping station.

Recommended flow rate is 20 l/sec. Pressure before butterfly valve not less than 0.65 MPa. Total flow rate of system for work of 2 fire robots for extinguishing and of 2 fire robots for cooling: 2x20+2x20= 80 l/sec.

Working time of foam extinguishing system for facilities of class B1 for fire danger is considered to be 15 minutes.

Working time of water cooling system consists of working time of foam extinguishing system and additional time for precipitation of smoke.

Main modes of work of robotic fire suppression system are automatic and remote.

The fire robots are installed in 2 tires: FR 1, 3, 5, 9, 11 at elevation of +0.600; FR 2, 4, 6, 10, 12 at elevation of +8.000.

The drawing shows the watering maps schemes for FR 1, 2, 11, 12.

International airport n.a. Yu.A.Gagarin, Orenburg
Koltsovo Airport, OAO AK Ural Airlines, Ekaterinburg
Hangar building № 2 and airplanes service station in “Sheremetyevo-1”-airport
The broad technical capabilities of fire robots allow to apply them for protection of public assembly and entertainment objects: sports stadiums, sports and entertainment complexes, concert halls - in places where other technical means are not effective.

With the increased requirements for the design the RFSS are equipped with fire robots of “inbox” modification, built in a niche with automatic turning of the front panel in case of a fire.

**The project for protection of the concert hall with an area of 3500 m² and 6000 seats (as an example: “Crocus” concert hall, Moscow).**

The concert hall includes a stage and an audience space. The seats for an audience are located in stalls, amphitheater and on the balcony of the hall.

Installation of the fire robots of the “IN BOX” type in a niche at the stalls level provides watering of every point of the audience by two streams without violating the design.

When the “Fire” signal is received, the doors of the niche are being automatically opened, the fire robot is moved out and starts scanning according to the specified program.

For the purpose of prompt observation of the situation in the fire area the installation of television cameras on fire monitors coaxial to their direction is provided.

The estimated flow rate in the fire extinguishing system is 40 l/sec, taking into account the simultaneous operation of 2 fire robots of the robotic fire suppression system with flow rate 20 l/s.

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**Legend:**

- Fire robot FR-LSD-S20U-IR-TV with flow rate 20 l/s.

Effective stream flow range of FR-LSD-S20U-IR-TV with flow rate 20 l/s at pressure 0.6 MPa before the fire robot butterfly valve is 50m.

FR №№ 1, 2 are installed in niches on the hall walls at elevation of +6,130.

FR №№ 2, 3 are installed in niches on the hall walls at elevation of +5,730

**MEC “Crocus Expo”, the concert hall of the exhibition pavilion №3 (Moscow)**

**Fire robots of “in box” modification**
Protection of sports facilities

Sports facilities are characterized by large areas and high dome space. Traditional sprinkler and deluge fire suppression systems are almost inapplicable to protect them.

Project for the protection of a sports facility by the vandal-proof fire robots by an example of "Zenith" stadium.

The stadium "Zenit" is a multifunctional football stadium of the highest category, category "A" (in accordance with the International Classification "Elite"), of year-round use equipped with a retractable field, retractable roof and a flagpole, with the total capacity of at least 68 thousand seats. The robotic fire suppression system (RFSS) is designed to extinguish a fire in the stands area with simultaneous signaling on the system operation and its status in the operator’s control room. It consists of fire robots and pump station. Automatic fire suppression in the stands area is provided with the fire robots’ straight and dispersed water streams. Water spraying is carried out simultaneously by 2 fire robots with flow rate 40 l/s each under the pressure of 0.6 MPa. The fire robots are installed in 2 tiers: a lower tier a) at the elevation of 6 m. and the top tier b) at elevation of 25,2 m. The fire robots are vandal-proof, have a protective housing which prevents access to the electrical equipment and control system.

In case of receipt of the “Alarm” signal the robot is moved out from the protective housing with use of linear actuators and performs working according to the program of fire extinguishing in the protected area. For the water supply the ring main pipeline is provided on each tier.
Protection of heliports

According to SP 136.13130.2012 “Heliports. Requirements for fire safety” the heliports should be equipped with fixed automatic foam extinguishing system. The fixed automatic fire extinguishing system provides fire extinguishing and cooling of a helicopter fuselage as well as extinguishing of possible spread of flammable liquids within a heliport area.

For fire protection of a helicopter deck on the roof of business center in a Russian city Izhevsk a robotic fire suppression system with two fire robots FR-LSD-S20Ue-IR with 25 l/sec flow rate is applied. Flame annunciators are used as devices of fire detection. A seat of fire extinguishing is provided by simultaneous foam former supply by two fire robots with foam eductors.

The freeze-proof foam former PO-6MP is used for making of low ratio foam when extinguishing fire. The robotic fire suppression system provides for automatic control of foam solution leak (reduction of total volume of foam former by 5%). Measuring of foam solution is provided by foam eductors included as a part of a fire robot.

Separated tube lines with solenoid valves are laid from storage tank to an foam eductor of a fire robot for foam former supply. Estimating a foam solution stock it is necessary to take the following conditions into account:
- time of foam supply is not less than 600 seconds;
- 100% of foam solution storage which is used if it is necessary to continue on fire extinguishing.

Protection of the chemical industry units

Equipping of sulfur storage with the robotic fire suppression system; an extinguishing solution is foam, an estimated area is fire of the deck of the area of 1000 m².

Special features: the system provides a fire source search, start of two closest fire robots and directing onto a fire source after getting of “Fire”-signal.

The fire robots are installed on the distance not less than 10 m from the deck on the towers along its length. An estimated time of foam supply for firefighting with application of the fire extinguishing system is 10 min.
Protection of the units of oil and gas industry

The earliest detection of emergency leaks and spills, and preventive local measures of precipitation, cooling and extinguishing on early stage to prevent development of emergency situation are the most important for explosive units of oil and gas industry on outside installations, feed, goods and reloading storages of the loading platforms.

Because of danger for a human the unattended technologies have been used more and more often; the fire robots are used for fire defense.

In explosive areas remote-controlled fire monitors and fire robots are used in explosion-proof modification. The placement of the monitors and robots, included into robotic fire suppression system, should be made, taking into account a effective stream range for providing of the best intensity.

It is over 90% of the foam solution range given in the characteristics sheet.

Within estimating of protected areas, it is necessary to consider, that each protected area should be in the range of two remote--

Protection of the berth complexes

The berth complex for reloading of the oil products of the Vitino-sea berth on the White Sea whole-year navigation serviced by nuclear ice breaker is protected by a water-foam fire suppression system.

For fire extinguishing on the technological there is provided a foam watering by two fire robots of the type FR-LSD-S60(20)U-Ex with a flow rate 30 l/sec working in the mode of extinguishing along a preset program.

The fire monitors LS-S20Uо with oscillators and flat deflectors with the total flow rate 40 l/sec are set along the berth to form a water shield of the height of 16,5 m between the berth and tanker of the type “Stena Arctika”.

Cooling of metal constructions in the range of 10 m from technological area is provided by the fire monitor LS-S20Uо with oscillator with flow rate of 12,5 l/sec. The installation was constructed in 2008.

The berth complex for reloading of the oil products of the Vitino-sea berth on the White Sea

The scheme of the berth complex
**Protection of energetic units – heat power stations, Heat power plants, State regional power stations**

Cooling of metal constructions of machinery halls’ frames. Fire extinguishing at early stages. Possibility of operation in terms of poor visibility in the smokescreen.

The coverage of Petrozavodsk HPP machinery hall is based on 10 frames which are 39 m in length, 3.6 m in height. A frame interval is 12 m. The frames of welded construction of double angle section with throat of 22 mm. Three T-100-130 turbo generators of 110 MW are installed in the machinery hall. There are three oil tanks of 32 m3 in immediate proximity to the turbo generators. The machinery hall is a fire hazardous facility of B2 class under SP12.13130-2009 and fire danger class P-IIa under Electrical Installation Code. Six fire robots with 20 l/sec flow rate and 0.6 MPa pressure of fire line are installed to protect a machinery hall with an area of 4212 square meters at Petrozavodsk heat electropower station with an automatic fire extinguishing system based on robotic fire suppression system. Water flow rate is 40 l/sec when 2 fire robots operate simultaneously.

**Protection of highly explosive manufactures and facilities**

For protection of highly explosive manufactures and buildings fire robots of explosion-proof version are applied.

The project of operation hall fire protection in the MIK unit («Roskosmos») with a total area of 1062 m2 and 16 m in height. The operation hall is a hazardous facility of A class under NPB Fire code 105-03 and B-1a class under Electrical Installation Code. An automatic and manual irrigation with water straight streams along the area with using of the robotic fire suppression system is provided for fire extinguishing of highly explosive areas.

The robotic fire suppression system water flow rate and working time are set in accordance with FGUP «26 ZNII MO RF» recommendations:
- 200 l/sec water flow rate if three fire robots with 67 l/sec water flow rate operate simultaneously;
- estimated time of robotic fire suppression system operation is 4 minutes.

The scheme of fire robots on the unit MIK («Roskosmos») location

Legend:
- Fire robots FR-LSD-S60U-Ex:
- Zone of line-by-line area scan
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