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**SCIENTIFIC-PRODUCING COMPANY "DOZA"**

**SRPS-05D RADIATION  
ALARM MONITOR**

Operation manual  
FVKM.412113.011RE



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This operation manual contains data on design, operating principle and specifications of the product necessary for its proper and safe operation (intended use, maintenance, running repair, storage and transportation) as well as its disposal data.

## 1 PRODUCT DESCRIPTION AND OPERATION

### 1.1 Product function

The SRPS-05D radiation alarm monitor FVKM412113.011 (hereafter referred to as monitor) is manufactured in accordance with the requirements of TU 4362-037-31867313-2008 and is intended to:

- measure ambient dose equivalent rate (DER) of gamma radiation;
- activate external alarms or actuators when a user-set DER value in the monitor area is exceeded.

The device is used to monitor the radiation situation at industrial facilities (nuclear power plants, radioactive waste processing enterprises) and areas adjoining these facilities and can operate both independently and as part of radiation monitoring systems, complexes and installations.

### 1.2 Specifications

1.2.1 Monitored gamma radiation energy range ..... 0.05 to 1.25 MeV.

1.2.2 Ambient gamma radiation DER measuring range ..... 0,1  $\mu\text{Sv/h}$  to 3,000  $\mu\text{Sv/h}$ .

1.2.3 Maximum permissible intrinsic relative error of DER measurement.....  $\pm[15+2.5/\dot{H}^*]$  %, where  $\dot{H}^*$  - non-dimensional quantity numerically equal to measured DER value in  $\mu\text{Sv/h}$ .

1.2.4 DER threshold setting range ..... 0,3 to 999  $\mu\text{Sv/h}$ .

1.2.5 Maximum permissible intrinsic relative error of monitor action relative to DER threshold .....  $\pm 25$  %.

1.2.6 Sensitivity anisotropy relative to energy of 660 keV when the angle of radiation incidence changes from 0 to  $\pm 90^\circ$  with respect to an axis normal to the monitor body plane, less than:

- at  $30^\circ$  ..... minus 5 %;
- at  $60^\circ$  ..... minus 15 %;
- at  $90^\circ$  ..... minus 40 %.

1.2.7 Monitor sensitivity dependence on gamma radiation energy .....  $\pm 30$  %.

1.2.8 Warm-up time under permanent ambient conditions ..... 1 min.

1.2.9 Alarm response time ..... 1 min.

1.2.10 The monitor allows for round-the-clock operation during 24 hours, with monitor reading instability over 24 hours continuous operation about average reading over the same time period doesn't exceed .....  $\pm 5$  %.

1.2.11 The monitor makes it possible to activate warning light and audible alarms and connects an external actuator when a user set DER threshold is exceeded.

1.2.12 The monitor is powered from a single-phase 220 VAC, 50 Hz network.

1.2.13 Monitor is operable at variations in supply voltage of 187 to 242 V and frequency of 47,5 to 52,5 Hz.

Maximum permissible complementary relative error of DER measurement due to variations in supply voltage or frequency from ratings .....  $\pm 5$  %.

1.2.14 Monitor power consumption ..... 5 VA.

### 1.2.15 Environmental conditions for proper use of the monitor:

- operating temperature range ..... 0 to +50 °C;
- relative air humidity ..... 80 % at +30 °C;
- atmospheric pressure ..... 84 to 106,7 kPa;
- corrosive agent content in the open air conforms to Type I atmosphere as per GOST 15150-69.

Maximum permissible complementary relative error of DER measurement due to ambient temperature variations per each 10 °C relative to normal conditions ..... ±5 %.

### 1.2.16 The monitor is resistant to sinusoidal vibrations in the frequency ranges:

- 2 to 13,2 Hz with shift amplitude of 1 mm,
- 13,2 to 80 Hz with an acceleration of 0,7 g.

1.2.17 In terms of seismic resistance, the monitor falls in Category II per NP-031-01, conforms to RD 25 818-87 requirements in regard to mounting location (Group A), and its design corresponds to Type 1 resistant to up to magnitude 7 earthquakes according to MSK-64 scale for elevation of 30 m above ground level.

1.2.18 The degree of protection against penetration of hard objects and water provided by the monitor enclosures is IP42 as per GOST 14254-96.

1.2.19 The monitor complies with electromagnetic compatibility requirements stipulated by GOST P 51522 for Class A equipment and performance criterion A.

Electromagnetic interference doesn't cause false triggering and forced restart of the monitor.

1.2.20 In terms of protection against electric-shock hazard, the monitor belongs to Class II GOST 12.2.007.0-75.

1.2.21 In terms of fire safety, the monitor complies with GOST 12.1.004-91 with a fire risk of less than  $10^{-6}$  year<sup>-1</sup>.

### 1.2.22 The monitor is resistant to decontaminating solutions:

- 1) boric acid ( $H_3BO_3$ ) – 16 g, sodium thiosulphate ( $Na_2S_2O_3 \cdot 5H_2O$ ) – 10 g, distilled water of up to 1 liter;
- 2) tri-sodium phosphate or sodium hexametaphosphate – 10-20 g/l in water (any synthetic detergents);
- 3) 5 % citric acid solution in rectified ethyl alcohol - for interior surfaces of electronic devices.

1.2.23 Monitor mass ..... 0,7 kg.

1.2.24 Overall dimensions ..... less than 226×120×75 mm.

## 1.3 Delivery kit

1.3.1 The monitor is a one-piece, stand-alone and packaged device.

The monitor comes with:

- RS-4TV cable receptacle.
- SPTA.

The monitor connection diagram is given in appendix A.

## 1.4 Design and operation

1.4.1 The monitor front panel, shown in figure 1, accommodates controls and indicators:

- 16 character x 2 line digital display to display the measurements;
- START button intended to forcedly restart the measurement process;
- MUTE button intended to manually silence audible signal (sound is muted only for the period when the alarm signal is activated);
- ALARM LED - its glow means that the user set DER threshold is exceeded; in this case an audible signal is generated that can be silenced by pressing the MUTE button; the LED and audible signal are automatically off when the measured parameter is below the threshold level;
- ON/OFF switch.

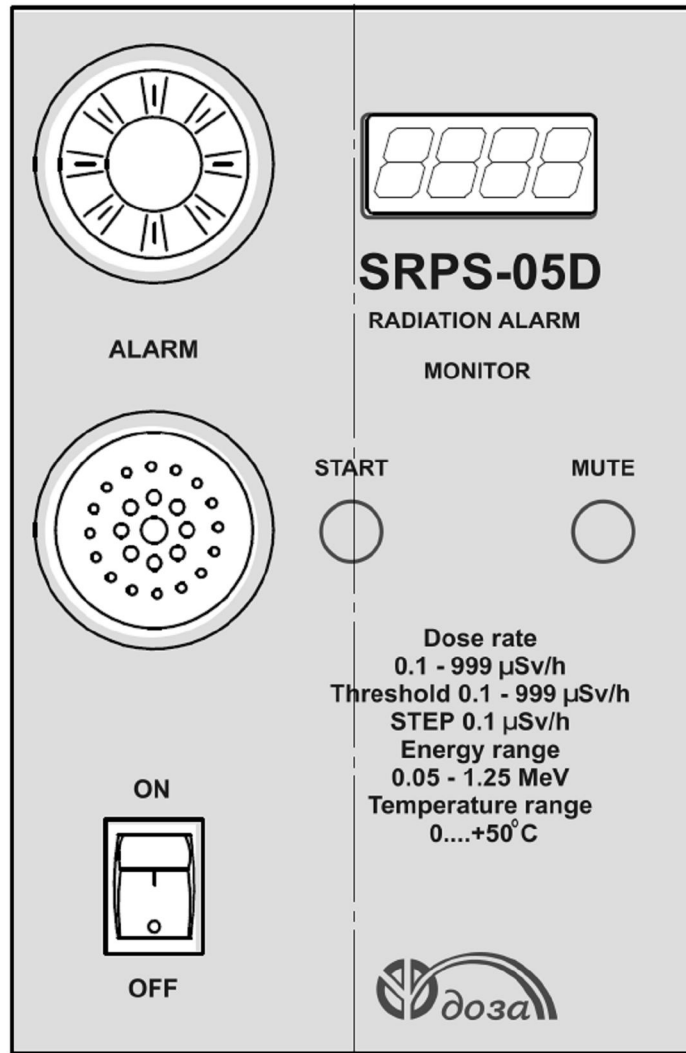


Figure 1 – Monitor front panel

1.4.2 The monitor is an electronic module with a Beta-2M type Geiger-Müller counter placed inside. Structurally, the monitor is encased in a plastic body and intended to be used as a wall-type device. Its front panel accommodates a display, control buttons and an alarm LED. The bottom surface carries an interface for connection of an external actuator activated by a signal exceeding the threshold. A power cord receptacle is located nearby.

1.4.3 The monitor determines the average count rate of pulses arriving from the G-M counter, which is the quotient of the quantity of registered pulses and time during which they have been registered. The derived count rate value, multiplied by the K conversion factor, is displayed in  $\mu\text{Sv/h}$ . To compensate its detector background, the monitor provides a possibility to enter an additional factor (N) representing the arithmetic average of the quantity of pulses registered by the detector due to its own background. In computing the entered value of the detector background is subtracted from the registered DER value.

Note – In DER measurement mode, the readings are continuously adjusted as the measuring run time increases. Simultaneously a decreasing statistical error value is displayed in the bottom line of the display allowing the user to consider the measurement ended when the desired accuracy is achieved.

1.4.4 The current DER measurement result is compared to a user set threshold (“L”) entered into the monitor’s non-volatile memory. When the threshold is exceeded, ALARM is given by a constant audible and light signal and also relay contacts, whose leads are brought out to a receptacle for connection of an external actuator, are closed.

## 1.5 Marking and sealing

1.5.1 The monitor body carries the following marking:

- manufacturer (supplier) trade mark or identification;
- item (item type) code;
- monitor serial number;
- year of manufacture;
- body protection degree according to GOST 14254-96;
- main specifications.

1.5.2 The place and method of marking the monitor shall be complied with the design documentation.

1.5.3 The monitor is sealed per design documentation. In specific cases the sealing points may be taped by a marking tape.

## 1.6 Packing

1.6.1 The monitor is packed into a packing box according to design documentation.

## 2 INTENDED USE

### 2.1 Operating limits

2.1.1 The monitor remains operable under conditions outlined in 1.2.15.

2.1.2 The monitor should be protected from mechanical damage caused by falls, impacts, and squeeze by a force exceeding 5 kg.

### 2.2 Product preparation for use

2.2.1 The monitor is secured to any vertical or slanted surface. Its operability doesn't suffer in any orientation in space.

2.2.2 Prior to using the monitor, it should be connected to a 220 VAC, 50 Hz power line.

Its overall and mounting dimensions are provided in appendix B.

2.2.3 The monitor requires no grounding or neutral grounding.

2.2.4 If required, set the alarm threshold L in Sv/h as per 2.4. On default, the parameter is set at  $(1.00 \cdot 10^{-6})$  Sv/h.

### 2.3 Product use

2.3.1 Switch on the monitor. The monitor is switched on/off by ON/OFF switch located on its front panel. The display lighting indicates that the device is on.

2.3.2 Upon the monitor's activation, the display shows the following information:

- upper line: 0.00  $\mu$ Sv/h value or \*\*\*\*\* symbols.
- bottom line: \*\*\*\*\* symbols.

2.3.3 Within 2–3 s the upper line displays the result of DER measurement in the form of a digital value in  $\mu$ Sv/h and the bottom line shows a statistical measurement error in percentage terms. The readings on the display are refreshed each 2 seconds and are presented in the following form (figure 2).

0	.	1	2	$\mu$	S	v	/	h
		$\pm$	2	0	.	5	%	

Figure 2 –Readings of the monitor display

2.3.4 When the monitor is in use, the function of its control buttons corresponds to inscriptions located nearby them.

2.3.5 Pressing the START button launches a new measurement. Repeating the button resets the previously measured value.

2.3.6 Pressing the MUTE button silences audible signal generated when the measured values exceed the preset threshold. Repeating doesn't turn audible signal on. The audible signal will be activated when the threshold is exceeded again.

## 2.4 Adjustment and setting

2.4.1 Adjustment and setting of the monitor consists of changing the values of the following parameters: conversion factor (K), dead time (T), alarm threshold (L) and inherent background value (N).

ATTENTION! ONLY PERSONNEL WHO HAVE UNDERGONE TRAINING AT THE MANUFACTURER'S FACILITY ARE AUTHORIZED TO MODIFY THE K, T, N VALUES. ONLY THE THRESHOLD VALUE IS AVAILABLE FOR FREE EDITING.

2.4.2 For editing the alarm threshold (L) value, switch the monitor on, while holding the MUTE button down.

2.4.3 After you have entered the edit mode, the bottom line of the display indicates earlier set parameter value (figure 3).

L	=					o	k
1	.	0	0	e	-	0	6

Figure 3 – Display reading in alarm threshold edit mode

The indication "OK" in the upper right corner of the display shows that this alarm threshold value has been written to the monitor's memory.

2.4.4 The alarm threshold (L) value is set in Sv/h. On default, the parameter value is set at  $(1.00 * e^{-06})$  Sv/h.

To edit the value, press the START and MUTE buttons simultaneously - the indication "OK" in the upper right corner of the display will disappear.

Editing the alarm threshold value is done by pressing the MUTE and START buttons (to increase and decrease the value respectively). The fractional and power parts of the value are successfully available for editing. To increase the power part, first press the MUTE button to achieve the maximum value (9.99). Accordingly, to decrease the power part, press the START button to achieve the minimum value (1.00).

Holding down the MUTE or START button in editing provides quick scanning of values.

2.4.5 To write the set alarm threshold value to the monitor memory, press the START and MUTE buttons simultaneously - the indication "OK" will appear in the upper right corner of the display.

To cancel the newly entered value and return to an earlier set one, switch the monitor off.

## 3 MAINTENANCE

### 3.1 General guidelines

Maintenance of the monitor is carried out to support its operability during the entire service life,

### 3.2 Safety precautions

3.2.1 Read this operation manual carefully before using the monitor.

3.2.2 In service, you should be guided by this Operation Manual, SP 2.6.1.758-99 Radiation Safety Standards (NRB-99), SP 2.6.1.799-99 Basic Sanitary Regulations for Radiation Safety (OSPORB-99), and Power System Safety Standards.

3.2.3 The monitor generates a DANGEROUS high voltage. Personnel operating the monitor must know the safety rules for working with voltages up to 1,000 V. Maintenance of the monitor must be provided by the personnel who hold at least Level 3 certificate in electrical safety.

### **3.3 Monitor maintenance procedure**

3.3.1 Maintenance is divided into routine maintenance and periodic maintenance.

#### *3.3.2 Routine maintenance*

3.3.2.1 Routine maintenance is conducted during regular service and includes visual inspection of the monitor to timely identify and eliminate factors that may degrade its performance and safety.

3.3.2.2 The following basic kinds and intervals of routine maintenance are recommended:

- visual inspection ..... monthly;
- external cleaning (decontamination) ..... monthly.

3.3.2.3 Visual inspection determines the condition of cables, connectors and security of mounting.

3.3.2.4 D Decontamination of the monitor is done according to work schedule operational at the enterprise:

- outer surfaces of the monitor are decontaminated with solutions 1) and 2) per 1.2.22: after surface treatment with a cloth moistened in decontamination solution wipe the surfaces by a cloth moistened in distilled water and then dry with filter paper;
- cable connectors are decontaminated with solution 3) per 1.2.22: no extra treatment with distilled water and desiccation with filter paper are required.

Dry cleaning is done at any frequency.

**DURING DECONTAMINATION AND DRY CLEANING THE MONITOR MUST BE DE-ENERGIZED.**

#### *3.3.3 Periodic maintenance*

Periodic maintenance consists of periodic calibration.

## **4 CALIBRATION PROCEDURE**

### **4.1 General requirements**

Calibration of the monitor is done by the State Metrology Service bodies or other authorized bodies. The requirements for calibration organization and procedure and calibration data presentation form are specified in the PR 50.2.006-94 “The State System of Measurement Assurance. Measuring Means Calibration Procedure.”

All newly manufactured, repaired and in-service monitors are subject to calibration.

Periodic calibration is done when the monitor is in service.

The calibration frequency is 1 year.

### **4.2 Calibration operations and facilities**

The calibration should involve the operations and facilities specified in table 4.1.



Table 4.1 – List of calibration operations and means to be used in calibration

Operation	Item number	Calibration means and their standard technical characteristics	Mandatory operations during	
			primary calibration	periodic calibration
1. Visual inspection	4.5.1	Visually	Yes	Yes
2. Testing	4.5.2		Yes	Yes
3. Determining the basic relative error of gamma radiation DER measurement	4.5.3	UPGD-2M-D gamma-ray calibration facility with a <sup>137</sup> Cs source according to TU 4362-064-31867313 that reproduces DER in the range from 5·10 <sup>-7</sup> to 5·10 <sup>-2</sup> Sv/h with error not exceeding ±5 %.	Yes	Yes
4. Presentation of calibration results	4.6		Yes	Yes

Note – Separate, newly developed or in-service calibration equipment and means comparable to those specified in this calibration procedure may be used.

### 4.3 Safety requirements

The safety requirements outlined in 3.2 and in documentation for the calibration means and equipment used must be observed.

### 4.4 Calibration environment and preparation

4.4.1 Calibration should be conducted against natural radiation background not exceeding 0.2 μSv/h subject to the following conditions:

- ambient air temperature ..... +(20 ±5) °C;
- relative air humidity..... 30 to 80 %;
- atmospheric pressure..... 84,0 to 106,7 kPa.

### 4.5 Conduct of calibration

#### 4.5.1 Visual inspection of the monitor

The visual inspection should determine:

- conformance to completeness of set;
- zero defects affecting the monitor performance;
- availability of operational documentation;
- body and control buttons integrity.

#### 4.5.2 Testing

Testing is reduced to actions outlined in 2.2.

#### 4.5.3 Determining the basic relative error of gamma radiation DER measurement.

The basic relative error of gamma radiation DER measurement is determined as indicated in MI 1788-87 at DER values corresponding to levels of 0.4 (400 μSv/h) and 0.7 (700 μSv/h) of the final value of the measurement range in the following sequence:

- 1) Place the monitor on the UPGD-2M-D calibration facility with its front panel facing the source so that the center of the monitor’s sensitive area is on the central axis of the gamma-ray beam at a distance from the source center corresponding to the selected DER value.
- 2) Switch the monitor on. Press the START button to launch a new measurement.
- 3) Measure the DER, having taken the monitor reading from the display when a statistical error is < 5%.
- 4) Conduct at least three DER measurements at each check point at a 100 s interval.

5) Calculate the average registered values  $P_{CP}$  from formula (4.1) for each check point:

$$P_{cpj} = \frac{\sum_{i=1}^3 P_i}{10}; \quad (4.1)$$

6) Calculate the basic relative measurement error from formula (4.2) for each check point (in percentage):

$$\delta_j = 1,1 \cdot \sqrt{\left(\frac{P_{CPj} - P_{II}}{P_{II}} \cdot 100\right)^2} + \delta_{II}^2; \quad (4.2)$$

where  $P_{II}$  – DER value reproduced by the UPGD-2M-D gamma radiation calibration facility in  $\mu\text{Sv/h}$ ;

$P_{CPj}$  – mean value of three DER values measured by the monitor at each check point ( $\mu\text{Sv/h}$ );

$\delta_{II}$  – relative error of gamma radiation DER reproduction by the calibration facility (taken from the facility's calibration certificate), %.

The calibration result will be considered positive, if the maximum basic relative measurement error doesn't exceed the value indicated in 1.2.3.

#### 4.6 Presentation of calibration results

4.6.1 The positive results of calibration are presented according to PR 50.2.006-94. The actual values of the basic relative measurement error and the values of adjusting factors shall be recorded in the calibration certificate as the result of primary or periodic calibration together with the due date of the next calibration.

4.6.2 If calibration produces unacceptable results, a report of unserviceable monitor shall be issued or a corresponding entry shall be made in technical documents and its use shall be not allowed.

### 5 RUNNING REPAIR

5.1 Running repair of the monitor consists in fault diagnosis and a way to eliminate it. The possible monitor problems and their remedies are listed in Table 5.1.

Table 5.1

Problem	Possible cause	Remedy
The device is switched on but shows no operability signs	Supply voltage is not available. Faulty internal power unit	Apply a supply voltage. Send the monitor to the manufacturer for repair
Zero readings on the display	Faulty Geiger-Müller counter	Send the monitor to the manufacturer for repair

### 6 STORAGE

6.1 Before putting in operation the monitor must be stored in a dry, heated and ventilated warehouse in its original packaging at the ambient temperature of +5 to +40 °C and relative air humidity of up to 80% at +25 °C.

6.2 The storage conditions of the unpacked monitor: +10 to +35 °C and relative air humidity of 80 % at +25 °C.

6.3 The storage space should be free of dust, acid and alkali vapors, aggressive gases and other harmful impurities causing corrosion.

The storage area should protect the monitor from direct sunlight.

## 7 TRANSPORTATION

7.1 The monitor in its original packaging can be transported by all types of transport to any distances:

- rail shipment should be carried out in clean boxcars;
- in carriage by open automobiles, containers with the monitors should be covered with waterproof material;
- in carriage by air, containers with the monitors should be placed in a pressurized heated compartment;
- in carriage by water and sea, containers with the monitors should be placed under deck in a special sealed package providing product protection level VZ-10 in accordance with GOST 9.014-78.

7.2 Stowing and fastening of the containers on vehicles should provide their stable position while in transit and prevent them from movement and colliding with each other.

7.3 The requirements of inscriptions indicated on transportation packaging should be observed during loading/unloading operations.

7.4 Transportation conditions:

- temperature ..... -25 to +50 °C;
- humidity ..... up to 98% at +35 °C;
- sinusoidal vibrations ..... 10 to 55 Hz with shift amplitude of 0,35 mm.

## 8 DISPOSAL

8.1 Upon expiry of the total service life of the monitor (its components), before dispatch for repair or conducting calibration, it needs to be checked for surface radioactive contamination. The criteria for deciding on decontamination and further use are outlined in OSPORB-99, section 3.

8.2 Decontamination should be done with solutions as indicated in 1.2.22 when the level of radioactive contamination of the monitor surfaces (including those accessible for repair) can be lowered to acceptable values as per NRB-99, section 8 and OSPORB-99, section 3.

8.3 According to SPORO-2002, section 3, the dose rate absorbed near surfaces (at 0.1 m) may be used as a criterion for further use of the monitor contaminated by unknown gamma radiating radionuclides.

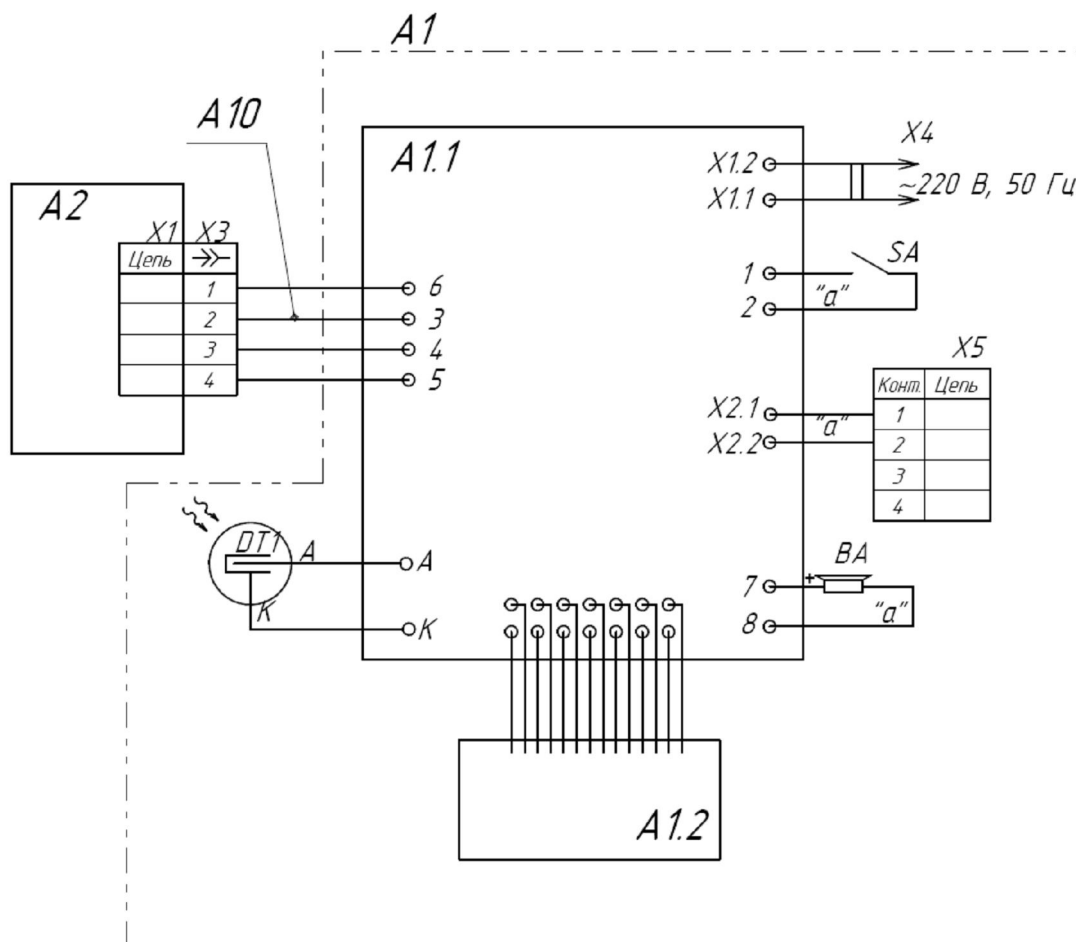
8.4 If after decontamination the dose rate exceeds the background by 0,001 mGy/h (1 μSv/h) or the admissible values of surface radioactive contamination are exceeded, the monitor must be viewed as nuclear waste. Nuclear waste needs to be classified and handled (disposed of) in accordance with SPORO-2002, section 3.

8.5 The monitor admitted for use after decontamination needs to be repaired or replaced in case of failure. The monitor unserviceable for further use, whose surface radioactive contamination level does not exceed the acceptable values, must be dismantled to prevent its further use and sent to specially allocated areas at industrial waste disposal sites.

8.6 The monitor with an expired service life, admitted for use after decontamination, shall be subjected to condition examination. If its technical condition is satisfactory, the monitor shall be subjected to calibration and its further life shall be determined.

Appendix A  
(mandatory)

**MONITOR CONNECTION DIAGRAM**



Ref No.	Name	Q-ty.	Note
A1	Printed circuit unit (FVKM.469135.022)	1	
A1.1	Monitor board (FVKM.469135.038)	1	
A1.2	Display (MTC-S0802XFGHSAY-11A)	1	
A2	Lamp (FVKM.305369.001)	1	
A10	Cable (A10 FVKM.685631.237)	1	
X3	Receptacle (BLS-4)	1	
BA	Sound generator (SC0715BL)	1	
DT1	Beta-2M counter	1	
SA	B100G Switch (250 V, 3 A)	1	
X4	Power cord with molded plug (ShVVP-2x0.5 2.5 m GOST 28244-96)	1	
X5	Cable receptacle (PS-4 TV AVO.364.047TU)	1	

**OVERALL AND MOUNTING DIMENSIONS**

