A Device for Monitoring Changes in the Radiation Situation in Places where Radioactive Sources are Stored

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1. Purpose of the device

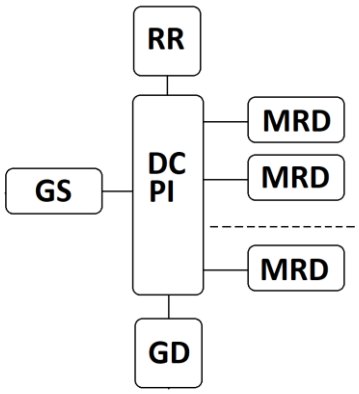
To ensure reliable storage of radioactive sources, various physical protection systems are used, including mechanical devices, video surveillance systems, and access control systems. This paper describes a system designed to perform automated monitoring of changes in the radiation environment in real time at the locations of the devices that are part of the system. The system provides visualization of measurement results, generation of an "ALARM" signal and notification of the monitoring network operator in the event of a change in the radiation situation at the location of the detection devices.

2. System Structure

There re four types of devices used in the system structure:

- Device for collecting and processing information (DCPI)
- Gamma spectrometer (GS)
- Mixed radiation detector (MRD)
- Radon radiometer (RR)
- Gamma dosimetr (GD)

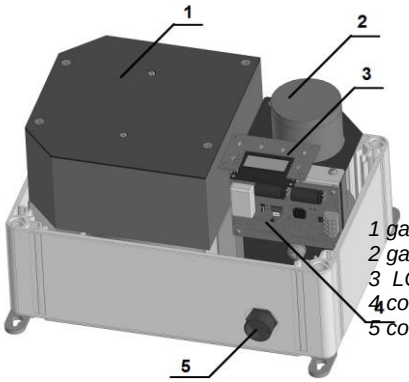
Each kit includes one DCPI, one GS, one RR, one GD and from 1 to 10 MRD. DCPI is the head unit of the system that collects information from detection devices (radiometers and detectors), and also serves as a power source for them. All detection devices within the same room are connected to the same power supply and communication line using junction boxes.



Block diagram

3. Detection Devices

The DCPI device is designed to generate an "alarm" signal when the gamma or neutron radiation flux deviates from certain fixed values by a certain amount.



1 gamma-neutron radiometer
2 gamma spectrometer
3 LCD screen
4 control board
5 connector

A gamma-neutron radiometer is used in the MRD to monitor the radiation situation. The sensitive element of the detector is a polystyrene scintillator for registration of gamma quanta, one plane of which is optically connected to a photomultiplier, and five other planes are surrounded by scintillation plates based on ^{6}LiF:ZnS(Ag) for neutron detection. To increase the detector sensitivity to neutrons, the polystyrene-^{6}LiF:ZnS(Ag) assembly is placed in a polyethylene moderator. A built-in gamma spectrometer is used to monitor changes in the spectral composition of gamma radiation.

The main task of the MRD is to analyze the count rates corresponding to the registration of gamma radiation and neutrons in the control mode and generate an alarm signal when the recorded value goes beyond the permissible upper and lower limits. This ensures the prevention of unauthorized movement of stored radioactive sources.

A gamma spectrometer is used to control changes in the spectral composition of gamma radiation and determine the isotopic composition. The possibility of using different types of spectrometers is provided - both built-in in the MRD and an external spectrometric device.

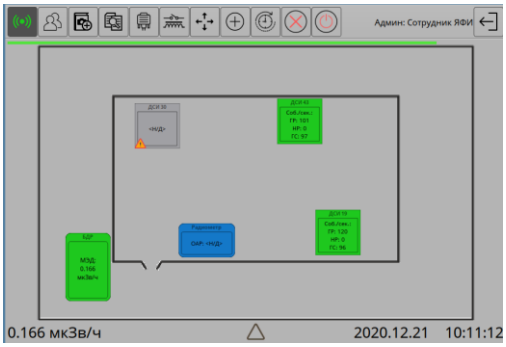
The radon radiometer periodically automatically measures the radon concentration in the room, the dosimetric device transmits data on the dose rate of gamma radiation.

A dosimetric device for determining the equivalent dose rate of a case at its location.

4. Operation

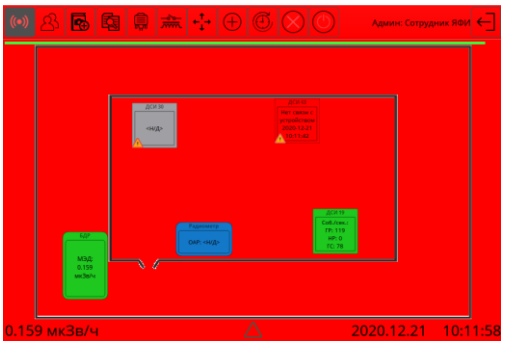
The operator's screen displays a conditional diagram of the controlled room. Each location detection device is indicated by a mnemonic diagram, the color of which displays the state of the device (“Inactive”, “Ready for control”, “Background set”, “Alarm”). The mnemonic diagrams also display textual information about the state of the device.

After turning on and setting the background by the detection devices, the system switches to the “On control” mode. The MRD mnemonic diagrams display the count rate for the gamma and neutron channels.



System under control

In the event of a change in the radiation situation in the control zone of the MRD (deviation of the current readability by the gamma channel or (and) by the neutron channel from the background countability outside the threshold values), the MRD goes into the "ALARM" state. The color of the MRD mnemonic diagram and the background color of the screen change, an audible signal sounds.



ALARM

5. Conclusion

The device for automatic monitoring of changes in the radiation situation in real timewas designed and manufactured. The device is put into serial production.