

**CALIBRATION CERTIFICATE**

Spectrometric backpack-based radiation detector: AT6101C

Serial number: 1411

Manufacturer: ATOMTEX, SPE

Conditions of climate:

* Ambient air temperature, oC 20 ± 5
* Relative air humidity, % 60 (+20; - 30)
* Atmospheric pressure, kPa 101.3 (+5.4; -15.3)

1. Equipment used for spectrometer radiation calibration:

* Spectrometric reference point sources type OSGI (see table 2.1) with activity of main radionuclides from 1 to 90 kBq. Uncertainty ± (3-6) % (P=0.95). Certificates of compliance № MN0100769-4818, MN0100782-4818, MN0100784-4818 issued by BelGIM, Minsk, Belarus.
* Spectrometric reference point sources type OSGI (see table 2.1) with activity of main radionuclides from 100 to 190 kBq. Uncertainty ± 3 % (P=0.95). Certificate of compliance № 210/1313-2018 issued by VNIIM, St. Petersburg, Russia
* Dosimetric reference gamma-beam irradiator type UDG-AT110, s/n 013 with collimated sources Am-241, Cs-137, Co-60. Air kerma rate range from 0.013 nGy/s to 52.6 μGy/s. Uncertainty ± 5% (P=0.95). Certificate of compliance № 210/1426-2018 issued by VNIIM, St. Petersburg, Russia
* Neutron calibration facility UPN-AT140 s/n 001 with collimated neutron radiation sources Pu-Be. Certificate of compliance № 210-1508/18 issued by VNIIM, St. Petersburg, Russia (uncertainty ±4 %).

2. Results of calibration

* 1. Conversion response (The dependence between gamma radiation energy and channel number), integral nonlinearity (INL)

|  |  |  |
| --- | --- | --- |
| Gamma standard sources OSGI-3 | | 20 – 3000 keV |
| Radionuclide | Energy line, keV | channel |
| Am-241 | 59.5 | 21.1 |
| Cd-109 | 22 | 7.5 |
| 88 | 30.9 |
| Co-57 | 122 | 42.2 |
| Ce-139 | 166 | 56.6 |
| Sn-113 | 392 | 131.6 |
| Mn-54 | 835 | 277.2 |
| Na-22 | 511 | 170.8 |
| 1275 | 424.2 |
| Co-60 | 1173 | 389.4 |
| 1333 | 443.4 |
| Eu-152 | 40 | 14 |
|  | 1408 | 470.6 |
| Cs-137 | 32 | 10.6 |
| 662 | 220.2 |
| Th-228 | 239 | 81 |
| 2614 | 869.9 |
| Y-88 | 898 | 298 |
| 1836 | 614.5 |
| INL, % | 0.29 | |

* 1. Relative energy resolution and efficiency

|  |  |  |  |
| --- | --- | --- | --- |
| Type of source | Gamma radiation energy | Resolution | Efficiency |
| Cs-137 | 662 keV | 7.3 % | 7.62 % |

* 1. Identification in Scanning mode

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Type of source | Dose rate at the NaI detector, μSv/h | Name and type of identified radionuclide | | Identification time, s |
| Am-241 | 0.085 | Am-241 | Industrial | 15 |
| Co-57 | 0.154 | Co-57 | Industrial | 5 |
| Сs-137 | 0.231 | Сs-137 | Industrial | 10 |
| Ba-133 | 0.169 | Ba-133 | Industrial | 20 |
| Eu-152 | 0.238 | Eu-152 | Industrial | 20 |
| Na-22 | 0.241 | Na-22 | Industrial | 15 |
| Co-60 | 0.231 | Co-60 | Industrial | 15 |
| Ra-226 | 0.248 | Ra-226 | Natural | 10 |
| Th-232 | 0.158 | Th-232 | Natural | 70 |
| K-40 | 0.112 | K-40 | Natural | 35 |

* 1. Dose rate calibration data

BDKG-11M

|  |  |  |
| --- | --- | --- |
| Radionuclide | Conventionally true value of dose rate, , μSv/h | Calibration data,  μSv/h |
| Cs-137 | 0.070 | 0.065 |
| 0.700 | 0.628 |
| 7.00 | 6.39 |
| 70.0 | 68.0 |
| 130 | 132 |
| Co-60 | 7.00 | 6.66 |
| Am-241 +0.3 mm Cu | 3.00 | 2.52 |

* 1. Intrinsic background level of spectrometer with neutron radiation detection unit

|  |  |
| --- | --- |
| Detection unit type | Intrinsic background level, s-1 |
| BDKN-05 | 0.180 |

* 1. Sensitivity to neutron radiation

|  |  |
| --- | --- |
| Detection unit type | Sensitivity, counts·cm2/neutron |
| in the direct beam Pu-Be neutron source |
| BDKN-05 | 8.63 |

Date of calibration ATOMTEX, SPE

Calibrated by: D. Obolonski

Technical control: N. Kurbatova