16. Radiation

Indicators
16.1 Number of existing nuclear power plants (NPP) in a 1,000-km zone from the borders of Latvia
16.2. Gamma background total annual dose
16.3. Concentration of Cs$^{137}$ in the surface soil

16.1. Number of existing NPP in a 1,000-km zone from the borders of Latvia

Latvia at the present time has no nuclear facility, which is working. The Salaspils research nuclear facility was stopped in 1998 and at the moment it is being decommissioned. The nearest and potentially most dangerous nuclear facility is the Ignalina nuclear power plant in Lithuania. Thanks to pressure from the European Union, negotiations are being conducted regarding the full shutdown of the Ignalina nuclear power plant in 2008-2009. Figure 16.1.1. shows all nuclear power facilities that are located up to 1000 km in distance from the Latvian border. The data is taken from the Danish Nuclinfo 2001 up-dated database, which is freely accessible.

For nearly twenty years no new nuclear power stations have been started. Stations under construction at Rovno, Khmelnitski and Kursk have in fact been frozen. Finland is the only European state, which after a ten-year interruption, in 2002 took a decision to build a new nuclear power station, most probably beside the existing one. There are five nuclear power stations within a 300 km zone from the border of Latvia - Ignalina (Lithuania), Loviisa (Finland), Sosnovij Bor (Russia), Oskarshamn (Sweden) and Smolensk (Russia). The Ignalina nuclear power station is the potentially greatest threat to Latvia for two reasons: as the closest (only 6 km from the Latvian border) and as a station containing RBMK type reactors (also Chernobyl had RBMK type reactors, they are considered as having an increased risk factor). Therefore, the density of monitoring stations in the Daugavpils district is the largest in comparison with the rest of the territory of Latvia. In Daugavpils the only uninterrupted air filtration station Snow White is also operating, which is intended to monitor aerosol type existing radio-nuclides in the air.

Latvia's Automatic gamma monitoring and radiation accident early warning system consists of two sub-systems - AAM (9 local stations) and PMS (7 local stations). The local stations sufficiently evenly covers the territory of the State and the current number of stations and the coverage of territory is considered sufficient. In comparison: Denmark has 11 PMS, Estonia - 11 (4 AAM and 7 PMS), Lithuania - 25 (5 AAM, 9 PMS and 11 AGIR). In relation to the fact that the basic function of the Automatic gamma monitoring and radiation accident early warning system is the early warning of radiation accidents, since April 2002 officially, but since 15 October 2002 also practically, the system has transferred to the supervision of the Radiation Safety Centre.

1 All the local stations contain Geiger-Miller detectors RD-02L (Rados Technology), which every 5 minutes register the level of gamma radiation and stores the data in the memory. PMS is also measures the temperature and rainfall and have an automatic NaI crystal gamma spectrometer TD3X3, which allows the determination of radio-nuclides that create radioactive pollution. Data, utilising dial-in access, in normal circumstances three times daily (in conditions of necessity more often) is collected on central servers. Of all the 16 local stations at this particular time one is suspended - due to damage of the Geiger-Miller detector in Rucava.
The total annual dose is the gamma radiation dose of the surrounding environment, which a person would receive in one year being located in a particular area. One needs to take into account that due to considerations of the physical safety of the detector, most of the station measurements take place 5 to 15 m above the surface of the ground. Therefore, the doses given in Figure 16.2.1 are somewhat lower in comparison with doses at the level human being height.

On the other hand, the Daugavpils SW monitoring station's values as a result of measurements are higher because in contrast to the other stations, the G-M detector is located beside the air sampling filter, and therefore in addition to the gamma background it measures also the aerosol gamma radiation collected on the filter.

The annual total gamma doses conform to those levels of dose, which are received from natural sources of gamma radiation. A typical dose capacity level for Latvian conditions is 50-100 nSv/hour. Fairly rare are the cases where the dose rate exceeds for a short time the 1st warning level, which is 200 nSv/h. As is shown by PMS stations, which apart from gamma dose rate are capable with automatic gamma spectrometers to specify also radionuclides that create this
gamma radiation, then these exceeding of levels are caused by natural processes. Mainly this occurs when particular meteorological conditions obtain, when radon gas depending upon the type of soil, continually emitted from the soil, does not dissipate into the whole atmosphere, but collects in lower levels of the atmosphere.

### 16.3. Concentration of Cs\textsuperscript{137} in the surface soil

<table>
<thead>
<tr>
<th>Year</th>
<th>Name of location</th>
<th>Demene</th>
<th>Svente</th>
<th>Sībi</th>
<th>Riči</th>
<th>Naujene</th>
<th>Sāsajas</th>
<th>Dervas - nābie</th>
<th>Gatvete</th>
<th>Brasas</th>
<th>Abilde</th>
<th>Medurni</th>
<th>Medurni estate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>19.3</td>
<td>90.0</td>
<td>108.7</td>
<td>11.7</td>
<td>92.4</td>
<td>62.0</td>
<td>62.9</td>
<td>1.1</td>
<td>92.6</td>
<td>92.4</td>
<td>1.1</td>
<td>92.6</td>
<td>1.1</td>
</tr>
<tr>
<td>1998</td>
<td>11.0</td>
<td>9.0</td>
<td>13.0</td>
<td>8.0</td>
<td>12.0</td>
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<td>9.0</td>
<td>1.0</td>
<td>9.0</td>
<td>9.0</td>
<td>1.0</td>
<td>9.0</td>
<td>1.0</td>
</tr>
<tr>
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<td>6.7</td>
<td>13.0</td>
<td>7.6</td>
<td>10.5</td>
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<td>8.6</td>
<td>1.0</td>
<td>8.6</td>
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<td>1.0</td>
<td>8.6</td>
<td>1.0</td>
</tr>
<tr>
<td>2000</td>
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<td>5.0</td>
<td>13.0</td>
<td>8.0</td>
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<td>1.0</td>
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<td>1.0</td>
<td>8.0</td>
<td>1.0</td>
</tr>
<tr>
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<td>4.1</td>
<td>13.0</td>
<td>5.7</td>
<td>10.0</td>
<td>6.4</td>
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<td>6.4</td>
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</tr>
<tr>
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<td>4.7</td>
<td>24.0</td>
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<td>8.6</td>
<td>8.6</td>
<td>8.6</td>
<td>8.6</td>
<td>8.6</td>
</tr>
</tbody>
</table>

Table 16.3.1. Concentration of gamma radio-nuclide Cs\textsuperscript{137} in the surface soil (0-5 cm in depth), Bq/kg

Source: Latvian Environment Agency

A similar conclusion can be made when analysing also other radiation situation characterising environment indicators - the content of radionuclide Cs\textsuperscript{137} in the surface soil\textsuperscript{1}. Cs\textsuperscript{137} is a gamma radiating radionuclide of technogenic origin, which entered the environment as a result of nuclear weapon testing and reactor accidents (for example, Chernobyl). During the period of the Chernobyl accident the meteorological conditions were favourable for the territory of Latvia. Therefore, the clouds of radioactive pollution either went past or over Latvia - not settling, as during the relevant period there was no rainfall, which would wash the pollution into the soil.

It can be seen that the content of radionuclide Cs\textsuperscript{137} in the soil changes greatly depending upon the type of soil. In sandy soils the Cs\textsuperscript{137} quickly washes into the deepest levels of the soil and a small amount remains in the surface layers. In contrast soil rich in humus the Cs\textsuperscript{137} is preserved for a long time in the surface layers. In looking at the changes in the content of Cs\textsuperscript{137} over time, one can see that the Cs\textsuperscript{137} content in the surface layers of the soil has a tendency to decrease.

The main two reasons for this, is the aforementioned washing of the Cs\textsuperscript{137} quickly into the deepest levels of the soil and the radioactive decay of the Cs\textsuperscript{137} itself, because the radioactive half-life of the Cs\textsuperscript{137} is 30 years. In accordance with the State significance ionising radiation object (SSIRO) control plan, in those same soil samples in addition to their Cs\textsuperscript{137} content, the beta radiating and technogenic origin Sr\textsuperscript{90} content is also specified utilising the radio-chemistry and liquid scintillation method. Data regarding Sr\textsuperscript{90} content in the soil samples correlates well with the data regarding Cs\textsuperscript{137} content.

In the new 2002 SSIRO control programme it is provided that commencing in 2003 to control for Cs\textsuperscript{137} and Sr\textsuperscript{90} content not only in soil, but also in surface waters, as is specified in Cabinet Regulation No. 149, Regulations for Protection against Ionising Radiation (9.04.2002) and the 8 July 2000 Regulation 2000/473/EURATOM in relation to Article 36 of the EURATOM Agreement.


**Author:** Visvaldis Grāveris

\textsuperscript{1} The specification of the radioactive pollution of soil by Cs\textsuperscript{137} is performed in the laboratory department of the Latvian Environment Agency (LEA) by the gamma spectrometry method. The taking of samples is conducted in accordance with the accredited LEA methodology R-03-2001 "Environmental quality - Radiology - Determination of radio-nuclides and radioactivity by the gamma spectrometry method for fixed sample geometry". In order to ensure the quality of the test results, a quality management and control system is maintained in conformity with the requirements of the LVS ISO/IEC 17025 standard.