Environmental Radioactivity Monitoring
Uranium mining in Romania

-3 uranium mining branches:

- Banat area - closed out;
- Bihor area - closed out;
- Suceava area - underground mine, operational; it is the main raw uranium ore producer;

From National Uranium Company S.A.
Monitoring and Sampling strategy

• 3 environmental matrices:
  ▪ water – surface and underground water (wells)
  ▪ soil - uncultivated soil
  ▪ vegetation - spontaneous vegetation (grass)

• sampling frequency: from 1/year to monthly
Measuring methods

- **low background total beta counter**
  - counter background was between 2.5 and 6 counts per minute
  - $^{90}$Sr/Y reference standard for determination of equipment detection efficiency.
  - measuring time: after 5 days from sampling, for 3000 sec.

- **gamma spectrometry**
  - high purity and resolution Canberra HPGe detector, model BE 3820, tip n, planar (from 3 keV to 3MeV) and minimal efficiency of 35%
  - Energetic resolution: 5.9 KeV → 450 eV; 122 Kev → 750 eV; 1332.5 KeV → 2100 eV.
  - Data analyse— Genie 2000 software
  - Energy calibration – reference source and spectrum peaks
  - Efficiency calibration – ISOCS software and certified reference materials from IAEA in different matrix.
  - measuring time: 64800 sec.
Monitoring of Suceava uranium mining area

- 2 operational underground mines – Crucea and Botusana

From National Uranium Company S.A.
Water monitoring

Concentration of U-235 in surface water

Bq/m³

0 20 40 60 80 100 120 140

R. Suceava
R. Siret
Pr. Suha av confl. Pr. Botusana
Pr. Suha av confl. Pr. Botusana
Pr. Stoluri - av. Botusana
R. Moldova
Pr. Crucea - av. confl. Pr. Troaca - gavanului
Pr. Troaca Gavanului - av Gal 8
Pr. Crucea - av confl. Pr. Troaca - gavanului
Pr. Crucea - av. St. Epurare
Pr. Crucea - av. St. Epurare
R. Bistrita

Botusana

Crucea

2008
2009
2010
2011
2012
2013
Water monitoring

Concentration of Ra-226 in surface water

Bq/m³

Year

2008 2009 2010 2011 2012 2013

R. Suceava
R. Siret
Pr. Suha am confl. Pr. Botusana
Pr. Botusana - av
Pr. Stoluri - av. Botusana
Pr. Moldova
Pr. Crucea - am. confl Pr. Troaca gavanului
Pr. Troaca Gavanului - av Gal 8
Pr. Crucea - av confl Pr. Troaca gavanului
Pr. Crucea - av. St. Epurare
R. Bistrita

Botusana
Crucea
Water monitoring

Concentration of Th-234 in surface water

Bq/m³

2008
2009
2010
2011
2012
2013

R. Suceava
R. Siret
Pr. Suha am confl. Pr. Botusana
Pr. Botusana - av
Pr. Stoluri - av. Botusana
R. Moldova
R. Bistrita
Pr. Crucea - av. confl. Pr. Troaca gavanului
Pr. Troaca Gavanului - av Gal 8
Pr. Troaca Gavanului - am Gal 8
Pr. Crucea - av. St. Epurare
Pr. Crucea - am confl. Pr. Botusana
Pr. Stoluri - av. Botusana
Pr. Suha am confl. Pr. Botusana
Botusana
Crucea
Soil monitoring

Concentration of U-235 in uncultivated soil

Bq/kg dry mass

- Suceava
- Ouside Botusana
- Ouside Crucea

2007 2008 2009 2010 2011 2012 2013
Soil monitoring

Concentration of Ra-226 in uncultivated soil

Bq/kg dry mass

2007 2008 2009 2010 2011 2012 2013

Suceava
Ouside Botusana
Ouside Crucea
Soil monitoring

Concentration of Th-234 in uncultivated soil

- Suceava
- Outside Botusana
- Outside Crucea

Bq/kg dry mass

2007  2008  2009  2010  2011  2012  2013
Monitoring of Bihor uranium mining area

• closed out
mobile gamma dose rate monitoring
Băița Plai – Bihor uranium minig area – sept 2015
mobile gamma dose rate monitoring
Băița Plai – Bihor uranium mining area

Soil radioactivity near CNU site, Bq/kg
Băița Plai – Bihor uranium mining area

Water radioactivity near CNU site, Bq/mc

- Th-234
- Ra-226
- U-235

Graph showing water radioactivity levels for Th-234, Ra-226, and U-235 from 2010 to 2013.
Poiana– Bihor uranium mining area

Soil radioactivity near Poiana site, Bq/kg

- **Th-234**: 1000 Bq/kg (2010), 2000 Bq/kg (2012), 1000 Bq/kg (2013)
- **Ra-226**: 5000 Bq/kg (2010), 3000 Bq/kg (2012), 5000 Bq/kg (2013)
- **U-235**: 100 Bq/kg (2010), 200 Bq/kg (2012), 100 Bq/kg (2013)
Poiana– Bihor uranium mining area

Water radioactivity Poiana site, Bq/mc
Monitoring of Brazava dump, Arad county
Monitoring of Brazava dump, Arad county

Soil radioactivity Barzava dump site, Bq/kg

- **Th-234**
- **Ra-226**
- **U-235**

Graph showing the soil radioactivity levels of Th-234, Ra-226, and U-235 at the Barzava dump site from 2009 to 2013.
Monitoring of Brazava dump, Arad county

Water radioactivity Barzava site, Bq/mc

- **Th-234**
  - 2010
  - 2012
  - 2013

- **Ra-226**
  - 2010
  - 2012
  - 2013

- **U-235**
  - 2010
  - 2012
  - 2013
Conclusions

• Environment monitoring is a mandatory task for all mining and milling activities in order to determine the impact on the environment;
• Based on the environment radioactivity monitoring performed by the Local Environmental Protection Agency and the operator, monitoring locations and maximum allowed limits for radioactive pollutants, like uranium and radium are permanently improved;
• Devices, reagents, personnel, procedures are all ensured in order to undertake proper laboratory works.
Thank you for your attention!