



# Czech innovative technologies in Free Release Measurement

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# Presentation outline

## Contents:

- ENVINET a.s.
- RW characterization and Free release measurement experience
- Present Research and Development
- Advanced FRM system
- Future of European FRM



# GENERAL INFORMATION



## ENVINET a.s.

|                |               |
|----------------|---------------|
| Foundation:    | 1995          |
| Headquarters:  | Trebic, Czech |
| Basic capital: | 2 mil. EUR    |
| Turnover 2012: | 17 mil. EUR   |
| Staff:         | 250           |
| QMS:           |               |



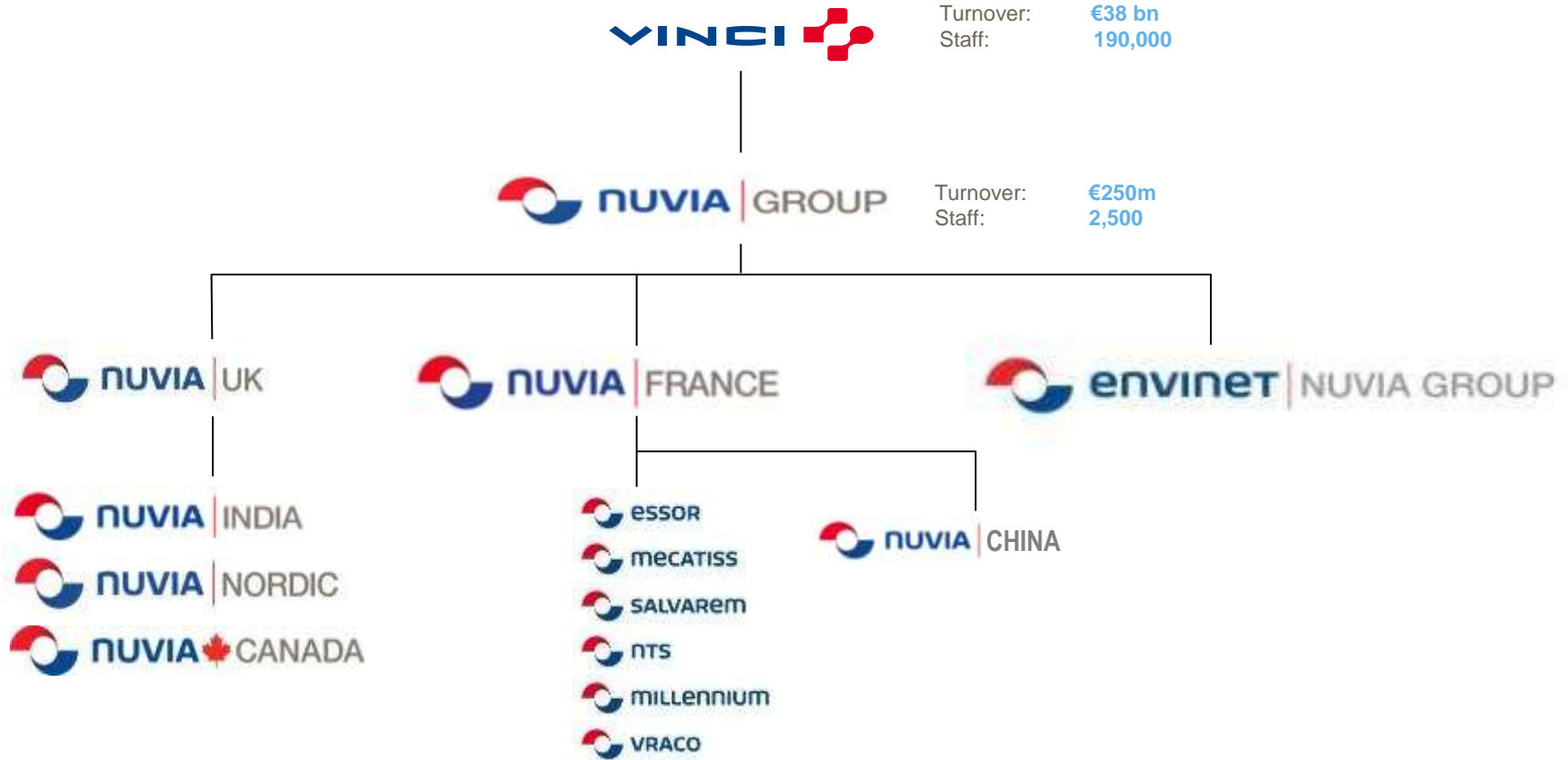
ISO 9001, ISO 14001,  
ISO 27001, ISO 20000-1,  
OHSAS 18001



## DIVISIONS

- Nuclear Power
- Project and Engineering
- Radiometric Systems
- Detectors Technology
- Laboratory Technology
- Business Development
- Industrial Automation
- Mechanical Production
- Software Development

# ENVINET – Nuvia Group member



# Radwaste characterization, radiological analyses, FRM

## ENVINET`s capability

- Own comprehensive solution – design, development, manufacturing, SW, methodology, operation, service
- Gamma spectrometric characterization of all radwaste originated in both Czech NPPs (the only Czech company authorized by State Office for Nuclear Safety and Czech Metrology Institute for provision of free release measurement of RW)
- GAMWIN SW – gamma spectroscopic analyses software
- WASTIS SW – radioactive waste tracking, accounting and management
  
- **LABONET - International Network of Laboratories for Nuclear Waste Characterization (auspiced of IAEA) Steering Committee member**
- **Active participation in EURAMET's European Metrology Research Programme (EMRP): Metrology for radioactive waste management**



Measurement system MERLIN  
(Dukovany NPP )



Measurement system EDRUS  
(Dukovany NPP )

# Czech Nuclear Power Plants

## Dukovany NPP

4 units VVER 440/213 in operation

1985

1986

1986

1987

Total electric power 2000 MWe



## Temelin NPP

2 units VVER 1000/320 in operation

2003

2004

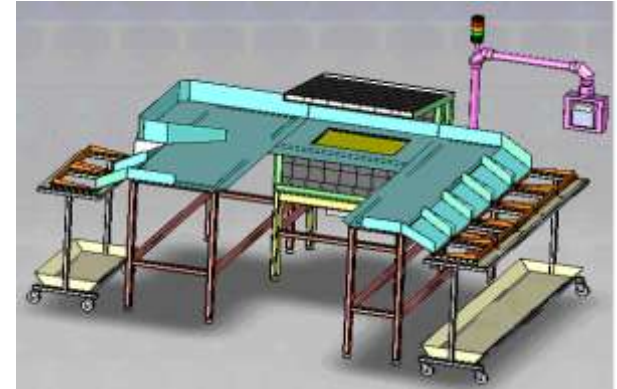
Total electric power 2000 MWe

# Characterization of radwaste from Czech NPPs



# Characterization of radwaste from Czech NPPs (cont'd)

- Radioactive waste collecting and sorting
- Pre-treatment characterization
- Characterization for external processing
- Characterization for disposal
- Fulfillment of waste management Limits and Conditions





# Characterization of radwaste from Czech NPPs (cont'd)

**ENVINET's workshop at Dukovany NPP area:  
measurement of all low-level radioactive waste from Dukovany and Temelin  
NPPs**

- **spectrometry gamma**
- **certified gamma activity measurement for clearance**
- **certified surface activity and dose rate measurement**
- **design, construction and maintenance of sorting equipment**
- **IT support – Waste Management Information System LOIS /WASTIS**
- **specialized gamma spectrometry measurement**

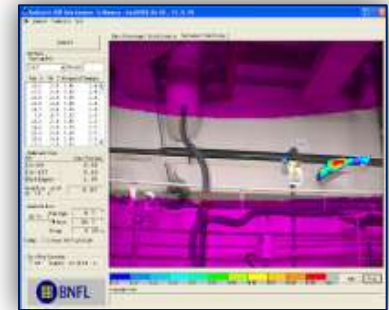


- **About 100 t radwaste per year is measured at ENVINET facility**
- **Free Release Measurement: FRM scenerio and regulatory body authorization**
- **About 95% measured material is released into the environment (good pre-treatment, sorting table + carousel)**

# Radiological analyses reference – JRC Ispra, Italy

## RADIOLOGICAL ANALYSES FOR PRE-DECOMMISSIONING RADIOLOGICAL CHARACTERIZATION OF SHUT DOWN NUCLEAR FACILITIES

- Characterization of research reactors, hot cells, radiochemistry laboratories, liquid effluents treatment
- Destructive and non-destructive analyses: in-situ measurements; smear sampling; sampling of structures and components
- Gamma-ray imaging with RadScan 800 gamma camera



Reactor bioshield drilling and sampling



# FRM reference – Ignalina NPP (under decommissioning), Lithuania

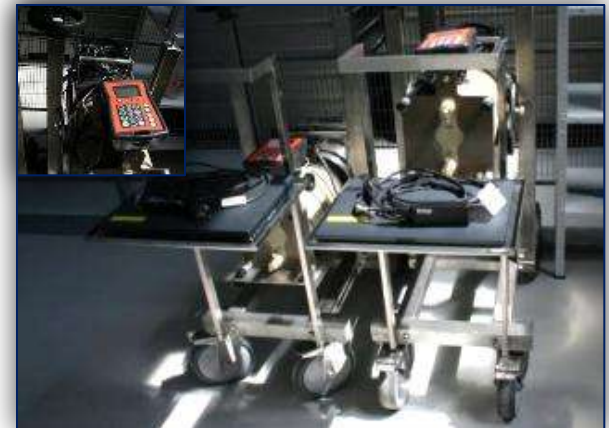
## FREE RELEASE MEASUREMENT FACILITY

Stationary and mobile systems for RW free release measurement which determines the possibility of waste release into the environment

- 3x HPGe detectors ORTEC
- 3x MCA analyzers DSPEC j.r. ORTEC
- IsoCart + MCA DigiDART
- SW GAMS04, RAOS, GamaVision, Isotopic 32

## PROCUREMENT OF TOOLS AND EQUIPMENT FOR RADIOLOGICAL CHARACTERIZATION

- Supply and installation of the measuring and laboratory equipment
- Development of radiochemical methods & procedures
- Creation of the system database for archiving and presentation of the measured data
- Training of radiochemical laboratory personnel



# FRM reference – SUE SIA „Radon“, Russia

## RADIOACTIVE WASTE CHARACTERIZATION SYSTEM

- Stationary system with HPGe detector and a conveyor for 25 drums for automatic RW measurement
- 2 mobile systems with HPGe detector and a turntable ISO-CART + MCA DigiDart device
- SW GamControl, RAOS, GamaVision, Isotopic 32
- Generating reports for the State control and accounting system of RW&RM



Conveyor for 25 drums



Drum rotating unit

# Radwaste measurement systems for acceptance at repositories and for free release

| MODEL   | GAMS 01                                       | GAMS 02   |
|---|---|---|
| Type of packaging                               | Packed or unpacked objects                    | DRUMS   |
| Description                                     | Gamma radiation measurements at any location  | Mobile equipment for the spectrometric values measurements of high/low-activity waste in drums from 20 to 200 l |
| Application                                     | In situ measurement                           | characterization  |
| Dimension [LxHxW]                               | 132 x 130 cm x 48 cm                          | 1800 x 1800 x 900 cm  |
| Weight  | < 100 kg                                      | < 800 kg  |
| Energy range                                    | 50 - 2000 keV                                 | 50 - 2000 keV   |
| Transport of packaging                          | NO  | NO  |
| Rotation system                                 | NO  | YES   |
| Number of detectors                             | 1   | 1   |
| Position of detector                            | Variable                                      | Vertical variable   |
| Detector type                                   | HPGe  | HPGe  |
| Type of cooling                                 | Nitrogen                                      | Electric cooling/Nitrogen   |
| Relative efficiency                             | from 10 %                                     | from 10 %   |
| Weighing system                                 | NO  | YES   |
| Weighing range                                  | x   | 0 - 400 kg  |
| Weighing accuracy                               | x   | 0,2 kg  |
| UPS   | NO  | YES   |
| SW type   | GamWin/GammaVision/IsoPlus + RAOS + ORACLE XE | GamWin/GammaVision + GamControl + RAOS + ORACLE XE  |
| Average capacity of measured packaging per hour | x   | 8 drums   |
| Collimator                                      | YES   | YES   |
| Shielding material                              | Lead 5 cm                                     | Detector shielding: Lead 10 cm  |



**GAMS 01**



**GAMS 02**

# Radwaste measurement systems for acceptance at repositories and for free release (cont'd)

| MODEL   | GAMS 03  | GAMS 04   |
|---|--|---|
| Type of packaging                               | DRUMS  | DRUMS   |
| Description                                     | Equipment for the spectrometric values measurements of high/low-activity waste in 200 l. drums | Equipment for measuring of potential radwaste packed in drums |
| Application                                     | characterization   | free release measurement                                      |
| Dimension [LxHxW]                               | 465 x 250 x 400 cm   | 330 x 180 x 230 cm  |
| Weight  | < 3000 kg  | < 7500 kg   |
| Energy range                                    | 50 - 2000 keV  | 50 - 2000 keV   |
| Transport of packaging                          | T - shaped conveyor belt   | T - shaped conveyor belt                                      |
| Rotation system                                 | YES  | YES   |
| Number of detectors                             | 1,00   | 3   |
| Position of detector                            | Vertical variable  | Fixed   |
| Detector type                                   | HPGe   | HPGe  |
| Type of cooling                                 | Electric cooling/Nitrogen  | Electric cooling/Nitrogen                                     |
| Relative efficiency                             | from 10 %  | from 30 %   |
| Weighing system                                 | YES  | YES   |
| Weighing range                                  | 0 - 500 kg   | 0 - 500 kg  |
| Weighing accuracy                               | 0,2 kg   | 0,2 kg  |
| UPS   | YES  | YES   |
| SW type   | GamWin/GammaVision + GamControl + RAOS + ORACLE XE   | GamWin/GammaVision + GamControl + RAOS + ORACLE XE            |
| Average capacity of measured packaging per hour | 8 drums  | 6 drums   |
| Collimator                                      | YES  | NO  |
| Shielding material                              | Detector shielding: Lead 10 cm   | Lead 10 cm, stainless steel 0,15 cm, cooper 0,05 cm           |



**GAMS 03**



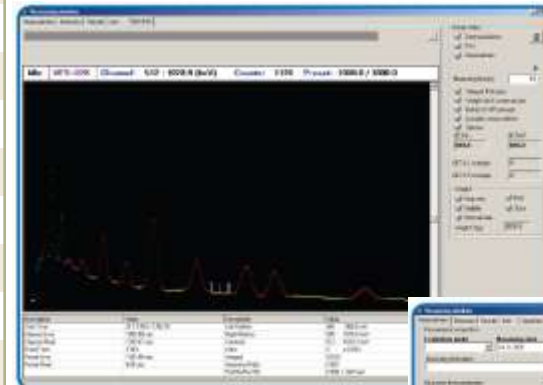
**GAMS 04**

# Radwaste measurement systems for acceptance at repositories and for free release (cont'd)

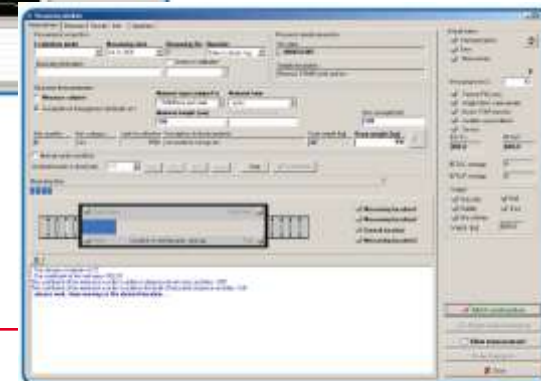
| MODEL   | MERLIN  |
|---|---|
| Type of packaging                               | CONTAINER (120x40x40 cm)  |
| Description                                     | Equipment for measuring of potential radwaste – freely stored               |
| Application                                     | free release measurement  |
| Dimension [LxHxW]                               | 2 mobile units:<br>1] 327 x 260 x 244 cm<br>2] 606 x 260 x 244 cm           |
| Weight  | < 10000 kg  |
| Energy range                                    | 50 - 2000 keV   |
| Transport of packaging                          |   |
| Rotation system                                 | NO  |
| Number of detectors                             | 3   |
| Position of detector                            | Fixed   |
| Detector type                                   | HPGe  |
| Type of cooling                                 | Electric cooling/Nitrogen   |
| Relative efficiency                             | from 30 %   |
| Weighing system                                 | YES   |
| Weighing range                                  | 0 - 400 kg  |
| Weighing accuracy                               | 0,2 kg  |
| UPS   | YES   |
| SW type   | Genie2000/GammaVision + SW Merlin + DB Firebird                             |
| Average capacity of measured packaging per hour | 6 boxes   |
| Collimator                                      | NO  |
| Shielding material                              | lead central side: 10 cm, lead other sides: 15 cm<br>tin and cooper: 0,1 cm |



MERLIN 1.03 – measuring instrument



Spectral analysis



SW Merlin: Measuring process

# R&D national and European projects participation

- **RANUS – TD: Radiation and Nuclear Safety Technology Development**

- Competence Centre
- Co-financed by Technology Agency of Czech Republic
- Duration: 2012 – 2019
- <http://www.ranus-td.cz>



- **Metrology for Radioactive Waste management “MetroRWM”**

- EURAMET European Metrology Research Programme
- Duration: 2011 – 2014
- ENVINET`s participation on Development of standardised traceable measurement methods for solid FRM and disposal / Development of novel instruments and methods for in-situ measurements
- <http://www.radwaste-emrp.eu>

- **Metrology for decommissioning of nuclear facilities**

- Start 2014





# MUM – advanced free release measurement facility

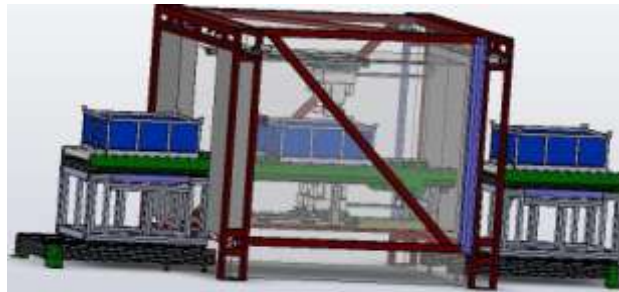
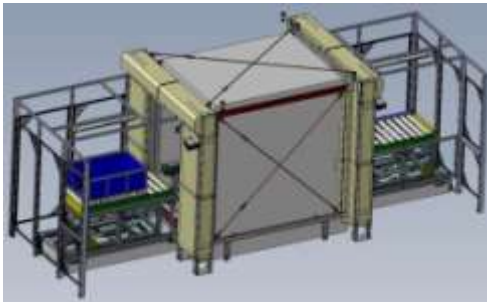
Facility for measuring of potential RW prior to its release into the environment.

|   |  |
|---|--|
| Type of packaging                               | CONTAINER (120x80x40 cm)   |
| Description                                     | Equipment for measuring of potentially radwaste freely stored    |
| Application                                     | free release measurement   |
| Dimension [LxHxW]                               | 580 x 310 x 200 cm   |
| Weight  | < 36000 kg   |
| Energy range                                    | 50 - 2000 keV  |
| Transport of packaging                          |  |
| Rotation system                                 | NO   |
| Number of detectors                             | 4  |
| Position of detector                            | Fixed  |
| Detector type                                   | HPGe   |
| Type of cooling                                 | Electric cooling   |
| Relative efficiency                             | 50%  |
| Weighing system                                 | YES  |
| Weighing range                                  | 0 - 500 kg   |
| Weighing accuracy                               | 0,2 kg   |
| UPS   | YES  |
| SW type   | GamWin/GammaVision + GamControl + RAOS + ORACLE XE               |
| Average capacity of measured packaging per hour | 6 boxes  |
| Collimator                                      | YES  |
| Shielding material                              | Tunnel is made of special construction with a low level material |

# MUM – advanced free release measurement facility

Prototype of unified Europe wide FRM methodology system.

- Low-background measuring tunnel;
- 4 HPGe Interchangeable Detector Modules with lead collimators;
- Conveyor for moving the measuring container;
- 4 measuring containers;
- Air-conditioning and filtration unit for measuring tunnel.



# MUM – advanced free release measurement facility

## Low – background concrete like shielding material.

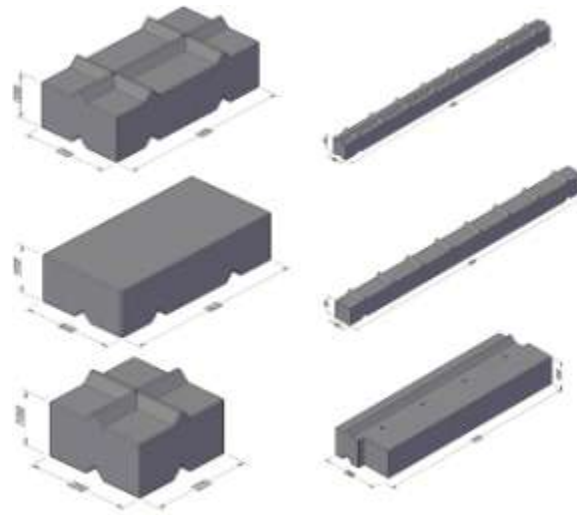
High density material – bulk density in the interval 2 300 – 3 250 g/m<sup>3</sup>

### Key advantages:

- Easy, dry and clean construction.
- Modular construction system.
- Self-supporting construction.
- Cheap production

### Internal content of radionuclides:

|        |            |
|--------|------------|
| K-40   | 10.6 Bq/kg |
| Ra-226 | 1 Bq/kg    |
| Th-228 | 0.7 Bq/kg  |



# MUM – advanced free release measurement facility

## Free Release Measurement system MUM construction



Construction commissioning

4 IDM ORTEC detectors



Site walls



lintel



Ventilation & doors

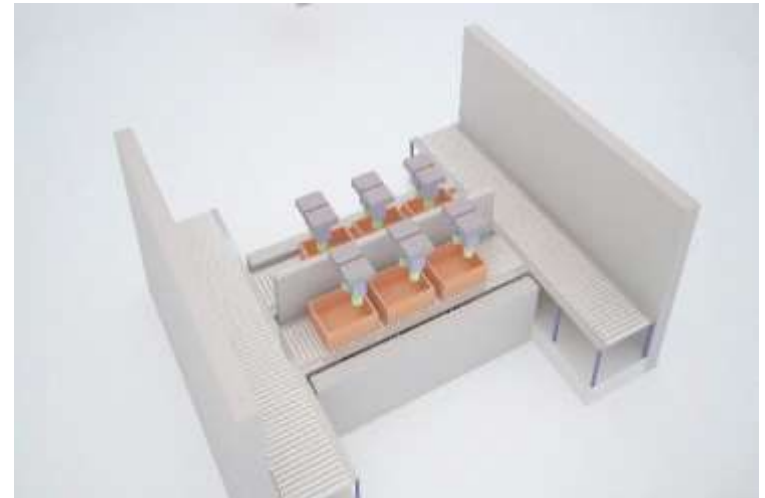


# Metrology for decommissioning nuclear facilities

## EMRP SRT-v19 project

Start in the middle of 2014.

- Radionuclide characterization of materials present on decommissioning sites, automated gamma spectrometry analyses
- Pre-selection of waste into streams (repository or potential free release)
- Implementation of 'free release measurement facility' on decommissioning site, scanning of heterogeneous waste
- Monitoring in radwaste repositories and decommissioning sites
- Calibration reference materials and standard sources



Free release measurement – engineering, innovation,  
implementation. Czech experience.

**Thank you for your  
attention!**

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