

Nuclear Power Plants: user perspective about calibration

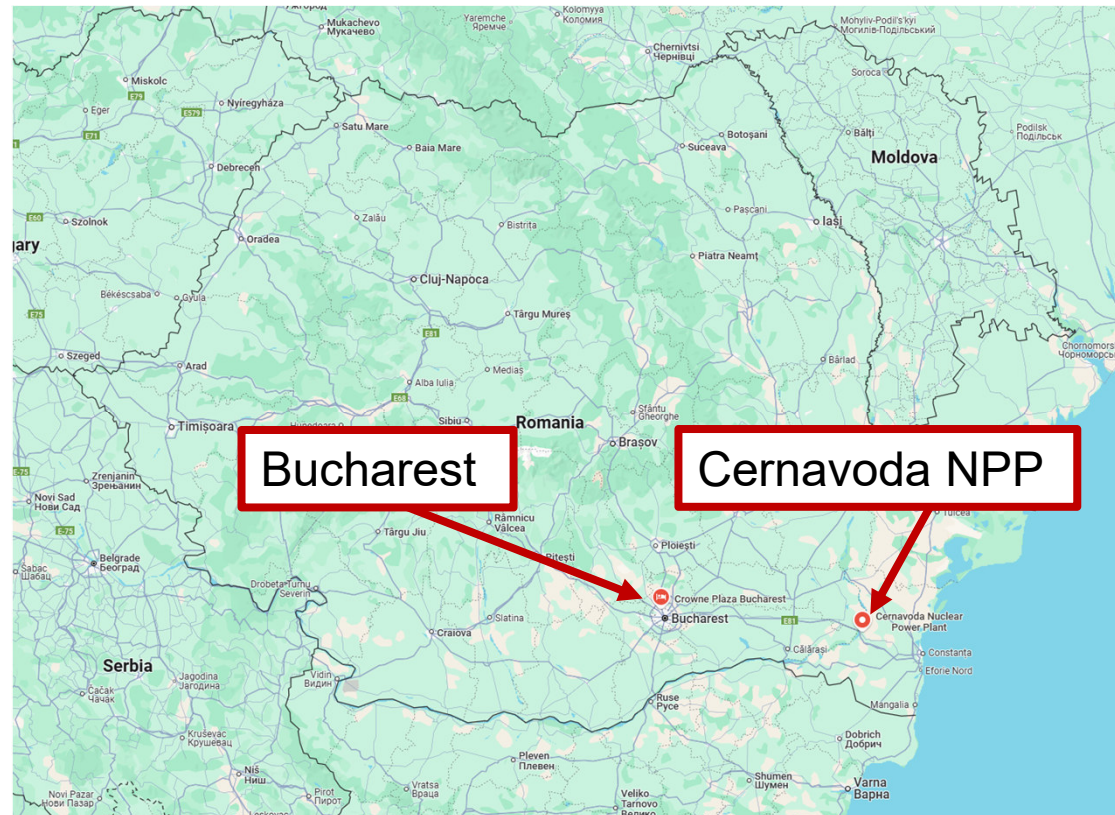
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Cernavoda NPP - Romania

The Nuclear Power Plant in Cernavoda is the only nuclear power plant in Romania.

It produces around 20% of the country's electricity.

It uses CANDU reactor technology from AECL, natural uranium as fuel and heavy water as moderator and coolant.



Radiation Protection at Cernavoda NPP

NPP (Nuclear Power Plant) Cernavoda is responsible for:

- **ensuring the radiological monitoring of the working environment**
- **monitoring the individual exposure of exposed workers and visitors**
- **management and characterization of radioactive waste generated as a result of its authorized practices.**

Individual Dosimetry Laboratory (IDL)



The Individual Dosimetry Laboratory (IDL) within NPP Cernavoda:

- ☐ **ensures both internal and external dosimetry services for exposed workers of NPP Cernavoda and the contractor**
 - ☐ 2 x Whole body counters with HPGe detectors: approx. 350 persons monitored per month
 - ☐ 4 x Tri-Carb using Liquid Scintillation Counter – For tritium detection in urine samples: approx. 3600 samples analyzed per month
 - ☐ 3 x Panasonic Automatic TLD Readers: approx: 2500 persons monitored per month
- ☐ **monitors the radioactivity in the samples of liquid and gaseous radioactive effluents from the plant.**

Individual Dosimetry Laboratory (IDL)



- **The equipments used in our laboratory for the dosimetric measurements are selected:**
 - to meet the requirements of national and international standards
 - type tested by the manufacturer according to the relevant EN/IEC or ISO standard
- **After installation we ensure that for all dosimetric measurements we have Metrological Traceability using standard sources calibrated to a secondary laboratory**
- **The reproducibility of the calibration is regularly controlled through regular checks on the dosimetric performance of the dosimetry systems**
- **IDL owns facilities for internal periodic calibrations:**
 - Irradiators for personal dosimeters
 - Standard sources for whole body counters and gamma spectrometers

General information about assuring Metrological Traceability



- **Dosimetry systems are calibrated before placing into service**
- **Dosimetry systems are checked after maintenance or repair**
- **Calibration cycles are properly documented**
- **Reference calibration is repeated at regular intervals**



Calibration



According to JCGM 200,

**Calibration is the operation that, under specified conditions:
in a first step**

- **establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties and,**

in a second step,

- **uses this information to establish a relation for obtaining a measurement result from an indication.**

Calibration of dosimeters for external dosimetry

- **Reference dosimeters are sent to the SSDL for irradiation in reference conditions. They are accompanied by transport / background dosimeters**
- **Reference dosimeters are read in the TLD readers**
- **Calibration factors are calculated**

Calibration of WBC for internal dosimetry

- **Whole Body Counters are calibrated on site**
- **As a reference, standard sources are used**
- **The calibration is done by placing the standard source on a phantom**
- **One of the major disadvantages is a potential lack of control over the environment.**
- **For example, you might not be able to properly control the temperature and humidity of the room where the equipment is, which can be an issue for sensitive devices.**

Type testing according to relevant standards implies determination of

- the dosimetric characteristics of the equipment
- repeatability and reproducibility
- effect of influence quantities,
- other factors linked to the measurement method

The advantages of seeing calibration and type testing closely interlinked



- **Accurate measurements**
- **Low Minim Detectable Activity / Lower Limit of Detection – High efficiency of the equipment**
- **Excellent results in the Inter Comparisons Exercises**

Challenges for On Site Calibration

- **Controlling the reference conditions for environmental factors which is an issue for sensitive devices like gamma spectrometry detectors used for whole body counters.**
- **The personnel needs special training (mainly new employees) for a better understanding of the calibration process.**

Necessities

- **Training courses for new employees in the calibration process for different types of measurements: gamma spectrometry, liquid scintillation, gross alpha-beta, etc.**
- **Easing the process of acquisition to contract the services with primary or secondary standard laboratory.**

Conclusion:



- **Measurements of reasonable accuracy and high reliability require rigor and attention to detail**
- **Close attention to meet the requirements of EN ISO/IEC 17025:2017**
- **Measurement accuracy is quantified by the assessment of the uncertainty**
- **Calibration and type testing have to be seen as closely interlinked**

**Thank you
for your
attention !**