

## $^{60}\text{Co}$ GAMMA RAY IRRADIATION FACILITIES “ROZA” and “PRAZDROJ”

Both Roza and Prazdroj irradiation facilities are of a well-type.

### DOSE RATE

Dose rate varies from 0.01 to 8 kGy/h depending on the sample size and on the distance from the cobalt source. High dose rates are achievable only near the cobalt source – i. e. in the middle of the irradiation shaft. To reach satisfactory irradiation homogeneity, samples must be turned during irradiation process.

### ENVIRONMENTAL CONDITIONS

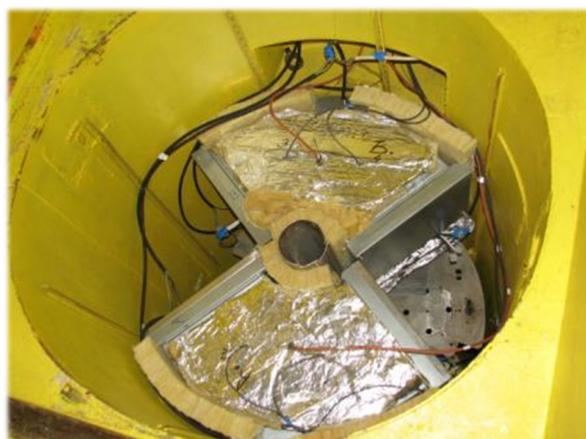
Irradiation temperature and atmosphere can vary in wide range according to the customer's requirements (e. g. from -196 °C to 500 °C). Special thermoboxes can be mounted into the irradiation shaft to achieve a homogeneous temperature.

### MEASUREMENTS

It is possible to perform functional measurements during the irradiation.



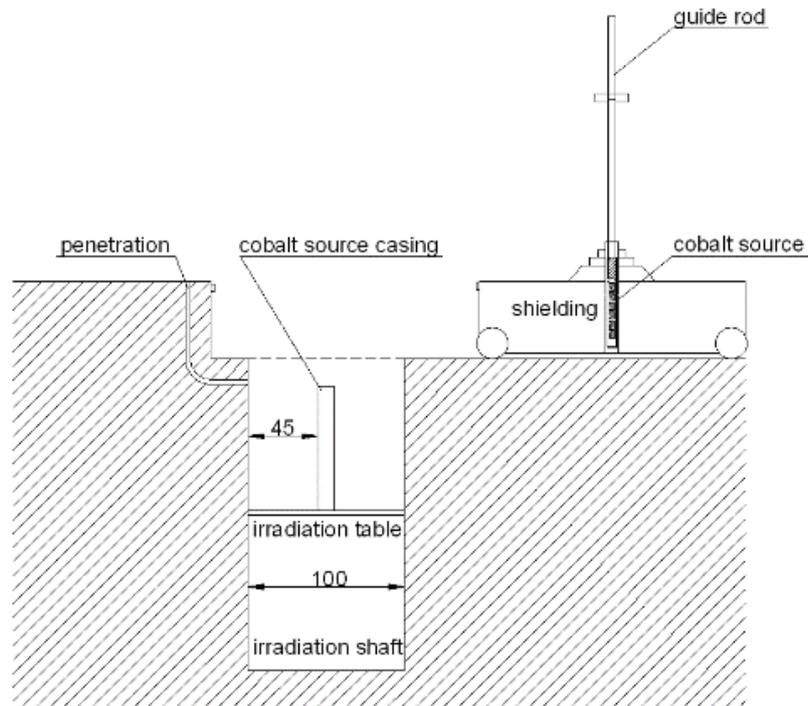
Cobalt source PRAZDROJ (left) and ROZA (right)



View into the irradiation shaft with installed thermobox for irradiation at elevated temperature.

*(shaft diameter 100 cm)*

## Irradiation shaft dimensions.

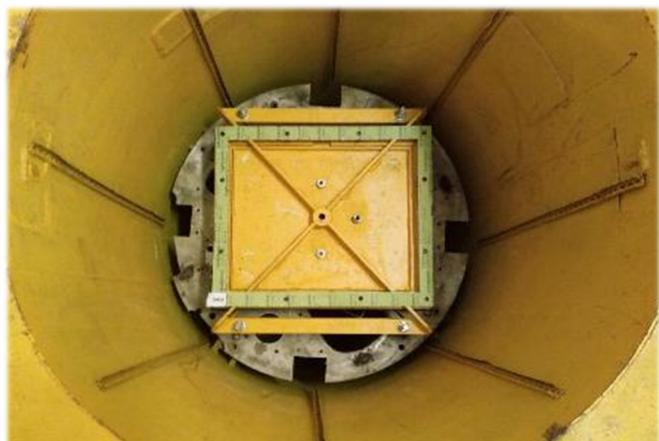


Schematic view of the irradiation facilities Roza and Prazdroj.  
*Dimensions in cm.*

Example of a **big sample irradiation** – irradiated at room temperature, average dose rate ca 300 Gy/h.



Sample handling.



Big sample inside the irradiation shaft.

Special thermoboxes are used for the **irradiation at elevated temperature** – see the pictures below. Depending on the box, the temperature can be set up to 300 °C. It is possible to construct customized box for special samples.



Small thermobox without cover.



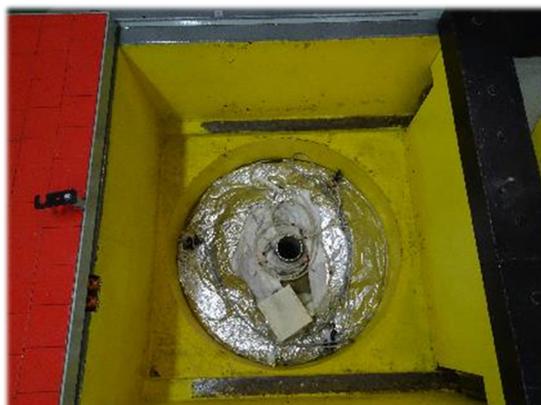
Box for irradiation at 300 °C.

Thermobox in Roza irradiation facility. This is designed for samples with diameter up to 85 cm. It can reach temperature 150 °C with circulating air.

Dose rate on the cylinder with diameter 50 cm is around 2 kGy/h, on the wall around 1 kGy/h.



Fiber optic components inside the box at room temperature with functional measurement.



Covered box inside the irradiation shaft.

# <sup>60</sup>Co GAMMA RAY IRRADIATION FACILITY “PANOZA”

## DIMENSIONS

The irradiator floor is about 3 × 3 meters. Its cross-section has a profile with circular vault of the height 3 meters. The rod source consists of a stainless tube, i. d. 27.4 mm, length 258 mm. Cylindrical sources, encapsulated into stainless cases, are placed coaxially inside the tube. The rod source is drawn out of the container into the irradiation position in the center of the irradiation annulus by a hand-operated steel rope.

## DOSE RATE

The dose rate value can vary depending on the source pulled-out length. Using this simple arrangement, it is possible to maintain constant irradiation value during long-term irradiation procedures (several years). The dose rate approx. 0.1 – 200 Gy/h.

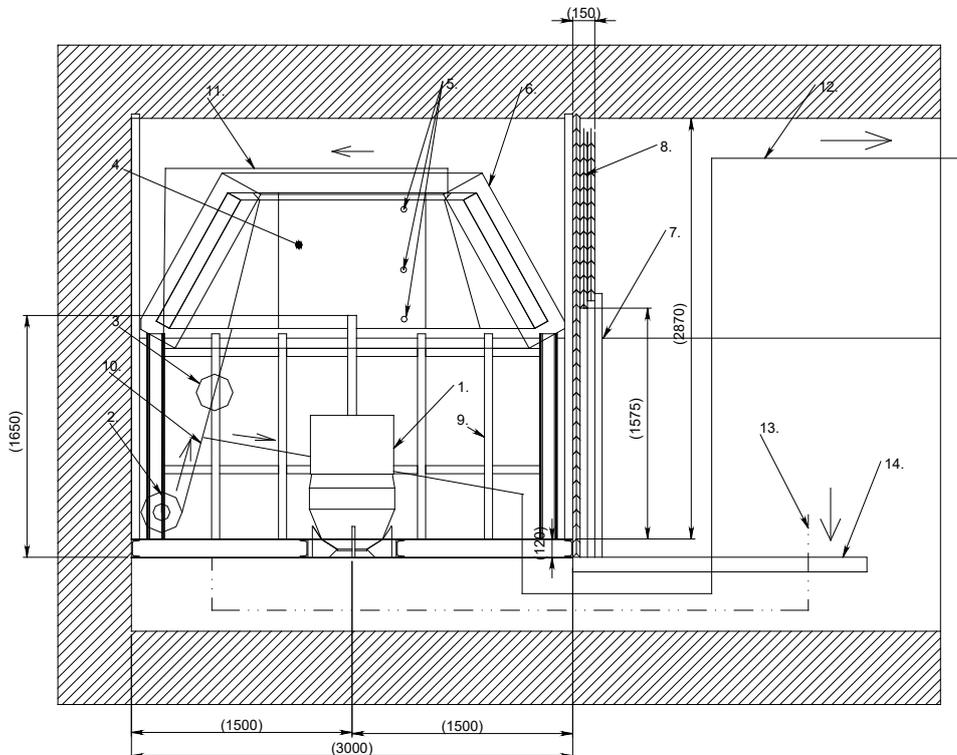
## ENVIRONMENTAL CONDITIONS

Long samples (e. g. cables) can be irradiated at elevated temperature up to 90 °C. Nevertheless, it is possible to construct individual thermobox for irradiation special samples at required temperature.

## MEASUREMENTS

It is possible to perform functional measurements during the irradiation.

Irradiation facility **dimensions**.



Schematic view of the irradiation facility Panoza.  
Dimensions in mm.



Container with the cobalt source in the standby position.



On-line measurement of the sample's properties during the irradiation.

## DOSIMETRY SYSTEM ALANINE/EPR

This system has become a routine technique for the dose assurance service in radiation processing (ISO/ASTM 51607-2013: Standard Practice for Use of the Alanine-EPR Dosimetry System). We use in our testing laboratory the Alanine/EPR system from Bruker company Germany. Alanine pellets with the height and diameter 4 mm and/or alanine strips 4×15 mm. Dosimeters are evaluated using EPR spectrometer e-scan. The absorbed dose is measured in the range 10 Gy – 200 kGy. From the irradiation time, the dose rate is calculated. The dosimetry system is traceable to National Physical Laboratory (NPL) in UK.

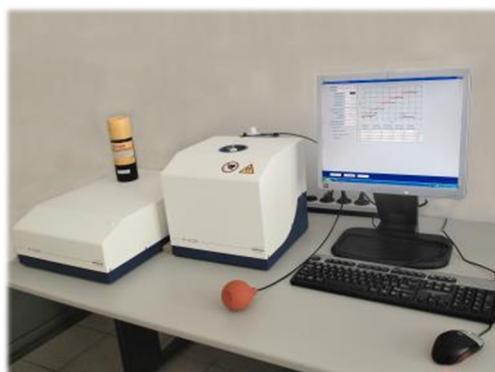
The principle of this dosimetry system is based on the determination of the concentration of stable free radicals by electron paramagnetic resonance spectroscopy (EPR). The radiation induced free radicals in alanine are far more stable than the free radical species produced by ionizing radiation in most organic substances. This is the primary reason for alanine being the most commonly used material for high dose EPR dosimetry.

Alanine/EPR system offers many advantages over other forms of dosimetry (e. g. thermoluminescence, spectroscopy)

- *Is non-destructive:* EPR analysis does not affect the measured sample physically or chemically, the sample can be measured many times
- *High accuracy:* measured accuracies of 1 % or less can be achieved
- *High sensitivity:* absorbed doses from 10 Gy can be detected using our EPR
- *High dynamic range:* doses ranging from 10 Gy to 200 kGy can be measured
- *Fast results:* typical EPR spectrum can be measured in a few seconds, making it suitable for on-line analysis
- *The irradiation temperature:* can be between -60 and +90 °C
- *Low response on irradiation temperature:* the temperature coefficient is 0.1 to 0.2 %/K
- *The radiation energy:* for photons and electrons can be between 0.1 and 28 MeV
- *Long term stability:* the fading (EPR signal decrease) is about 0.5 %/year
- Can be used for *archival purposes*



Alanine pellets or strips.



Evaluation using EPR spectrometer.



## CONTACT

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