

The SCK-CEN Activities in Neutron Dosimetry

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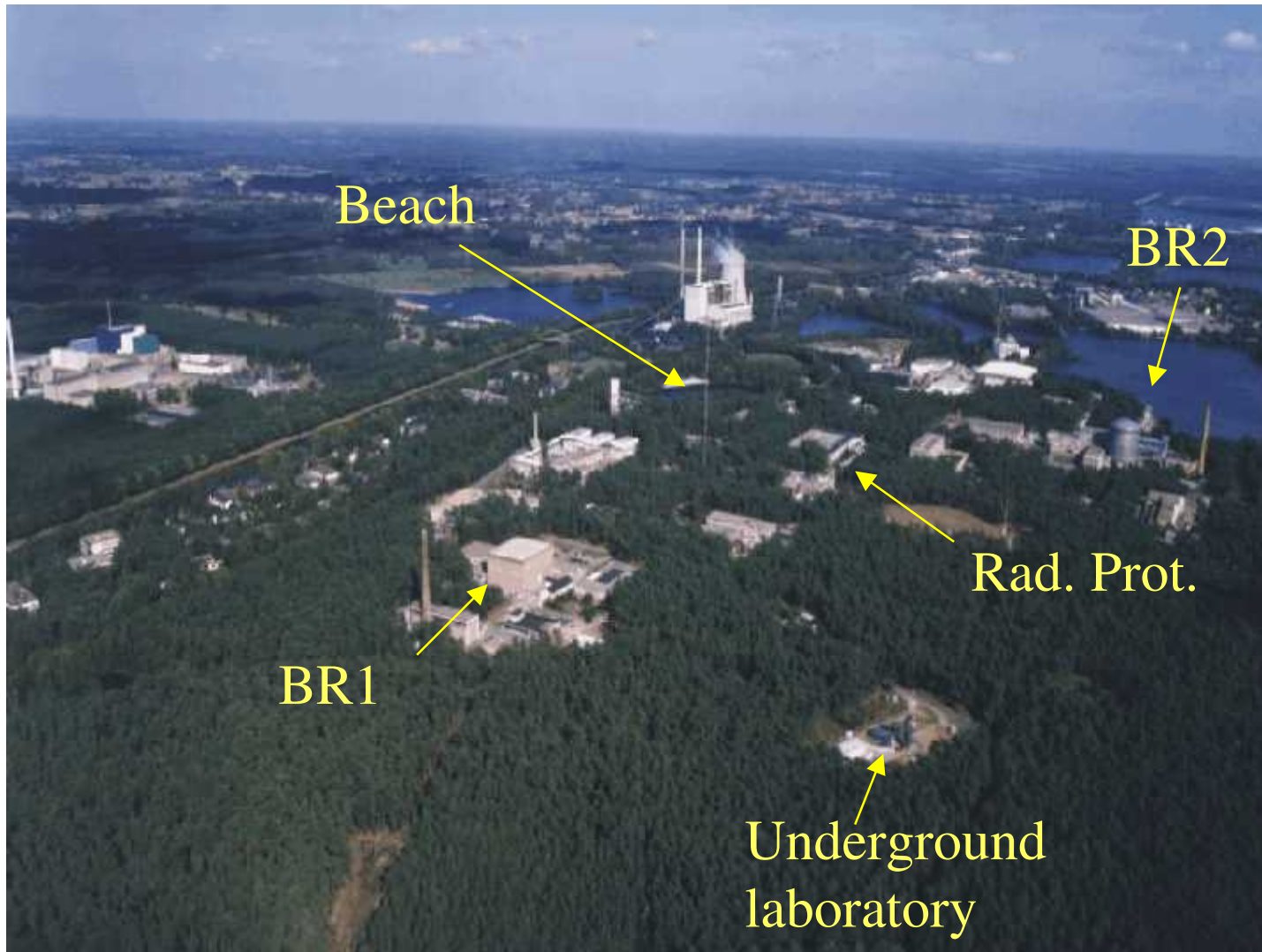
Belgian Nuclear Research Centre

SCK-CEN



STUDIECENTRUM VOOR KERNENERGIE
CENTRE D'ÉTUDE DE L'ÉNERGIE NUCLÉAIRE

The Belgian Nuclear Research Centre SCK-CEN





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SCK-CEN: Belgian Nuclear Research Centre

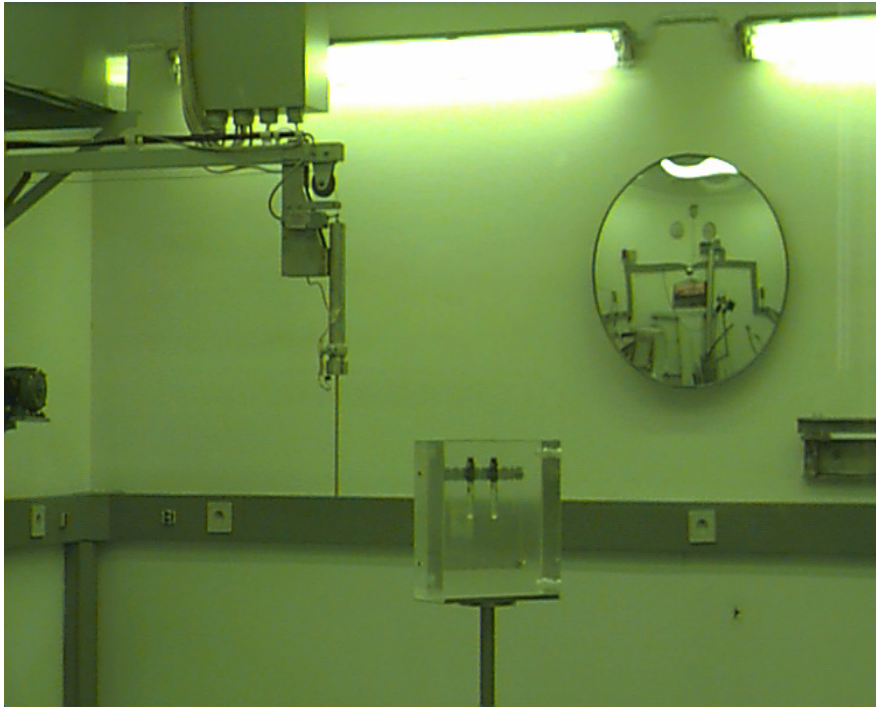
- 600 researchers mainly working in:
 - reactor safety
 - ◆ reactor material research
 - ◆ MYRRHA project: a multipurpose accelerator driven system
 - radioactive waste research
 - ◆ decommissioning of nuclear installations
 - ◆ disposal of vitrified waste in geological clay formations
 - BR2
 - ◆ R&D
 - ◆ isotopes production and NDT (neutron doping by transmutation)

Radiation Protection

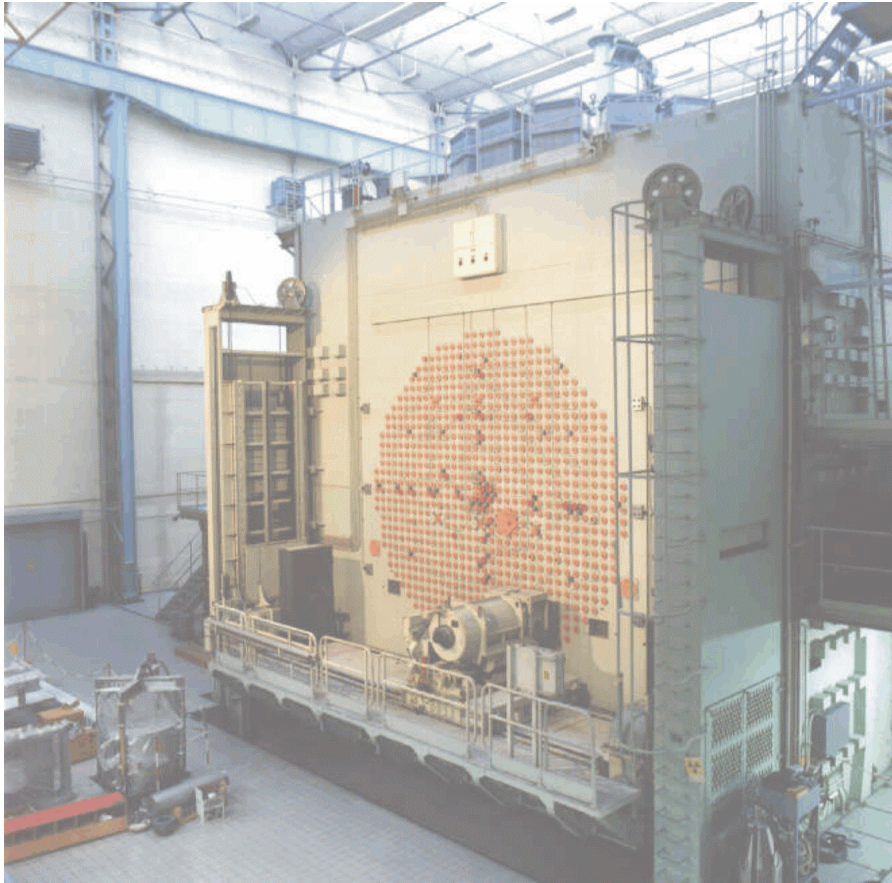
- Low-level measurements
- Decision strategy research
- Radiation Protection Research
 - radiobiology
 - Radon
 - radioecology
- Safeguards and measurements
 - safeguards
 - spectrometry and NAA (neutron activation analysis)
 - Instrumentation, calibration and dosimetry

Neutron calibration facilities at the SCK-CEN

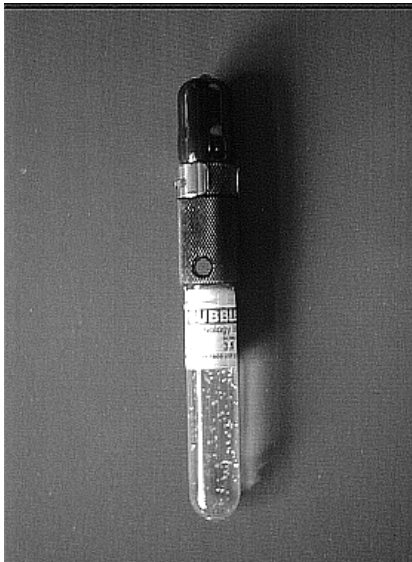
- Radionuclide sources:
 $2 \times {}^{252}\text{Cf}$, Am-Be, Ra-Be,
Am-Li
- Accreditation for ${}^{252}\text{Cf}$
calibrations of neutron
area monitors



Thermal neutron beam at the BR1 reactor



Dosimetry service



- Gamma and beta TL-dosemeters (TNO system, Harshaw detectors, 5000/month)
- Extremity and environmental dosimetry
- Neutron dosimetry: BTI bubble detectors
 - combination BD-PND and BDT
 - poole of 15 detectors (x2)
 - only used for specific applications

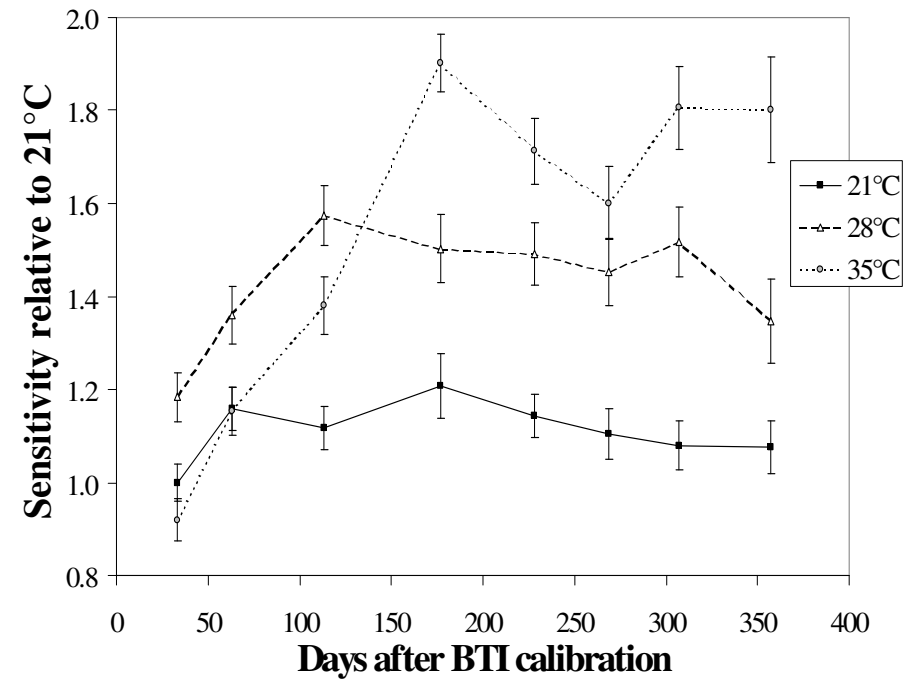
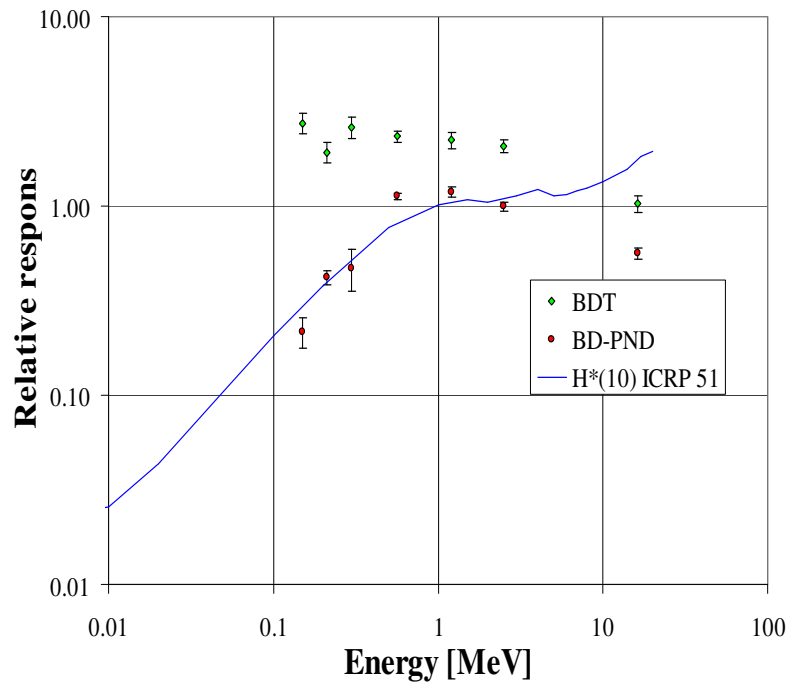
Criticality dosemeter

- Used at SCK-CEN, BN and FBFC in the Mol-area
- Based on activation of
 - $^{197}\text{Au}(n,\gamma)^{198}\text{Au}$
 - $^{115}\text{In}(n,n')^{115}\text{In}^m$
 - $^{32}\text{S}(n,p)^{32}\text{P}$
- Basic reconstruction of spectrum by algorithm
- Yearly test at BR1

Research on characteristics of the bubble detectors

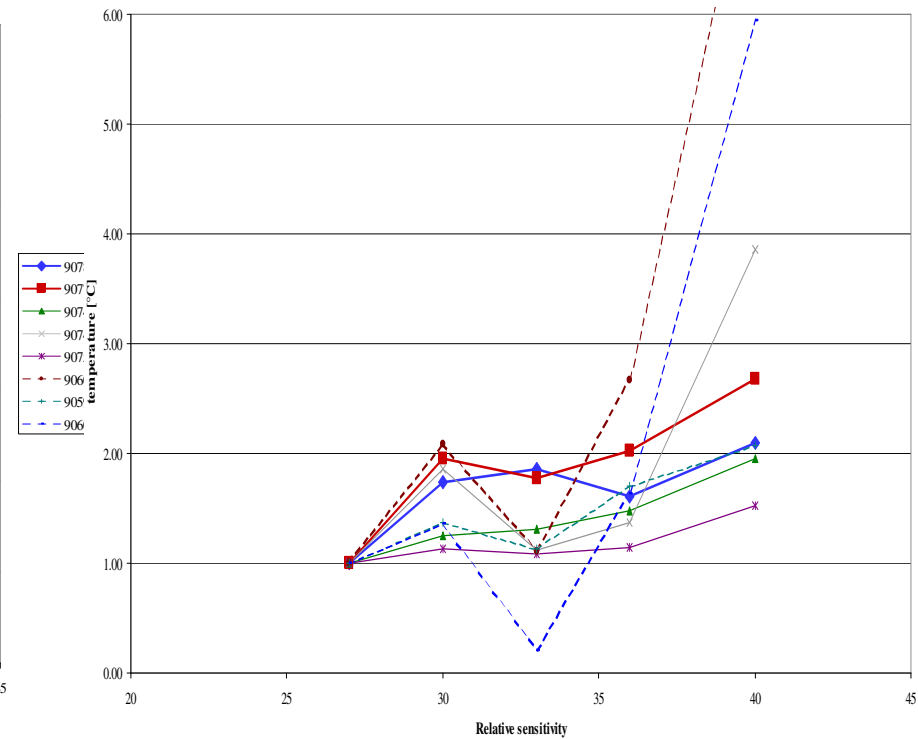
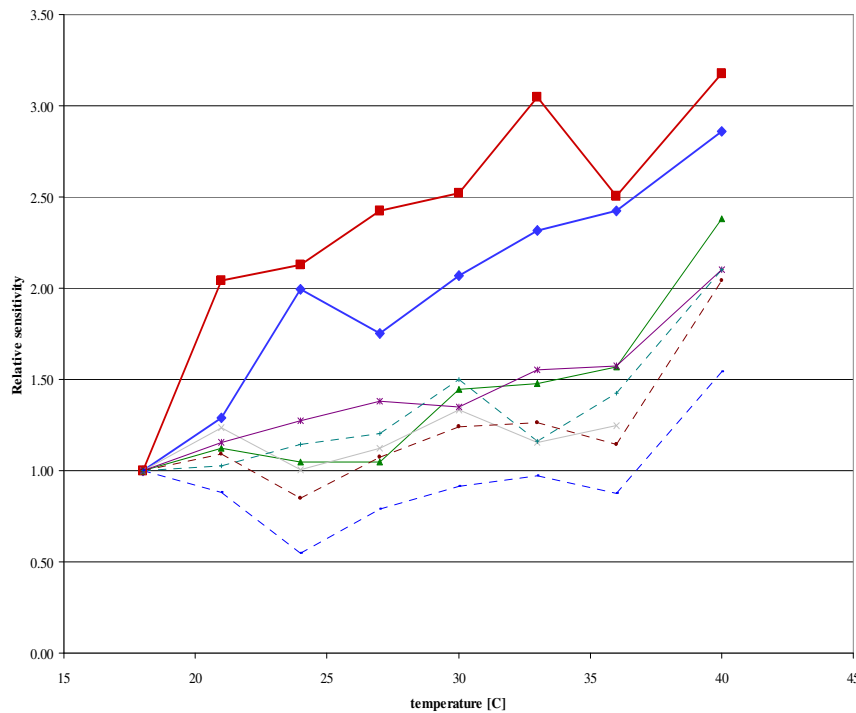
- PhD-work focussed on
 - energy dependence: combination of BD-PND and BDT
 - angular dependence
 - temperature dependence
- Application in
 - MOX-producing plant
 - nuclear power plant
 - medical field

Some results



Present research: temperature dependence of BDT detector

Pilot test of new type of temperature compensation: *preliminary results*



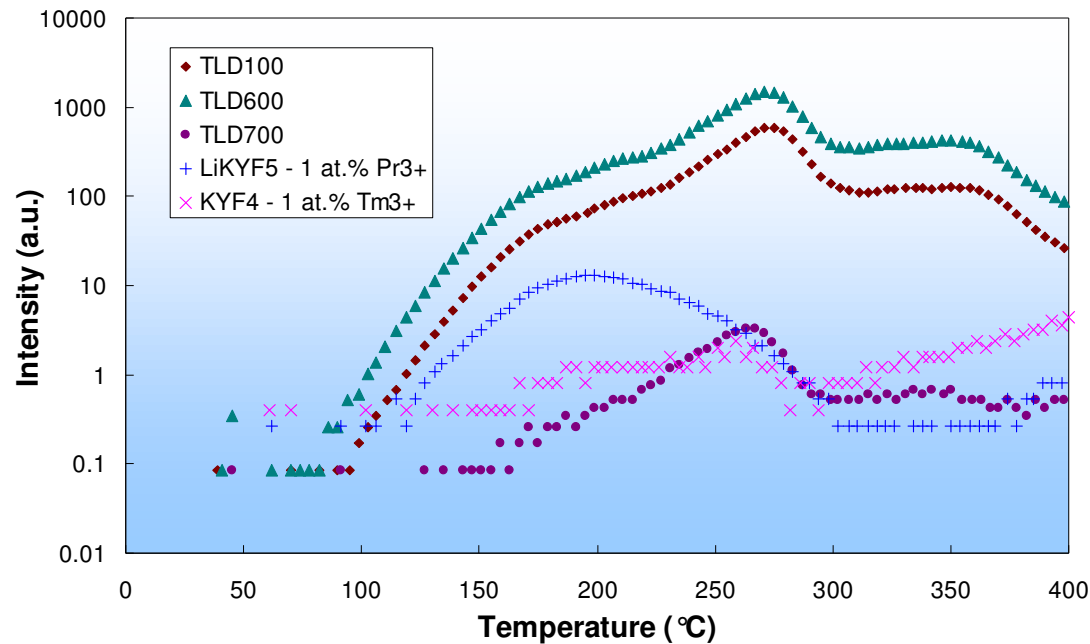
- Medical application:
 - neutron contamination at radiation therapy LINAC's
 - influence of IMRT
- High energy response of BTI detectors
- New type of BDT

Neutron sensitivity of new TL-materials

- Present personal dosimetry systems use LiF-based materials
- Other materials (new alkali fluoride compounds)?
 - **LiKYF₅:Pr³⁺**
 - ◆ % at. doping concentration 0, 0.1, 1, 3, 5, 10
 - **KYF₄:Tm³⁺**
 - ◆ % at. doping concentration 0.1, 1

**The main objective was to see if these materials are suitable for
gamma and/or neutron dosimetry**

Sensitivity to thermal neutrons vs. gamma's Comparison to TLD material

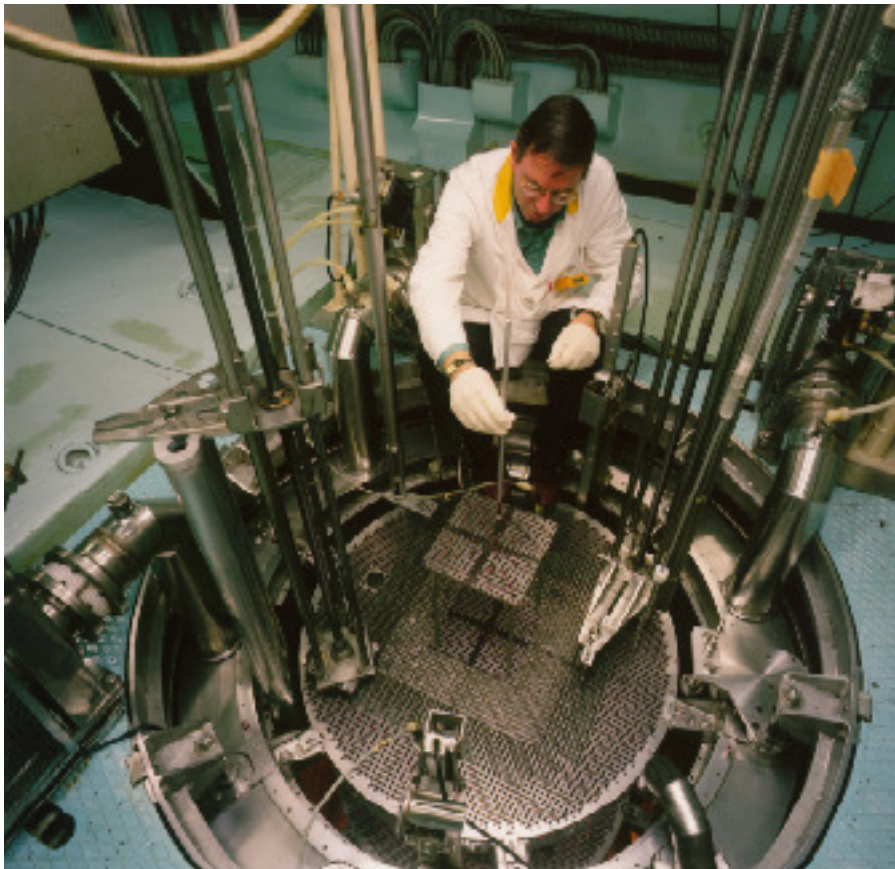


	n (+gamma)	1 mSv gamma	n/gamma
TLD100	581	2.8	208
TLD600	1490	2.8	532
TLD700	3.3	2.8	1
LiKYF5-1%	13	0.26	50
KYF4-1%	1.6	0.38	4

EValuation of Individual DOSimetry in mixed neutron and photon radiation fields: EVIDOS (FP5)

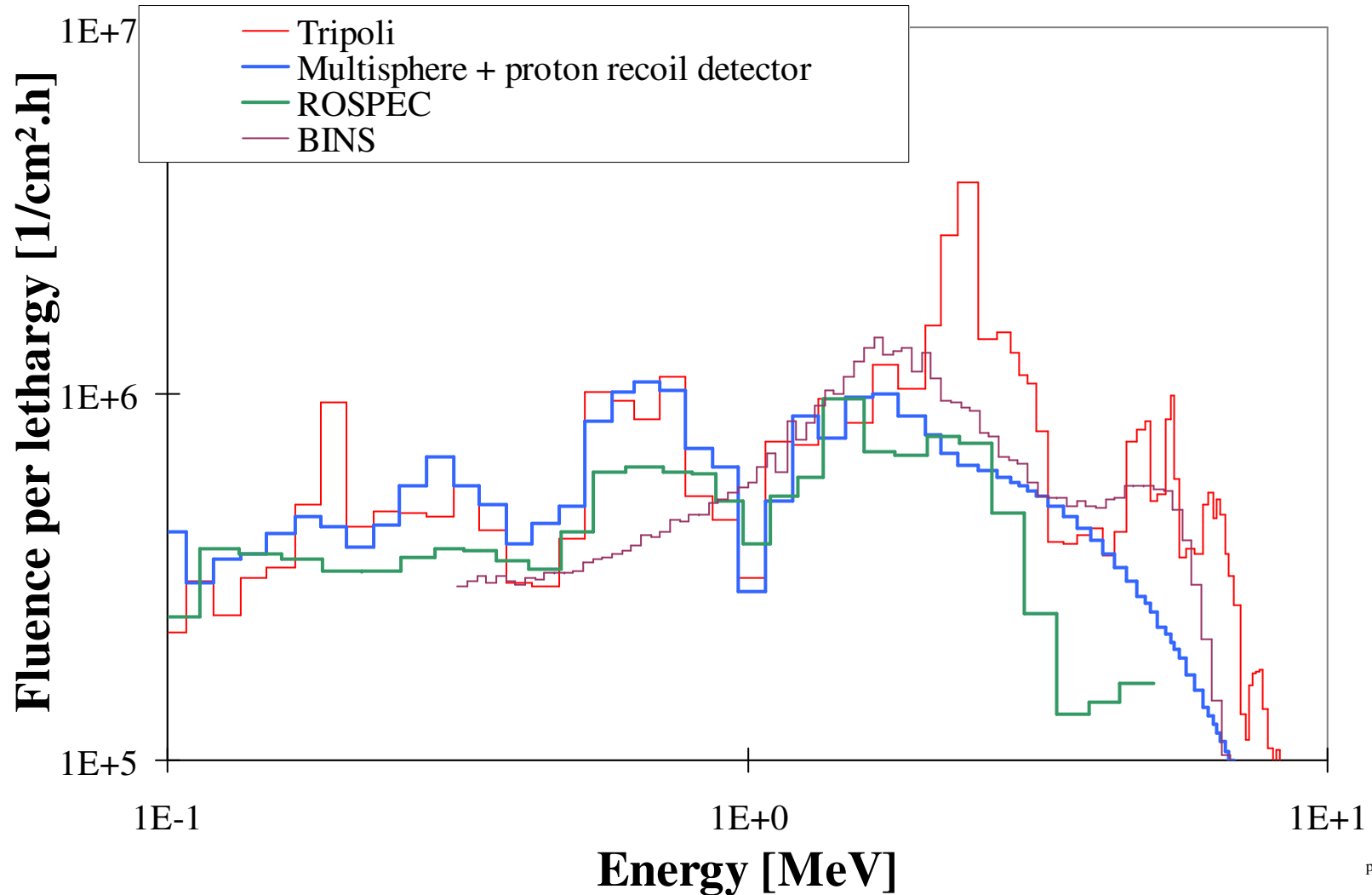
- PTB, IPSN, DIMNP, NRPB, SCK-CEN, SSI, PSI
- Characterisation of workplace fields + measurements with different detectors
- SCK-CEN:
 - bubble detector measurements
 - workplaces: Venus reactor and BN

The VENUS reactor facility



- Zero-power research reactor at the Belgian Nuclear Research Centre
- Studies on light water reactor fuels

Comparison of different neutron spectrometric methods



Tissue Equivalent Proportional Counter

- SW5 proportional counter (Far West Technologies): recent purchase
- Filled with propane-based tissue equivalent gas
- First test starting
- Measurements in neutron, gamma and mixed fields

Summary

- Neutron dosimetry: limited manpower, some interesting tools
- Goals:
 - to be experts in Belgium
 - to maintain expertise
 - to do usefull applied research
 - to collaborate with international groups