IAEA
International Atomic Energy Agency

Institute of Nuclear Chemistry and Technology

IAEA Collaborating Center for Radiation Processing and Industrial Dosimetry

Andrzej Chmielewski, INCT
Zbigniew Zimek, INCT
Iwona Kaluska, INCT
Anthony Berejka, Ionicorp+

Council on Ionizing Radiation Measurements and Standards
Meeting – 19 October 2010

International Atomic Energy Agency

The IAEA is an independent organization established in 1957 related to the United Nations (UN) by special agreement to promote the safe, secure and peaceful use of nuclear technologies and is the world's center of cooperation in the radiation area.

International Atomic Energy Agency

The IAEA Secretariat, headquartered at the Vienna International Centre in Vienna, Austria, has a team of 2,200 multi-disciplinary professional and support staff from more than 90 countries.

International Atomic Energy Agency

The IAEA's mission is guided by the interests and needs of member states and by the vision embodied in the IAEA Statute based on three main areas of endeavor: Safety and Security; Science and Technology; and Safeguards and Verification.

Institute of Nuclear Chemistry and Technology

The Institute of Nuclear Chemistry and Technology (INCT) was established in Warsaw in 1983 and was formerly operating since 1955 as the Chemistry Division of the Institute of Nuclear Research.

Institute of Nuclear Chemistry and Technology

The INCT is multi-disciplinary and is composed of three centers: Centre of Radiation Research and Technology, Centre of Radiochemistry and Nuclear Chemistry, Centre of Radiobiology and Biological Dosimetry and has a staff of 236 professionals and support personnel and is governed by a Science Council.

Institute of Nuclear Chemistry and Technology

The Institute has four pilot plants equipped in six electron accelerators: for radiation sterilization of medical devices and tissue graft, for radiation modification of polymers, for removal of SO_2 and NO_x from flue gases and for food hygenization.

In May 2010, the IAEA Division of Physical and Chemical Sciences announced the formation of a Collaborating Center for Radiation Processing and Industrial Dosimetry at INCT in Poland.

The IAEA has 18 such collaborating centers with member states in various disciplines throughout the world.

IAEA
International Atomic Energy Agency

Institute of Nuclear Chemistry and Technology

Andrzej Chmielewski,
Director General, INCT

N. Ramamoorthy, Director IAEA
Division of Physical and
Chemical Sciences

"The new Collaborating Centre 'RAPID' (from Radiation Processing and Industrial Dosimetry) is an important addition to the IAEA's resources in further serving Member States in feasibility assessment of emerging applications of radiation processing to facilitate adoption and industrial dosimetry intercomparison exercise, vital for effective and efficient application of the technology."

IAEA
International Atomic Energy Agency

Institute of Nuclear Chemistry and Technology

IAEA Technical Cooperation Project RER/8/010: 2005-2009

Quality Control Methods and Procedures for Radiation Technology

Middle European Dosimetry Inter-comparison Studies

Within the IAEA Technical Cooperation Project RER/8/010, *Quality Control Methods and Procedures for Radiation Technology,* two dosimetry inter-comparison studies were conducted: one in 2005-2006, the other in 2007-2008.

Both studies were organized according to the same protocol: the participating laboratories sent their own dosimeters for irradiation at the INCT reference laboratory and then read their dosimeters when returned to them.

The accredited Laboratory for Measurements of Technological Doses (LMTD) of the Institute of Nuclear Chemistry and Technology (INCT) in Warsaw, Poland was the reference laboratory.

Middle European Dosimetry Inter-comparison Studies

2005-2006 and 2007-2008 studies:

To check the ability of laboratories to make measurements using different dosimeters.

All irradiations were done at INCT to specified doses.

The laboratories reported back their readings on different dosimeters.

Calibration of dosimeters:

Absorbed dose-to-water and dosimeter response calibrated with gamma emitting cobalt-60 source.

Dosimeters: Alanine pellets, ECB, PMMA, dosimeter films, etc.

2010 gamma cell from India cobalt-60 supplied by BARC

Middle European Dosimetry Inter-comparison Studies

Study	Laboratories Participating	Dosimeters Evaluated
2005-2006	7	Alanine pellets ECB PMMA Dosimetric films (Sunna, FWT 600)
2007-2008	9 (4 taking part in both studies)	Alanine pellets ECB Sugar-UV Bipolar transistors

Middle European Dosimetry Inter-comparisons - 1

Dosimeters used in the first inter-comparison study Warsaw, 2006

3 laboratories used EPR to read alanine pellet response

3 laboratories read the optical density of dosimeter films

1 laboratory used a PMMA plate

1 laboratory used ethanol-chlorobenzene ampules (ECB)

(two sets of dosimeters were irradiated at different dose levels and used with each laboratory)

Middle European Dosimetry Inter-comparisons - 1

Results of the 2006 inter-comparison study

Per cent difference between readings at the reference laboratory (INCT) and at the participants' laboratories (%) at two different dose levels:

Alanine pellets:	+1.0;	+0.5;	-2.6;	-1.5;	+1.5;	+0.7
Dosimeter films:	-5.3;	+2.0;	+40.8;	+12.9;	+0.3;	-11.0
PMMA plate:	+16.8;	+17.9				
ECB ampules:	-1.0;	-0.8				

Green = accredited laboratory

Yellow =lack of traceability

Middle European Dosimetry Inter-comparisons -1

Factors having a negative influence on the inference of dose in the 2006 inter-comparison study:

1. Lack of traceability
2. Use of film and/or plate dosimeters

Factors having a positive influence on the inference of dose in the 2006 inter-comparison study:

1. Accreditation of the dosimetry laboratory ($\Delta \leq 1\%$)
2. Traceability (Δ from +2.0 % to -11%)
3. Use of standard dosimetry systems: EPR/alanine dosimetry (Δ from +1.5% to -2.6%) and ECB liquid dosimeters ($\Delta \leq 1\%$)

Middle European Dosimetry Inter-comparisons - 2

Conducted in 2008

1. 9 participants delivered 11 packets (9-12 dosimeters each) for irradiation with a reference dose at INCT.
2. There were 5 packets with alanine pellets and 4 with ECB ampules (both standard systems) and additionally 2 with the other dosimetry systems in this study (PMMA and films).
3. EPR-alanine system gave very good results for both a low (0.7 to 7 kGy) and a high dose range (17 to 45 kGy).
4. ECB gave slightly poorer, but still good results for the low dose range and was still acceptable for the high dose range.

Middle European Dosimetry Inter-comparisons - 2

Conducted in 2008

5. Technical parameters of both alanine and ECB dosimeters allow them to be used as the transfer dosimeters. IATA restrictions practically exclude ECB ampules as transfer dosimeters because they cannot be shipped by air.

6. The highest deviation between a participant's and the reference laboratory (11%) was observed for one packet from a laboratory that did not check the traceability of the dosimetry system. Nevertheless, even in this case, the result was inside the established uncertainty range.

7. Taking into account the mean values of all results, 72% of the results differed from the reference values by less than 2%

IAEA
International Atomic Energy Agency

Institute of Nuclear Chemistry and Technology

IAEA Technical Cooperation Regional Project RER/8/017: 2009-2011

Enhancing Quality Control Methods and Procedures for Radiation Technology

IAEA contact: Maria Helena Sampa, Technical Officer
Industrial Applications & Chemistry Section

Middle European Dosimetry Inter-comparisons

Within the IAEA Technical Cooperation Project RER/8/017, *Enhancing Quality Control Methods and Procedures for Radiation Technology, a* dosimetry inter-comparison study is being conducted in 2009-2010.

The study was organized according to the following protocol: the reference laboratory (INCT) sent standard transfer dosimeters (alanine pellets) for irradiation at 11 participating laboratories which were then read when the dosimeters were returned to the reference laboratory. 9 facilities irradiated the alanine pellets in Co-60 gamma sources, 2 facilities irradiated dosimeters with an electron beam.

Middle European Dosimetry Inter-comparison Studies

2009-2010 studies:

To check the ability of laboratories to irradiate alanine pellets to specified doses, 10 kGy and 25 kGy.

All irradiations were done at the participating laboratories.

All alanine readings were done at INCT.

Middle European Dosimetry Inter-comparisons

Conducted in 2009-2010

Because of delays due to the slowness in participants returning dosimeters to the reference laboratory (INCT), the results are still being compiled.

However, the first estimations show that results may be very similar to those obtained in the 2008 study.

Meetings held in Poland

Topic	Dates	Participants	
Quality Control Methods and Procedures for Radiation Technology	21-25 Feb. 2005	19	2 IAEA 4 experts 3 observers
Application of Monte Carlo Modeling Methods for Dosimetry Calculation in Radiation Processing	3-7 April 2006	17	2 IAEA 4 experts
Validation and Process Control for Electron Beam Radiation Processing	3-7 Dec. 2007	13	2 experts

Meetings held in other countries

1. Regional Training Course on Economical and Social Benefit of Radiation Processing; Standardization and Legislation Issues Regarding Radiation Processing Implementation in Europe at Eger, Hungary

2. Regional Workshop on Harmonization, Implementation and Use of Quality Assurance & Control Methods at Bran, Romania

3. Regional Training Course on the Use of Simulation methods for Quality Control of Gamma and X-Ray Processing at Kharkov, Ukraine

4. Regional Training Course on IAEA Validation and Process Control for Gamma Radiation Processing at Budapest, Hungary

INCT Radiation Capabilities

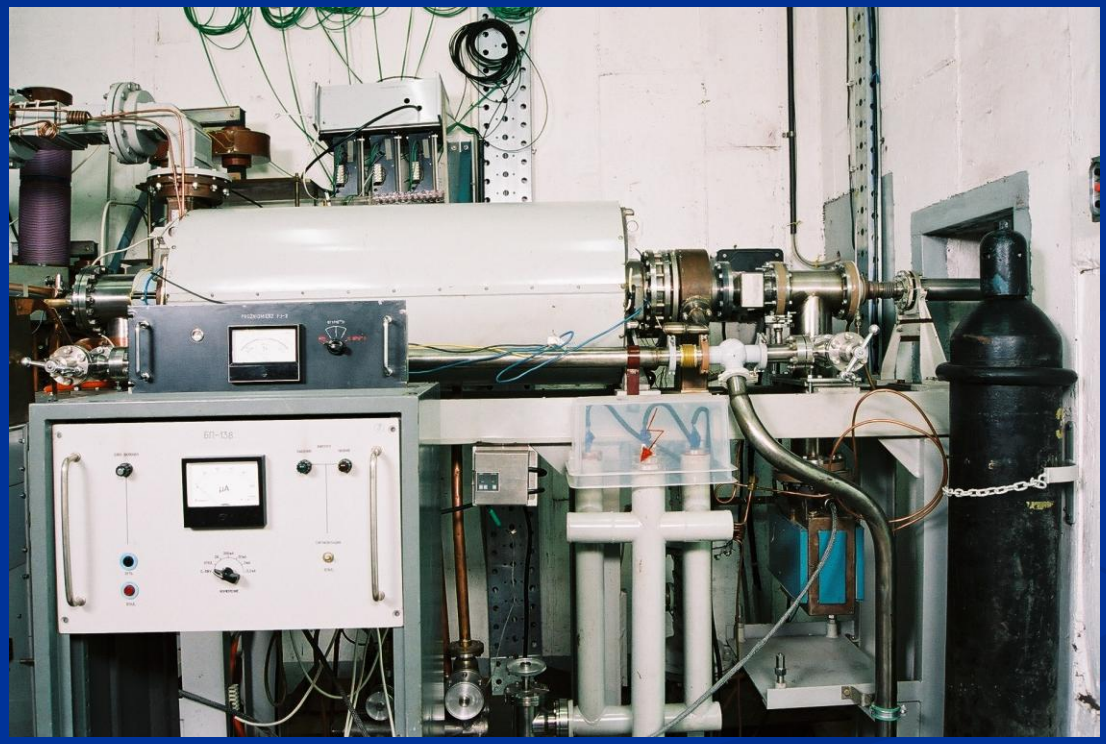
Basic research

- Pulsed radiolysis
- Code validation

Technology transfer

- Pilot plant studies
- Wire and cable irradiation
- Medical device sterilization
- Food hygenization
- Stack gas irradiation

Centre of Radiation Research and Technology
Pulse Radiolysis Laboratory (PulsLab)



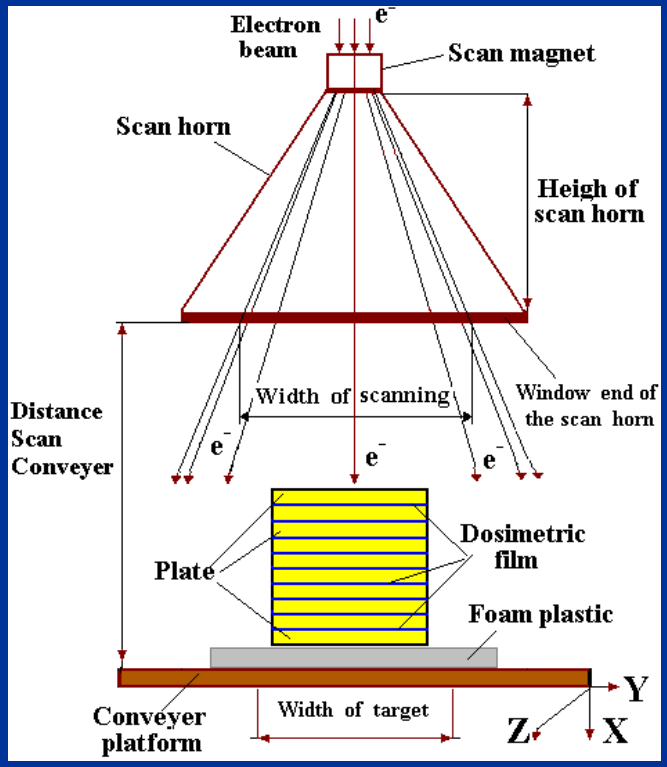
LAE 10 = 10 MeV linac, pulse duration 10 to 100 ns

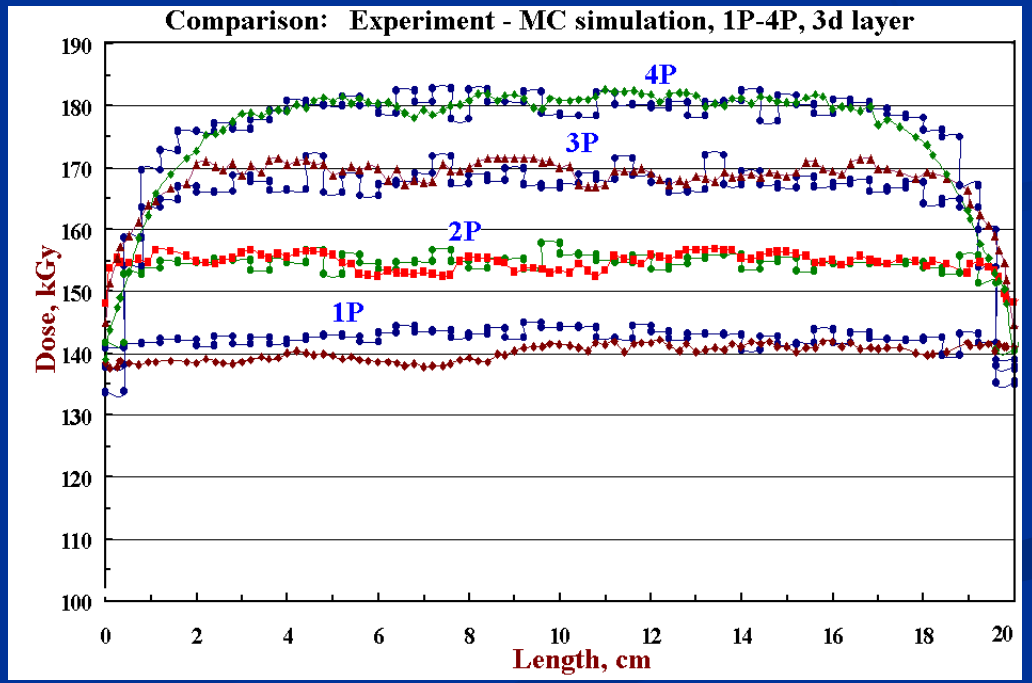
IAEA
International Atomic Energy Agency

Institute of Nuclear Chemistry and Technology

Code Validation

Benchmarking of Software ModeStEB for Simulation of EB Processing



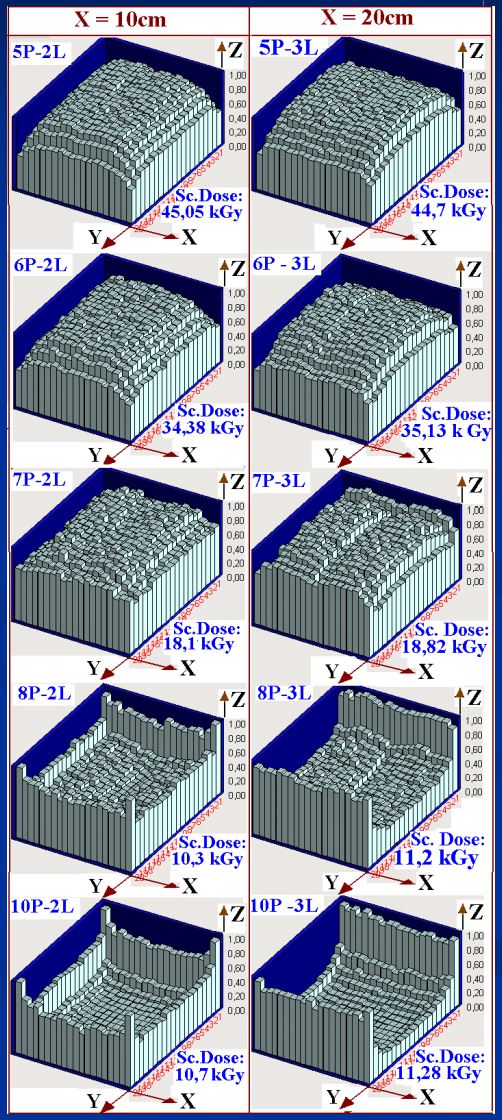


IAEA
International Atomic Energy Agency

Institute of Nuclear Chemistry and Technology

Code Validation

Benchmarking of Windows Compatible Software RT Office Code for Simulation of EB Processing

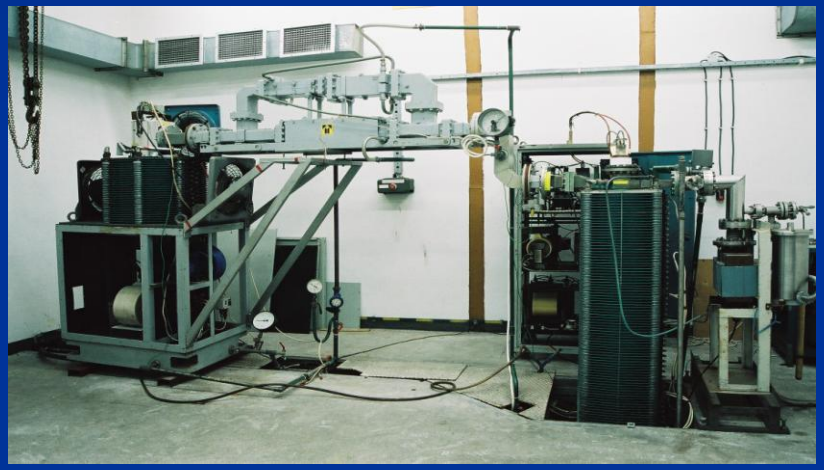


Pilot Plant Facility

ILU 6
electron accelerator
provided by IAEA
for pilot plant facility

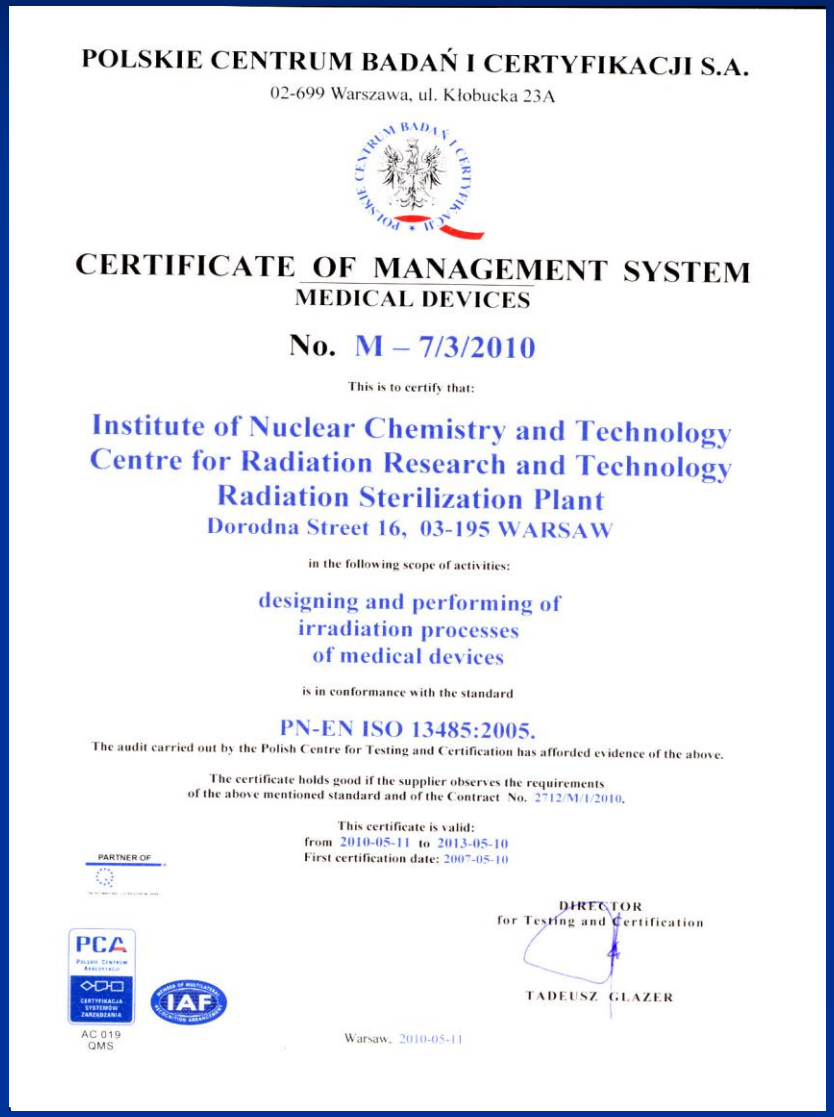
1.2 to 2.5 MeV
20 kW linac

Medical Device Sterilization



Elektronika 10/10
10 MeV, 15 kW
65 cm scan, 120 kVA
conveyor 0.3 to 7 m/minute

Building 1814 m^2 surface
Building 9230 m^3 capacity
Productivity 10,000 kg kGy/h



POLSKIE CENTRUM BADAŃ I CERTYFIKACJI S.A.
02-699 Warszawa, ul. Kłobucka 23A

CERTIFICATE OF MANAGEMENT SYSTEM
MEDICAL DEVICES

No. M – 7/3/2010

This is to certify that:

Institute of Nuclear Chemistry and Technology
Centre for Radiation Research and Technology
Radiation Sterilization Plant
Dorodna Street 16, 03-195 WARSAW

in the following scope of activities:

designing and performing of
irradiation processes
of medical devices

is in conformance with the standard

PN-EN ISO 13485:2005.

The audit carried out by the Polish Centre for Testing and Certification has afforded evidence of the above.

The certificate holds good if the supplier observes the requirements of the above mentioned standard and of the Contract No. 2712/M/1/2010.

This certificate is valid:
from 2010-05-11 to 2013-05-10
First certification date: 2007-05-10

PARTNER OF

DIRECTOR
for Testing and Certification

TADEUSZ GLAZER

PCA
IAF
AC 019
QMS

Warsaw, 2010-05-11

Date of the first certification:
10 May 2007

The current certification is valid until:
10 May 2013

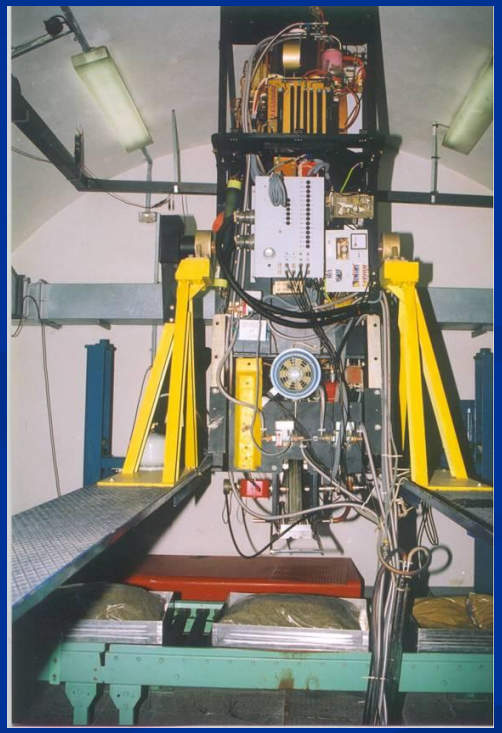
IAEA
International Atomic Energy Agency

Institute of Nuclear Chemistry and Technology

Radiation Hygenization of Foodstuffs

Pilot Plant for EB Irradiation of Food

Conveyor system with prepacked spices in boxes



Elektronika U-003
10 MeV, 10 kW linac

Accreditated Laboratories at the INCT

+ Laboratory for Detection of Irradiated Foods

+ Laboratory for Measurement of Technological Doses (LMTD)

INCT also publishes

http://www.nukleonika.pl/

NUKLEONIKA

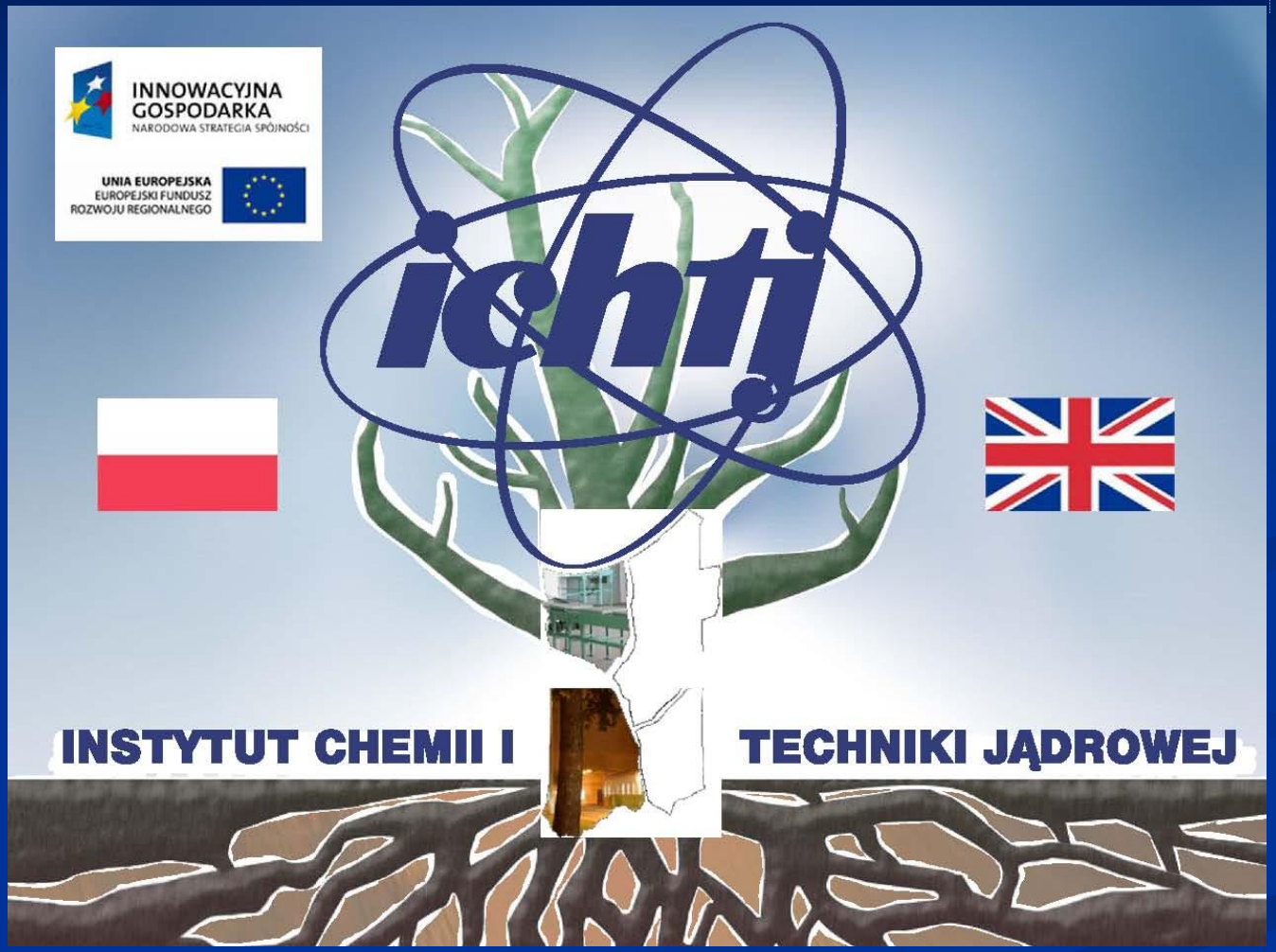
See for example:

Influence of boundary effects on electron beam dose distribution formation in multilayer targets (Kaluska et al. Nukleonika 2010 vol. 55 no. 3)

Radiation curing: coating and composites (Berejka et al. Nukleonika 2010 vol. 55 no. 1)

IAEA
International Atomic Energy Agency

Institute of Nuclear Chemistry and Technology



www.ichtj.waw.pl/drupal_eng/

Dziękuję!

Friends

IAEA Consultants Meeting – Cairo May 15-18, 2005

IAEA Consultants Meeting – Vienna July 21-25, 2008

IAEA Consultants Meeting – Sao Paulo August 8-11, 2005