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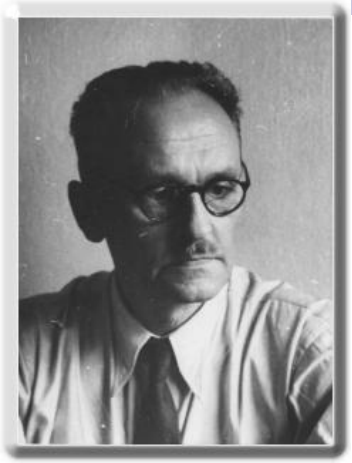
Radiation Science in Poland

- **Maria Curie-Skłodowska (1867-1934)**

Radiation Science in Poland

- **Andrzej Sołtan (1897-1959)**



- **Henryk Niewodniczański (1900-1968)**
- **Marian Mięsowicz (1907-1992)**

Research Institutions - history

- 4 June 1955 – creation of the Institute for Nuclear Research (IBJ)
- 1957 creation of Central Laboratory of Radiological Protection (CLOR)
- 1958 put into operation of EWA research reactor in Świerk and of first cyclotron U-120 in Cracow
- 1958 separation of the Institute of Nuclear Physics in Cracow (IFJ)
- 1971 put into operation of electron accelerator LAE-13-9 in IBJ Żerań
- 1974 put into operation of MARIA research reactor in IBJ Świerk

Research Institution - division

- **Very intensive participation of IBJ researchers in opposition activities under martial law in Poland resulted in the artificial division of IBJ**
- **Six research institutes in Poland:**
  - **Institute of Atomic Energy Polatom (IEA) Świerk**
  - **Andrzej Soltan Institute for Nuclear Studies (IPJ) Świerk**
  - **Institute of Radiation Chemistry and Technology (IChTJ) Warszawa-Żerań**
  - **Central Laboratory for Radiological Protection – Warszawa-Żerań**
  - **Institute of Plasma Physics and Laser Microsynthesis – Warszawa-Bemowo**
  - **Henryk Niewodniczański Institute of Nuclear Physics – Cracow – depending on Polish Academy of Science**

Nuclear Power Plant construction

- The **Żarnowiec Nuclear Power Plant** was supposed to be the first nuclear power plant in Poland. Due to changes in the economical and political situation in Poland after 1989, as well as public protests in the late 1980s and early '90s which escalated in the wake of the Chernobyl disaster, the construction was cancelled.

NPP Żarnowiec now

NPP Żarnowiec now

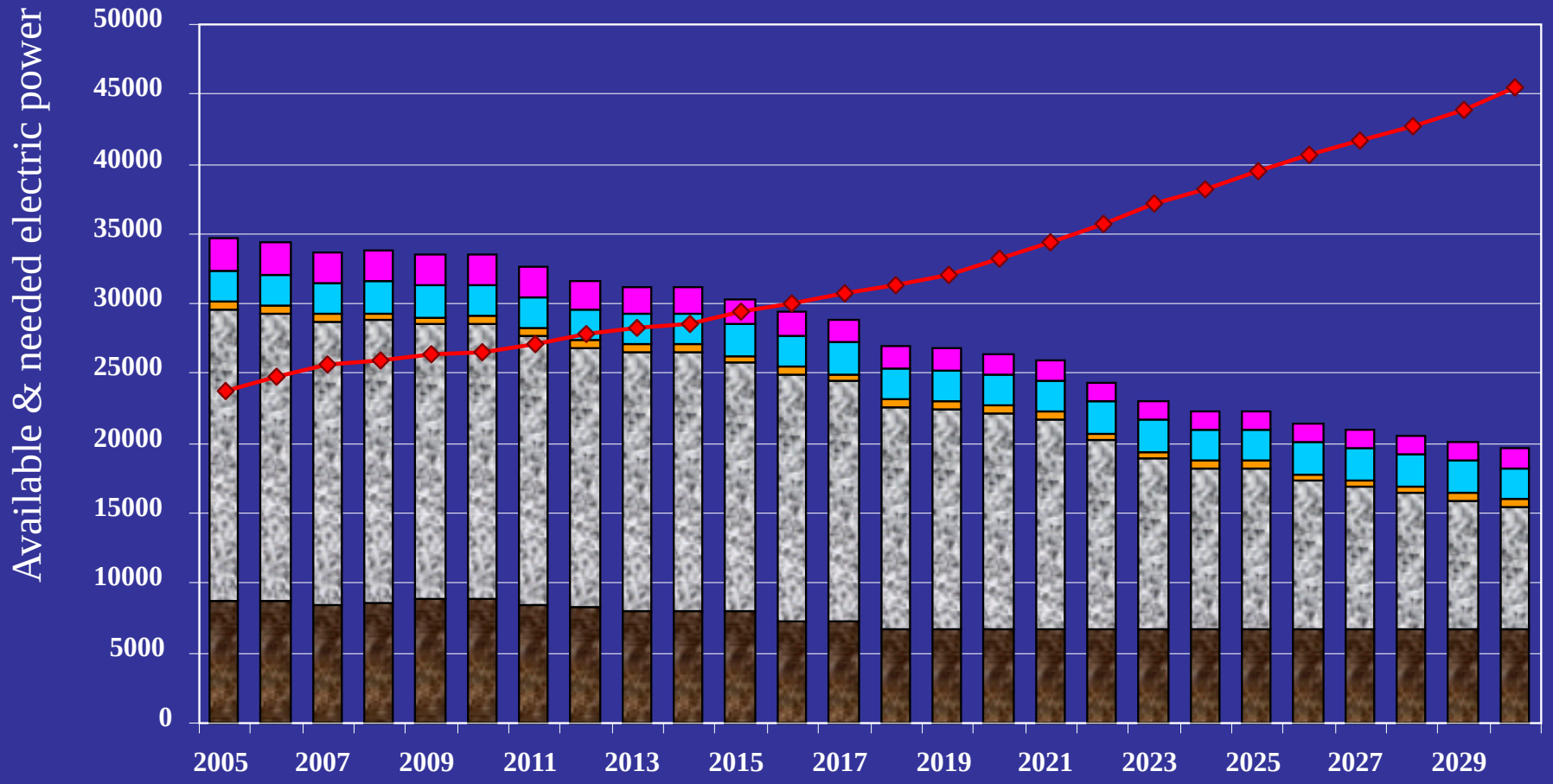
NPP Żarnowiec now

NPP Żarnowiec now

Nuclear Power Stakeholders in Poland

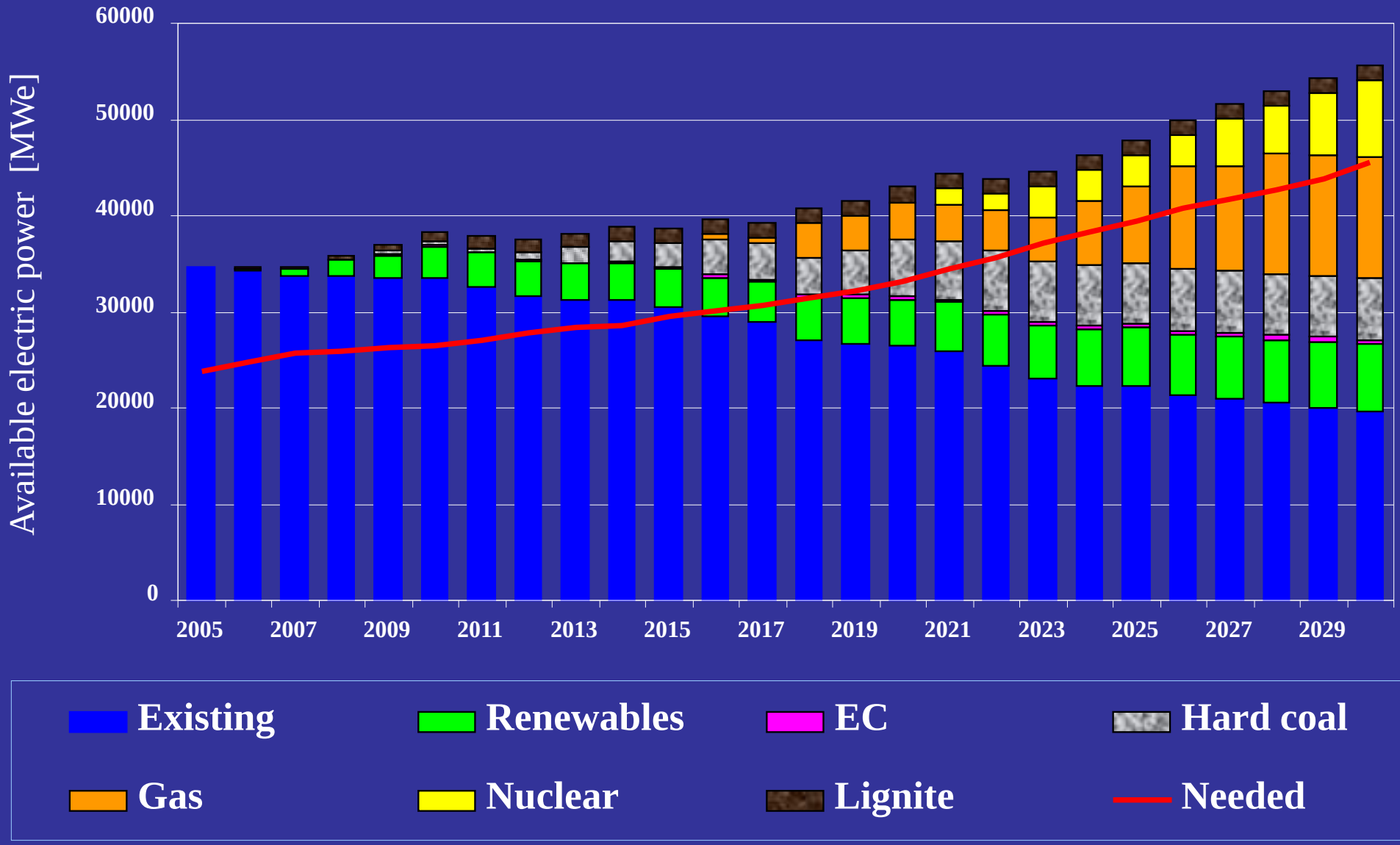
- NEPIO
  - Ministry of Economy, Department of Nuclear Energy
  - ~~Nuclear Power Agency (Agencja Energii Jądrowej)~~
- Investor & Operator: PGE EJ1 + partner
- Vendor: winner of the bid
- Regulatory Body
  - National Atomic Energy Agency (PAA)
  - Commission for Nuclear Safety & Radiological Protection (KBJiOR)
- TSO: NCBJ composed of IPJ + IEA + support organisations
- R&D: nuclear institutes + Technical Universities
- Waste Management: ZUOP

Production of electric power in Poland
with existing power plants



PGE S.A.

Plans to cover electric energy needs in Poland



PGE S.A.

Nuclear power in Poland by 2030

	2006	2030		
		min	mid	max
Final electric energy (all sources) TWh	111	172	197	209
reactors	0	6	8	10
Nuclear power MW(e)	0	4800	9600	12000
Net electric energy (nuclear) TWh	0	16	32	47
Nuclear energy fraction	0%	15%	25%	30%

min – „Polish Energy policy till 2030”
mid – more investors , larger reactors
max – higher demand

Polish Nuclear Power Program

- **13.01.2009 – governmental decision to prepare the nuclear power programme**
  - **Ministry of Economy created Department of Nuclear Energy, Governmental Commissioner appointed**
- **Today:**
  - **Legislations being finalised by parliament**
  - **PGE group opened bids for „owner's engineer" and site licensing**
  - **National Center of Nuclear Research under creation**
- **2020 – first power plant in operation**
  - **second reactor soon after the first one**

Fukushima consequences

- **IAEA International Fact Finding Mission Preliminary Results (some points):**
  - **The tsunami hazard for several sites was underestimated**
  - **Defence in depth, physical separation, diversity and redundancy reqirements should be applied for extreme external events**
  - **Hydrogen risk should be subject to detailed evaluation and necessary mitigation systems provided**

Fukushima consequences

- **German decision on nuclear phase-out**
- **Swiss decision on break of nuclear build programme**
- **Raise of energy prices in Europe**
- **Acceleration of power plant construction in the whole world**
- **Possible acceleration of some nuclear programmes**
- **Reinforced support of industry to new sources of stable and less expensive energy**

Polish R&D for Nuclear Programme

- **Support to the Government in the creation of necessary infrastructrure**
  - **Legal base**
  - **Part of NEPIO responsibilities**
  - **Creation of TSO and support for Safety Authority**
  - **Participation in the HR development**
  - **Public information**
  - **Public education**
  - **Scientific support for waste management**
  - **Collaboration with industry**
  - **Development of new technologies**

Polish nuclear R&D institutes

Institute	site	staff	prof.	phd	papers
Institute of Atomic Energy (IEA) POLATOM	Świerk	458	18	44	130
Institute for Nuclear Studies (IPJ)	Świerk, Warsaw	460	48	52	308
Inst. of Nuclear Chemistry & Technology (IChTJ)	Warsaw	241	24	44	236
Inst. of Plasma Physics & Laser Microsynth. (IFPiLM)	Warsaw	82	9	14	70
Central Lab. for Radiological Protection (CLOR)	Warsaw	52	3	7	
Institute of Nuclear Physics (IFJ) PAS	Cracow	486	71	115	~335
TOTAL		**1779**	**173**	**276**	**1080**

+ several universities & technical universities

National Centre for Nuclear Research

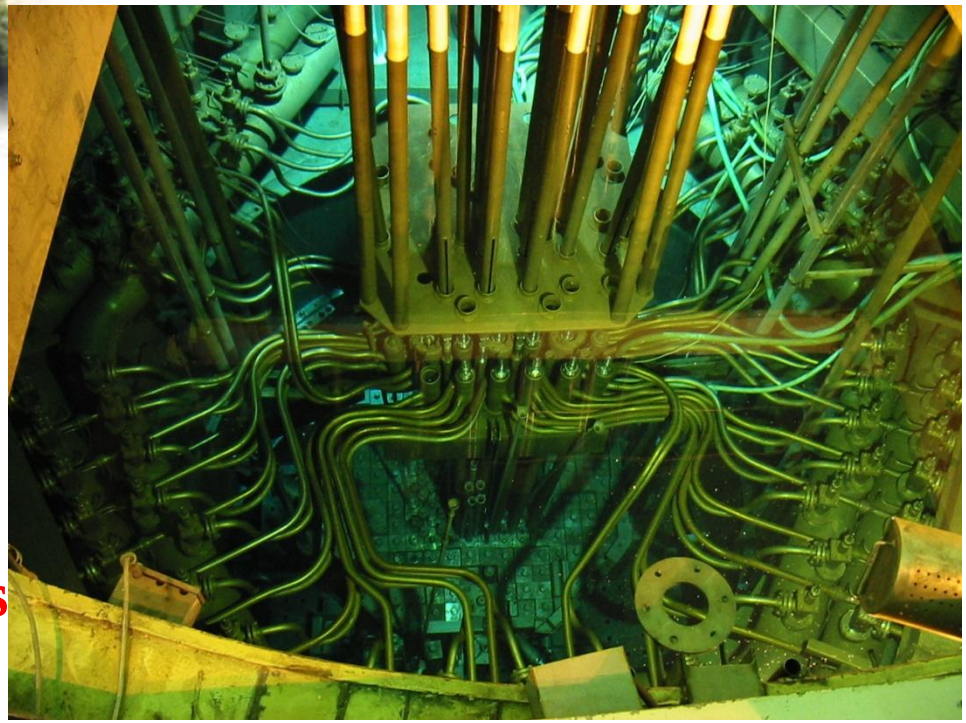
- **The two institutes in Świerk will merge to create the National Centre for Nuclear Research (NCBJ)**
- **Target date: July 1st**
- **Resolution of the Council of Ministers will define its role in the nuclear power programme**
  - **expert support for public administration**
  - **research infrastructure for scientists**
  - **public information centre**
  - **close collaboration with other institutes**
  - **symbiosis with universities**

Universities with nuclear research / education

- AGH Technical University in Cracow
- Jagiellonian University in Cracow
- Częstochowa University of Technology
- Gdańsk University of Technology
- Silesian University of Technology, Gliwice,
- Maria Curie-Skłodowska University in Lublin
- Warsaw University of Technology
- University of Warsaw
  - Heavy Ion Laboratory (cyclotron 200 MeV)
- Wrocław University of Technology
- University of Technology in Łódź
- …

Research reactor MARIA at Swierk

- built 1974, upgrade 1992
- neutron beam research, activation analysis, isotope production: ^{99}Mo for medical use



- pool type
- H_2O, Be moderated
- 30 MW thermal power
  - neutron flux:
    - thermal $4 \cdot 10^{14}$ n/cm^{2}s
    - fast $2 \cdot 10^{14}$ n/cm^{2}s

Research programme

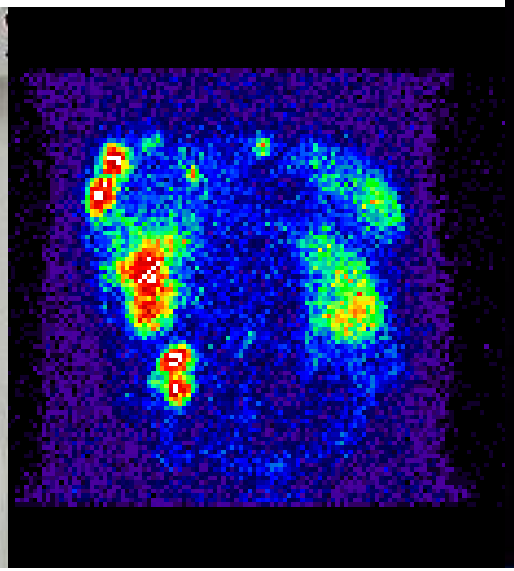
Nuclear power:

- Safety analysis
- Reactor materials
- Nuclear fuel
- Radiological monitoring
- Analysis of nuclear accidents
- Spent fuel
- Radioactive waste

Research and applications:

- Material modification
- Neutron radiography
- Neutron-boron therapy
- Production of isotopes
- Si transmutation for microelectronics

IEA radioisotope centre



Development of new technologies and manufacturing:

- **radioactive isotopes**
- **chemical compounds marked with radioisotopes**
- **isotope radiation sources**

Applications

POLATOM

Soltan Institute for Nuclear Studies

research program

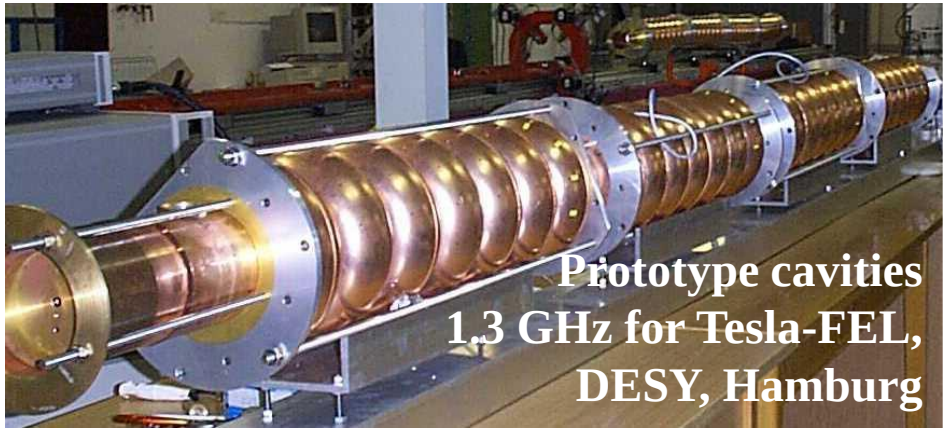
Domains:
- nuclear physics
- particle physics
- neutrino physics
- astroparticle physics
- plasma physics

Projects:
- FAIR
- LHC, ILC
- T2K, LAGUNA
- π of the Sky, POLAR, GRIPS
- ITER, W7-X
- FLASH, XFEL

Technologies:
- nuclear
- accelerator
- detector
- material
- informatics

Applications:
- energy
- industry
- medicine
- environment
- homeland security
- art history

Particle accelerators and detectors



Prototype cavities
1.3 GHz for Tesla-FEL,
DESY, Hamburg

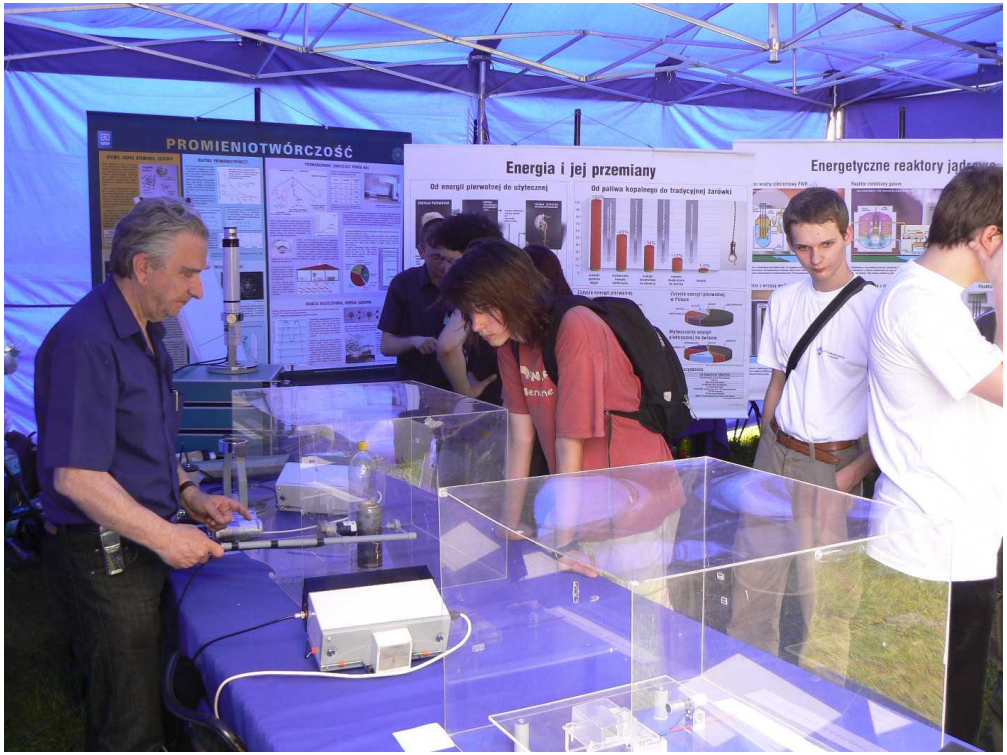
Target for experiment
Isolde, CERN, Genewa

From research instruments to commercial applications

Accelerator „Coline” for radiotherapy

www.HiTecPoland.eu

Training, education, outreach

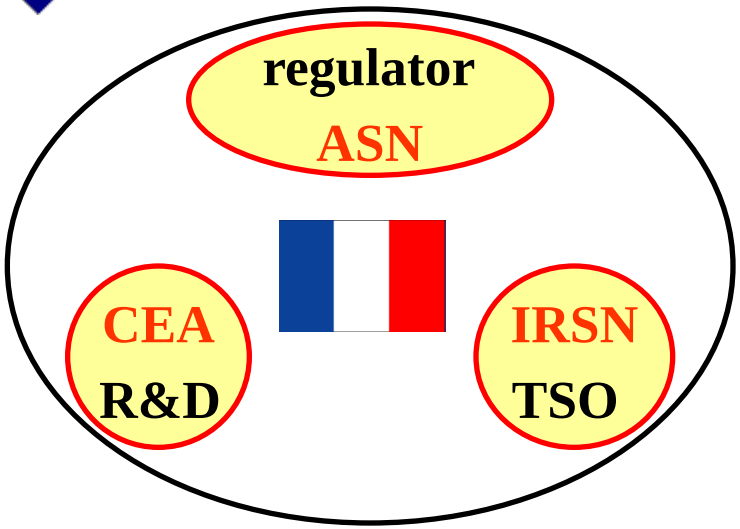


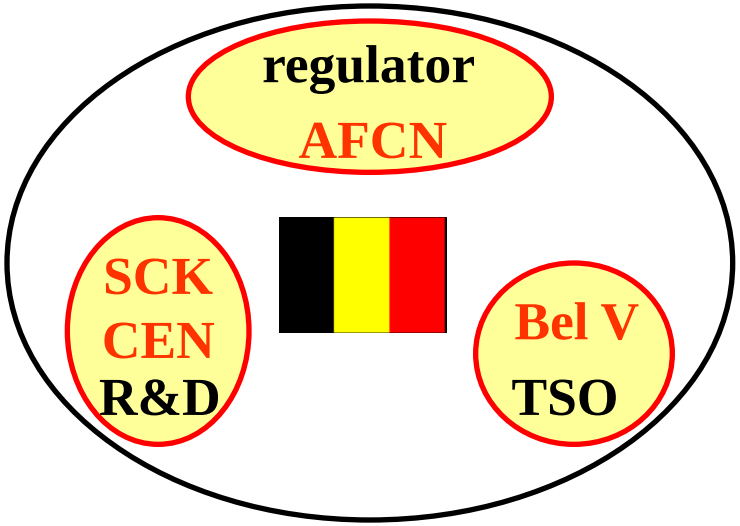
- 7000 visitors / year
  - visit to reactor
  - exibition
  - lectures
- Nuclear lab for students
- Courses for teachers
- Science festivals

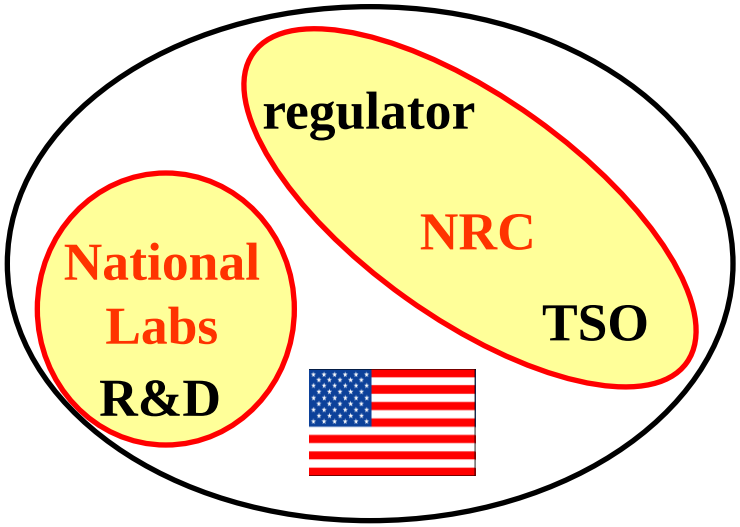
- Participation in NUPEX

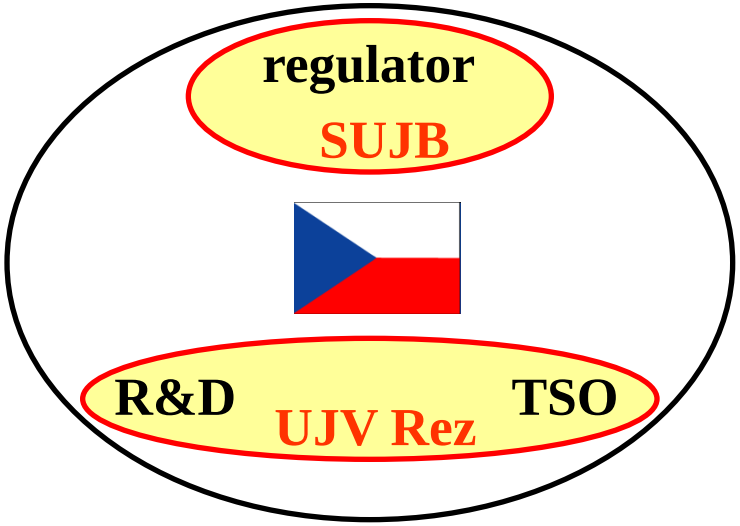
IPJ: „Science populariser 2007”
Aword of Polish Press Agency +
Ministry of Science and Higher Education

different models



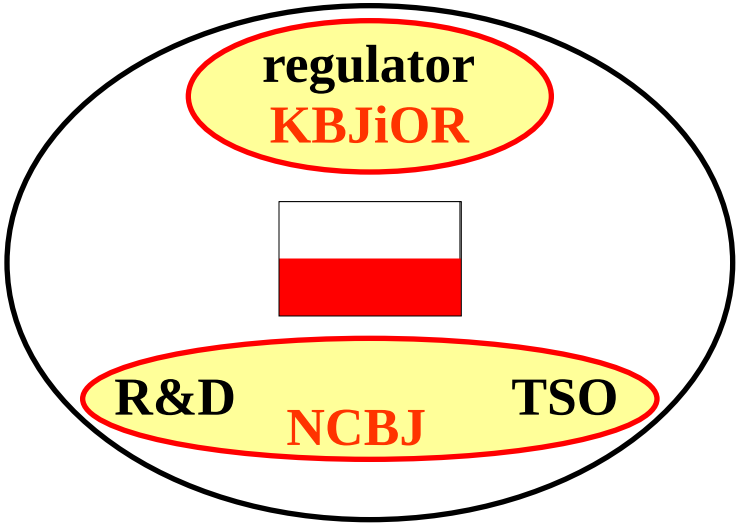






Which model for Poland?

Czech model seems to be the best for newcomers



It may evolve in future towards TSO concentrated on safety only

Designing the Centre:

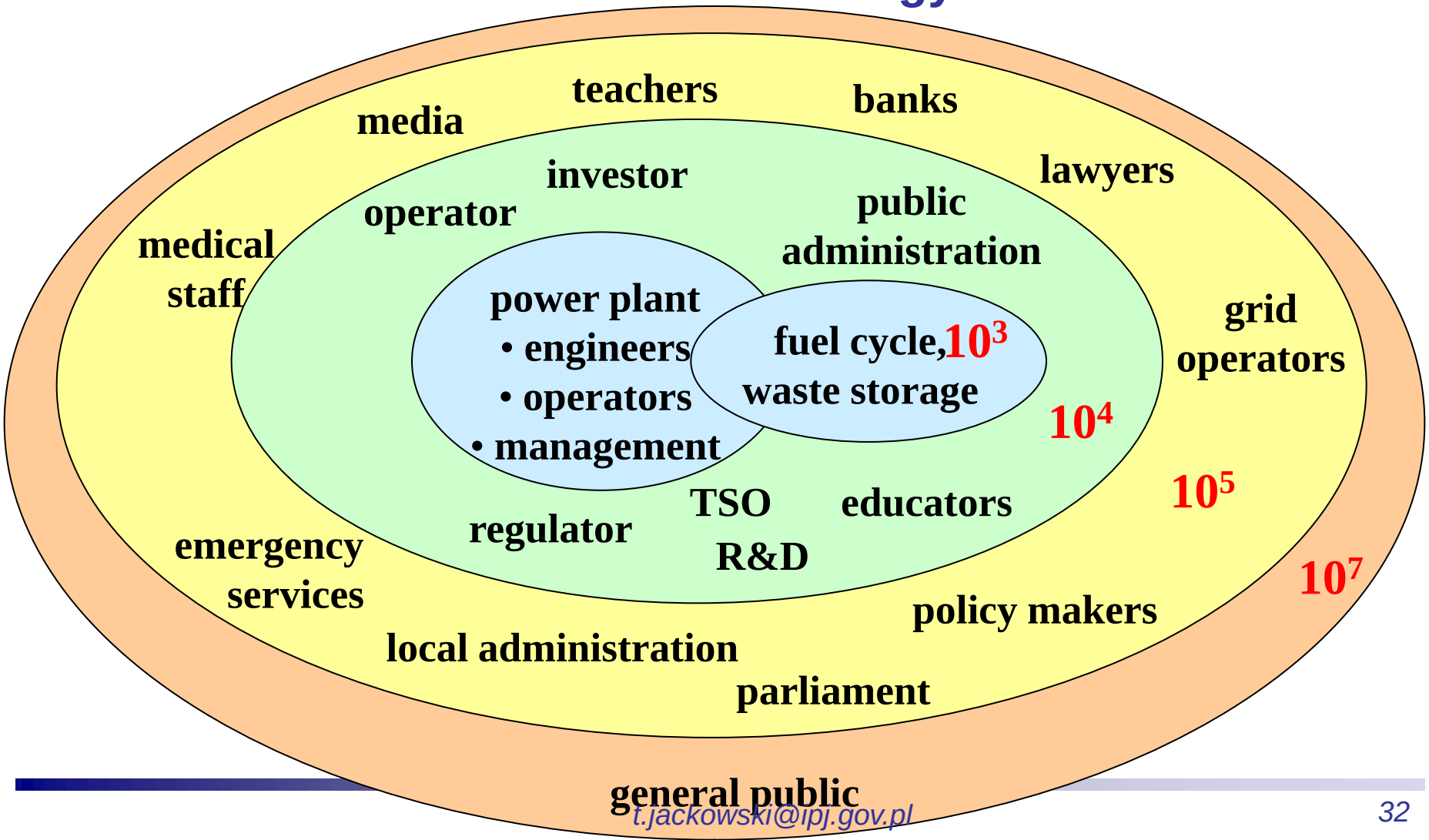
1. **Create list of competences needed to support the national nuclear power program**
   - **start from IAEA Guide**
   - **complete with CEA, UJV Rez, SCK-CEN data**
2. **Design a structure to maintain these competences**
   - **group the competences to form divisions & departments**
   - **take into account existing structure (Świerk, Żerań, …)**
3. **Superimpose projects & services**
   - **mattrix structure**
4. **Propose administrative environment**
   - **law, dependence, funding scheme, management structure**

Computing Centre Swierk (2010-2015)

- **24 M€, dedicated building, 5000 CPU**
- **Computing for research (GRID node)**
- **Support for nuclear power program**
  - ✓ **to perform safety assessment analysis**
  - ✓ **to understand severe accident phenomena**
  - ✓ **to study measures to mitigate the release of activity**
  - ✓ **to develop and assess computer models and codes**

National Centre for Nuclear Research

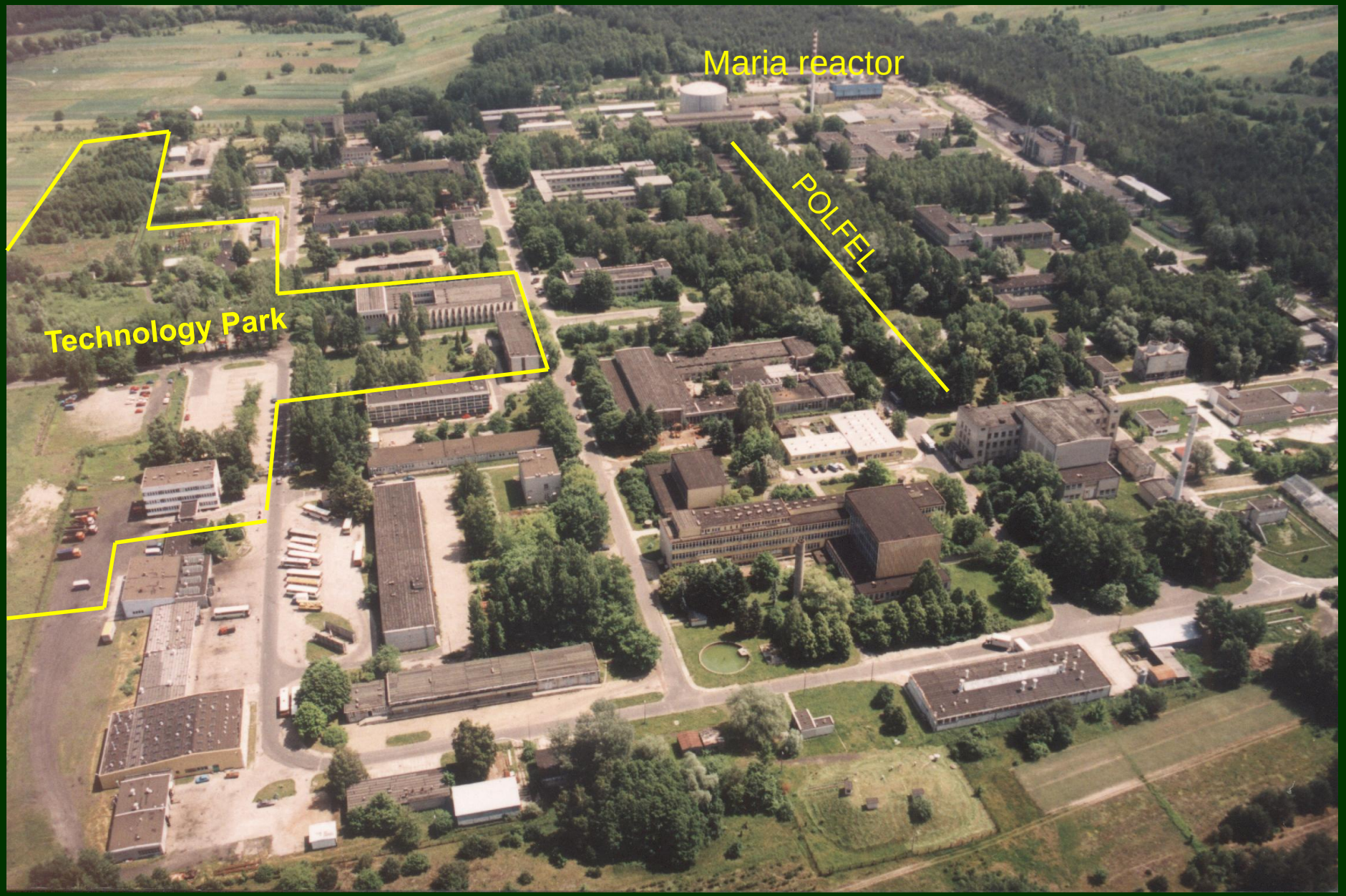
- **Human resources development**
- **Public information on nuclear energy and research**



Technology Park at Swierk (2010-2012)

- **Interface between research and industry**
  - **office & lab space, administrative & social support**
- **Specialised in particle accelerators & detectors**
  - **vacuum, cryogenic & magnet technologies**

Technology Park at Świerk



NCBJ as Technical Safety Organisation

Objectives:

- Support for Regulatory Body and public administration
- Reactor safety analyses and hazard management
- Dosimetry, radiobiology and radiological monitoring
- Improvement of reactor and fuel cycle technologies
- Human resources development
- Public information on nuclear energy and research
- Nuclear technologies for medicine and industry

Principles:

- Transparency (IAEA guidelines)
- Balance between basic and applied research
- Wide international collaboration

NCBJ – cooperation in nuclear safety

Actions:

- Create team of nuclear safety analysts
- Acquire safety assessment tools
- Learn deterministic and probabilistic methods of safety evaluation
- Implement new IAEA nuclear safety guides

Partners:

- IAEA Centre for Advanced Safety Assessment Tools
- CEA – MoU signed 10.2009, IRSN
- US NRC - agreement with Polish National Atomic Energy Agency (PAA) permitting to obtain codes (RELAP, MELCOR, SCDAP, …)
- US nuclear codes users' groups (ISS,…)
- EU nuclear codes users' groups (NURISP, NURENEXT)
- DoE, EPRI – collaboration with US research institutions

Towards National Centre for Nuclear Research

- **1.12.2010 – decision of the Minister of Economy**
  - **Committee appointed: MoE representatives, IEA & IPJ directors, tade unions, scientific councils**
  - **Committee report delivered 17.01.2011**
- **06.2011 – Resolution of the Council of Ministers**
  - **merging IEA i IPJ and giving new name**
  - **nomination for National Research Institute**
- **1.11.2011 – creation of NCBJ**

Collaboration with CEA

- **MoU**
- **SET Plan**
  - **ASTRID – observation - mainly French programme**
  - **MYRRHA, ALFRED – mainly belgian programme**
  - **ALLEGRO – preparation for next steering commitee**

    Hungary, Slovakia, Czech Republic as members, France as obserwator, possible Polish participation
  - **HTR cogeneration for industrial process heat – possible cooperation**

Collaboration with CEA

- **FP7 preparation**
  - **ASGARD reprocessing and transmutation of spent fuel - IChTJ**
  - **FIRST geological storage of irradiated fuel - ITG**
  - **PELGRIMM comparison of fuel transmutation pellets/spherpac IEA+ IChTJ**
  - **SUFI sustainable fuel cycle implementation IEA + IChTJ**
  - **Operation Support to New Member States IEA + IChTJ + IPJ**
  - **ARCHER**

Collaboration with CEA

- **Year of Maria Skłodowska - Curie**
  - **5 and 6 Apil at Montpellier - Seminar on Nuclear Chemistry,**
  - **6 April at Marcoule MoU with Visiatome concerning Public Information**
- **Cooperation RJH-MARIA**
  - **14-15 April meeting in Cadarache**
- **Code transfer and training**
  - **NURISP and NURENEXT**
    - CATHARE
  - **CEA – meeting 31 May**
    - CATHARE, URANIE, TRIPOLI, TRIO-U, FLICA, NEPTUNE, EUROPLEXUS, APOLLO

Collaboration with CEA

- **High Level Computing**
  - **Eurotalent Candidates**
  - **European Projects**
    - PRACE
    - EXASCALE
- **Robotics – meeting 7 March, 20, 21 June**
- **Offset – letter under preparation**
- **Interest for fundamental codes at little scale**