SAFIR2010 overview

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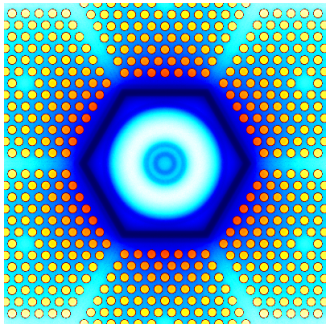
Background – Reactor Safety

- In Finland public nuclear safety research was organised into research programmes with 3-4 year duration at the end of 1980's
- SAFIR2010-programme (2007-2010) is a part of this continuum
- SAFIR2010 is based on Finnish Nuclear Energy act
- Programme has annual calls for proposals, evaluation and funding decisions
- Main funding sources VYR-fund (=funding collected annually according to the Nuclear Energy Act from Finnish utilities Fortum and TVO) and VTT, other funders include also foreign sources

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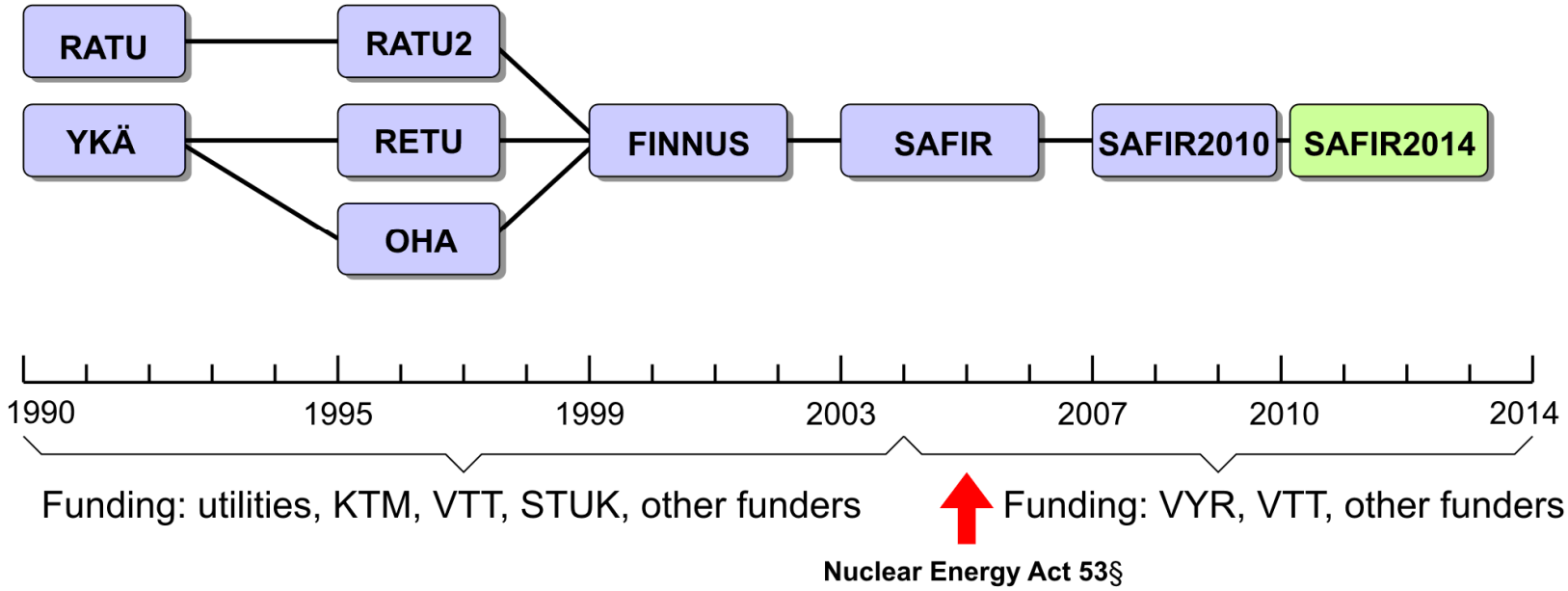
The research is a continuum

Publicly funded NPP safety research programmes 1990 - 2014



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Background – Other Research Areas

- In Waste Management area a similar programme, KYT2010, is going on (1-1,5 M€ annually)
- In GenIV area a relatively small NETNUC program funded by the Finnish Academy of Sciences started in 2008
- In Fusion Finland is actively participating in the EU/ITER research

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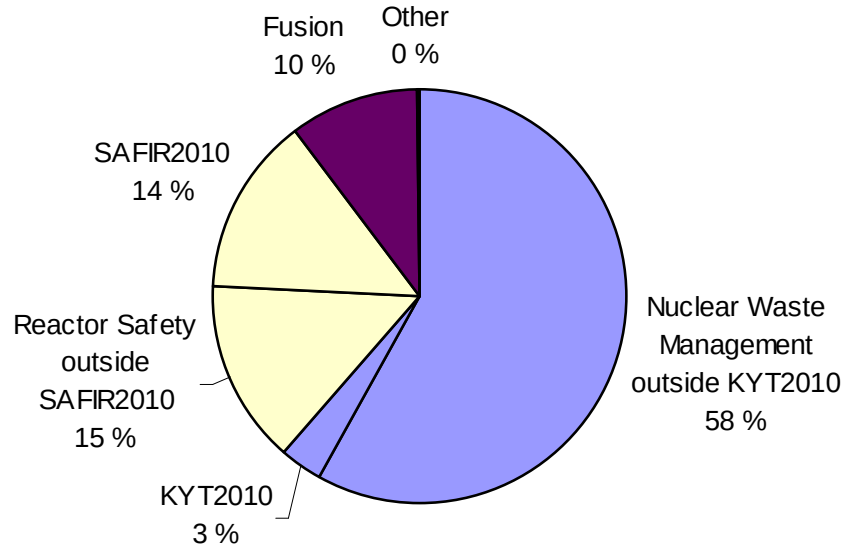
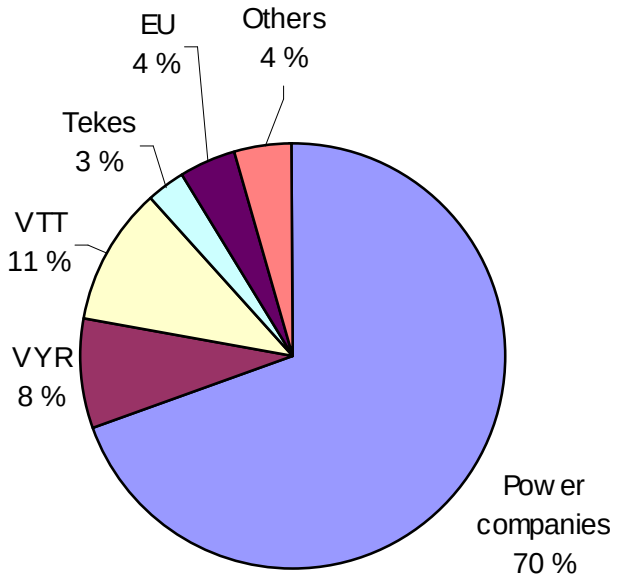
Nuclear Energy Research in Finland in 2007 and share of SAFIR2010 in Reactor Safety Research

Research Areas in 2007, Total 47,2 M€



Funding sources in 2007, Total 47,2 M€



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Basis and objectives of SAFIR2010

- SAFIR2010 research programme is strongly based on the chapter 7a, “Ensuring expertise”, of the Finnish Nuclear Energy Act. The objective is “to ensure that, should such new factors concerning safe operation of nuclear facilities emerge that could not be foreseen, the authorities have such sufficient and comprehensive nuclear engineering expertise and other facilities at their disposal that can be used, when necessary, to analyse without delay the significance of such factors.”

- The objective of SAFIR2010 is realised in the research work carried out and in the training of experts in these research projects. NB. In Nuclear Energy quartile is 25 years!

- SAFIR2010 is also an important network in Finland both in domestic and in international matters

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SAFIR2010 networking

- 16 members in Steering Group
- 80 members in Reference Groups
- 40-50 members in Ad Hoc groups
- 150-180 persons working annually in the research project (typically 1-6 months per person)

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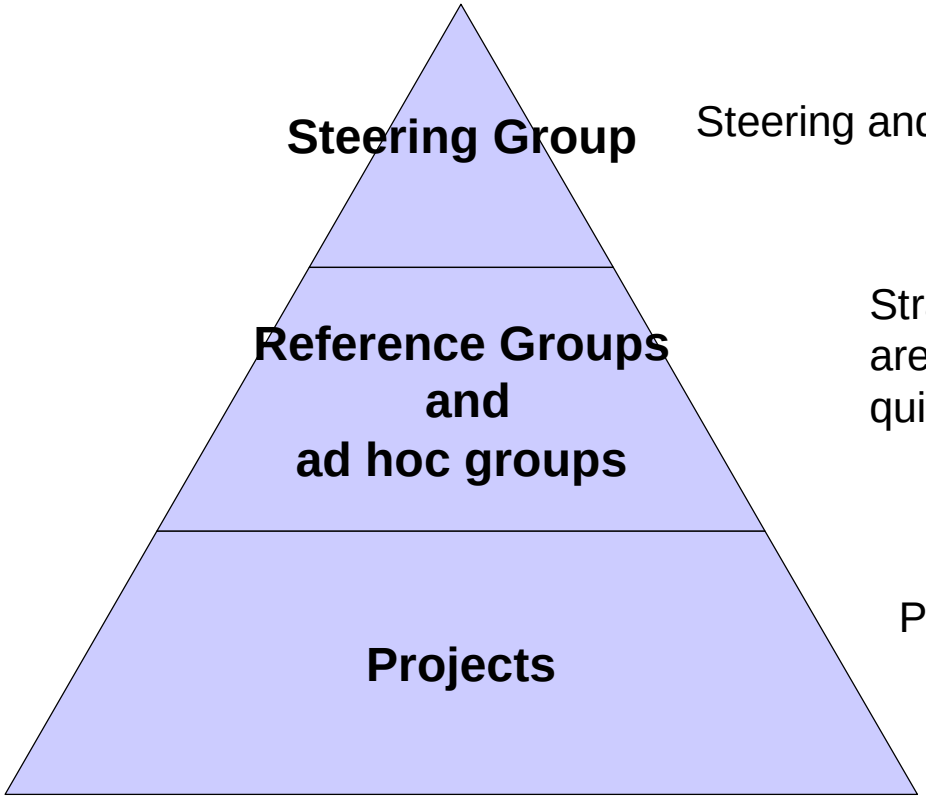
Organisation and quality management of SAFIR2010



Steering and strategic planning

Strategic planning in the area and scientific quidance

SAFIR2010 management handbook

Project realisation

According to Management system of research organisation

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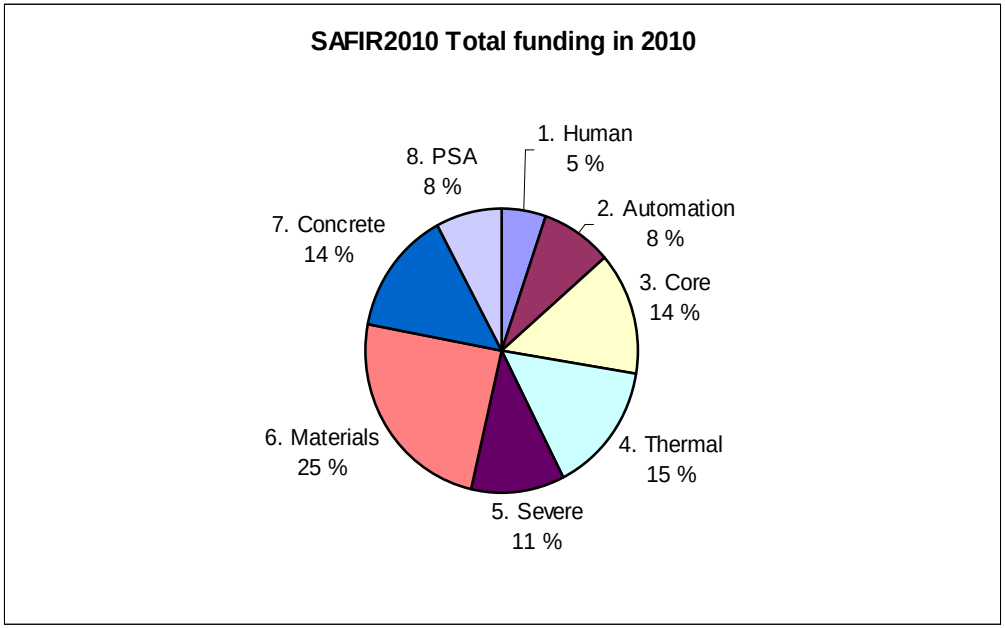
SAFIR2010 Research Areas

1. Organisation and human factors
2. Automation and control room
3. Fuel and reactor physics
4. Thermal hydraulics
5. Severe accidents
6. Structural safety of reactor circuit
7. Construction safety
8. Probabilistic safety analysis (PSA)



- Covers all essential areas of nuclear safety
- Emphasis on ‘nuclear specific’ areas

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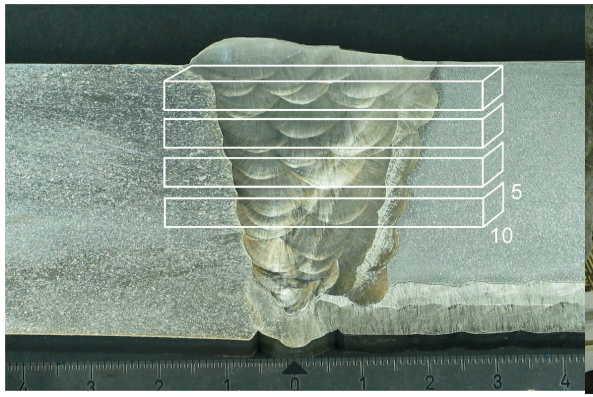
SAFIR2010 in 2010

- Last year of the programme (2007-2010)
- Packing up the four year research in most projects
- Planned volume appr. 7,1 M€, 48 p.y. and 33 research projects
- Most projects continued from 2008
- Two entirely new projects
- VTT co-ordinator and main responsible organisation in 26 projects, others LUT (3), HUT&TTL (1), HUT(1), FMI (1), Fortum (1)

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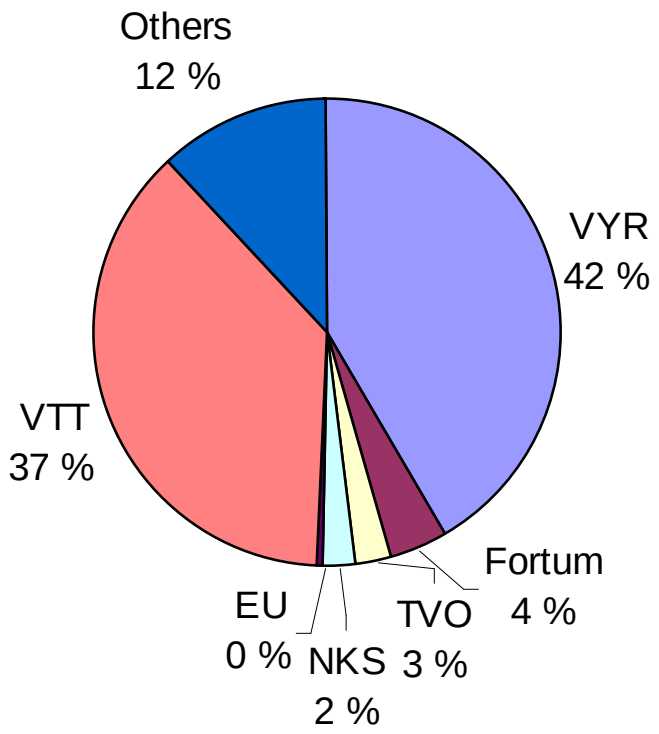
SAFIR2010 in 2010

Total funding in 2010
7,1 M€



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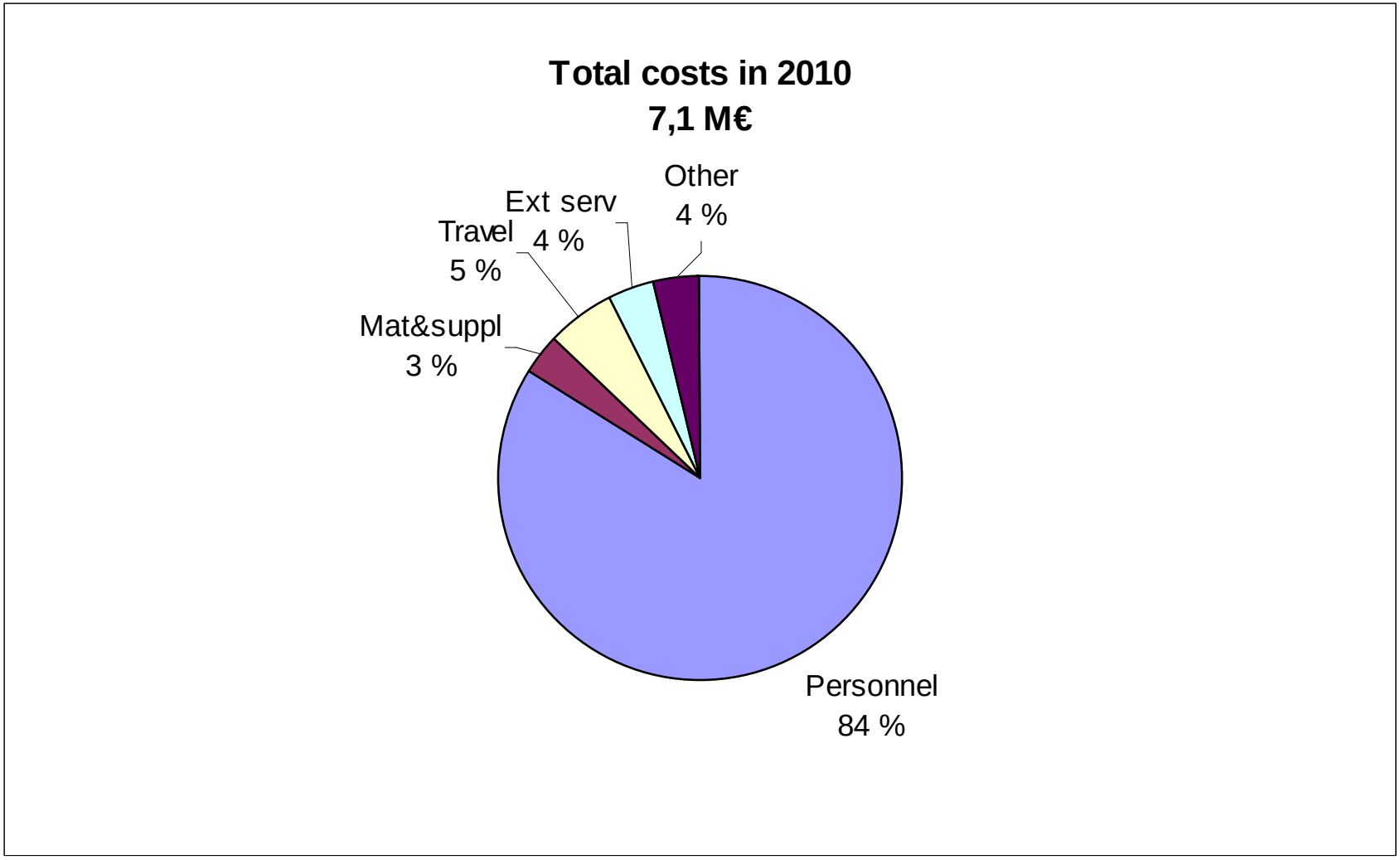
SAFIR2010 in 2010



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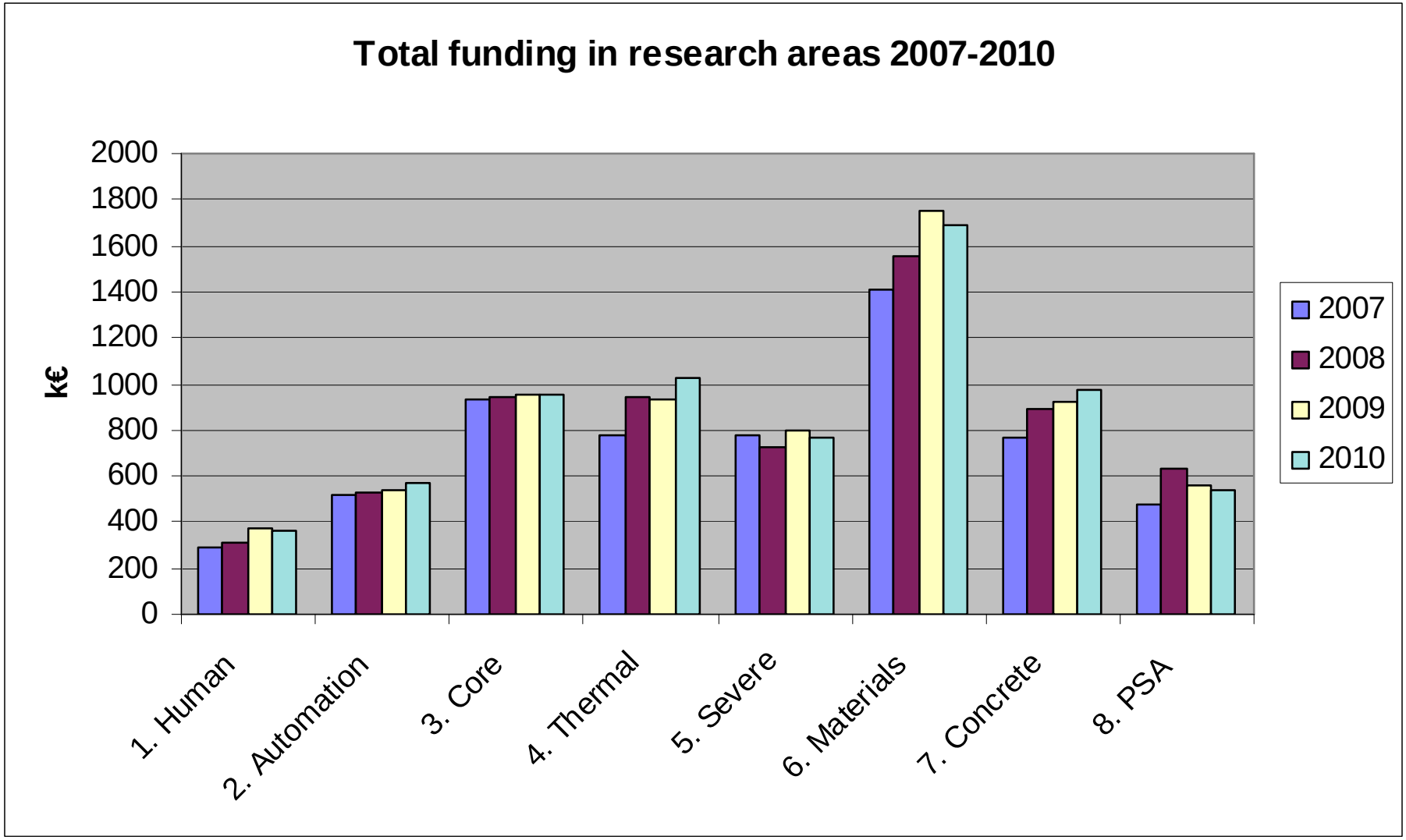

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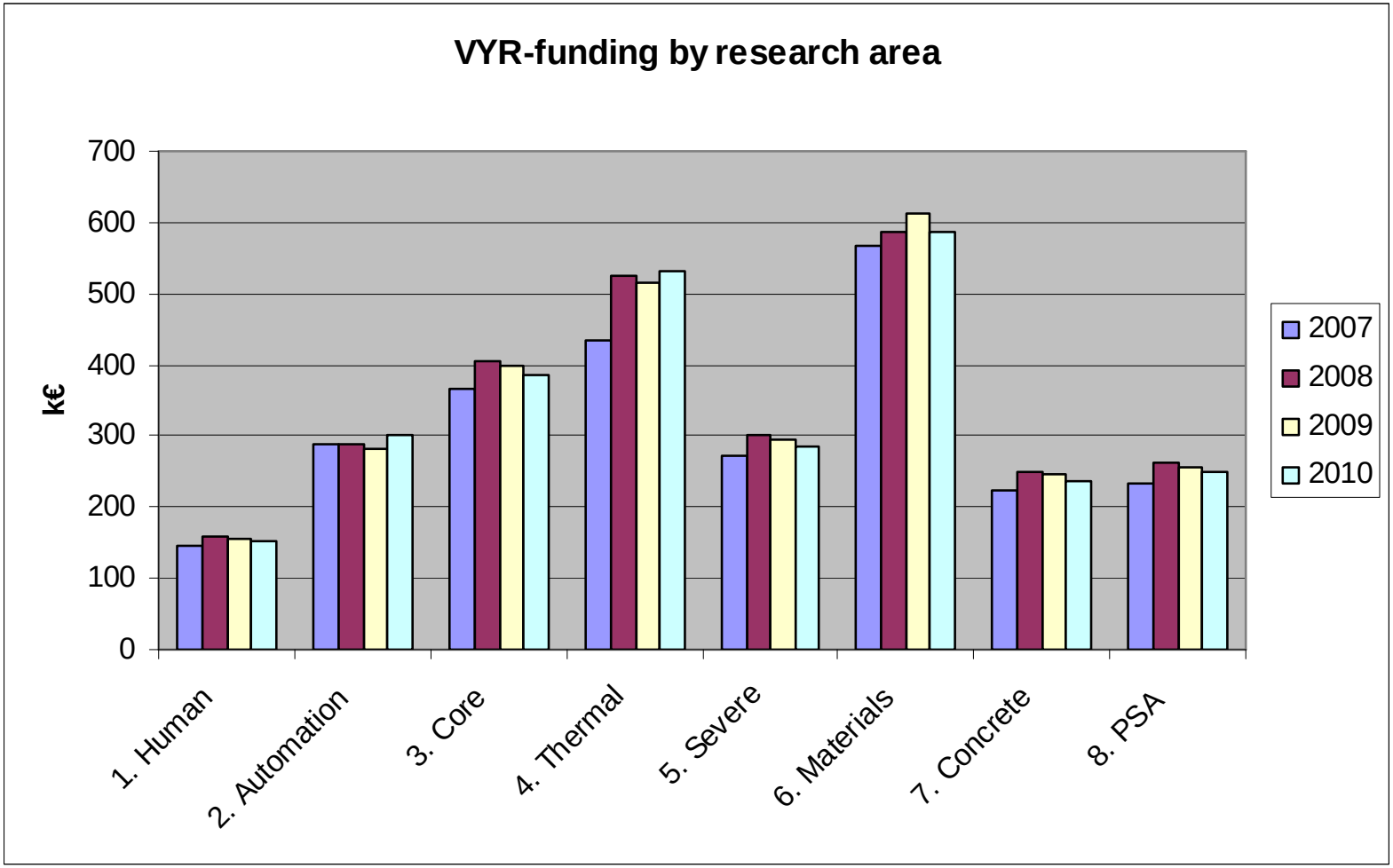
VYR-funding in 2007-2010



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SAFIR2010 Results

In 2007:

- 149 Specified research results (Deliverables)
- 195 Publications:
  - 19 Scientific,
  - 50 Conference papers,
  - 79 Research institute reports,
  - 38 Other categories
- 13 Academic degrees
  - 4 Doctoral,
  - 9 Master level

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SAFIR2010 Results

In 2008:

- 170 Specified research results (Deliverables)
- 194 Publications:
  - 20 Scientific,
  - 46 Conference papers,
  - 86 Research institute reports,
  - 42 Other categories
- 9 Academic degrees
  - 2 Doctoral,
  - 7 Master level

In 2009: similar magnitudes, Publication CD by June 2010

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SAFIR2010 Results

In 2009:

- 178 Specified research results (Deliverables)
- 235 Publications (preliminary count)*:
  - 29 Scientific,
  - 84 Conference papers,
  - 86 Research institute reports,
  - 36 Other categories
- 11 Academic degrees
  - 1 Doctoral,
  - 10 Master level

*Publication CD by June 2010

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SAFIR2010 Observations (regards from Eija Karita)

- SAFIR2010 has acted as the 'thin cover' of the most critical research in all the eight research areas
- Thus, stability in funding share between the areas has been the result, in particular in the VYR-funding
- In the VYR zero-sum-game finding funding for new has meant cutting it from others
- In the most nuclear specific areas the research organisations have also directed more than the required minimum of their own funding to the projects – thus indicating that they find the research important
- Some of these areas/projects have been able to attract also ample external funding – IMPACT2010 being the best!
- Automation is the contrary example: everybody talks about the importance, but nobydy is willing to put their own money there one cent above the minimum required !

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SAFIR2010 Observations (regards from Eija Karita)

- The young & hungry consider the stability as stagnation
- The old & lazy consider the surveillance, evaluation and reporting suffocative to the free research
- BUT: Keep in mind that this is not free academic research !
- This is research according the the Finnish Nuclear Energy Act with the ultimate goal: ”***to ensure that, should such new factors concerning safe operation of nuclear facilities emerge that could not be foreseen, the authorities have such sufficient and comprehensive nuclear engineering expertise and other facilities at their disposal that can be used, when necessary, to analyse without delay the significance of such factors.”***
- ***The objective of SAFIR2010 is realised in the research work carried out and in the training of experts in these research projects. SAFIR2010 is also an important network in Finland both in domestic and in international matters.***

Research Projects in 2010

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Organisation and human factors

- Two projects in the area in 2010:
- Safety culture and organizational learning (MANOR, VTT)
  - Safety culture studies have key role in the project
- Expert work in safety critical environment (SAFEX, TTL&TKK)
  - Studying such items as “Knowledge sharing in interorganizational context”

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Automation and control room

- Three old projects in the area in 2010, all run by VTT:
- Model-Based Safety Evaluation of Automation Systems (MODSAFE)
- Certification Facilities for Software (CERFAS)
  - Final project goal is to create a competent certification body in Finland
- Operator practices and human-system interfaces in computer-based control stations
  - Studies on Designing large screen overview displays for nuclear power plant control rooms
- NEW project: Requirements engineering in nuclear power plant (VAHAYA), TKK&VTT

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Fuel and reactor physics

- Three projects in the area in 2010, all run by VTT:
- Fuel Research:
  - Development and validation of Fuel performance codes (POKEVA)
  - Emphasis on using international well-known codes
  - Minor own development
- Reactor Dynamics:
  - Tridimensional core transient analysis methods (TRICOT)
  - Strong tradition of own code development
- Reactor Physics:
  - Total reactor physics analysis system (TOPAS)
  - Traditionally use of several international codes
  - Recently strong own code development

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Thermal hydraulics

- Both calculations with system codes (APROS, TRACE) and CFD (Fluent, Star-CD..) and experiments
- Projects run by VTT and Lappeenranta University of Technology
- Strong coupling of experiments and calculation methods
- Seven projects in 2010:
  - Numerical modelling of condensation pool (NUMPOOL,VTT)
  - Improved thermal hydraulic analyses of nuclear reactor and containment (THARE,VTT)
  - CFD modelling of NPP steam generators (SGEN,VTT)
  - Improvement of PACTEL Facility Simulation Environment (PACSIM,LUT)
  - Condensation experiments with PPOOLEX facility (CONDEX, LUT)
  - Passive system safety simulation (PASSIMU,LUT)
  - NEW project:OpenFOAM CFD-solver for nuclear safety related flow simulations (NUFOAM), (Fortum)

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Severe Accidents

- Aerosol research, code calculations (MELCOR and several other codes) own small/medium scale experiments
- Four projects in 2010, all run by VTT:
  - Release of radioactive materials from a degrading core (RADECO)
  - Primary circuit chemistry of fission products (CHEMPC)
  - Core melt stabilization (COMESTA)
  - Hydrogen combustion risk and debris coolability (HYBCIS2)

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Structural safety of reactor circuit

- Largest research area of SAFIR2010
- Covers small, medium and large scale experiments and versatile calculational tools
- Seven projects in 2010, all run by VTT:
  - Risk-Informed Inspections of Piping (PURISTA)
  - Fatigue endurance of critical equipment (FATE)
  - Water chemistry and oxidation in the primary circuit (WATCHEM)
  - Monitoring of the structural integrity of reactor circuit (RAKEMON)
  - Fracture assessment of reactor circuit (FRAS)
  - Influence of material, environment and strain rate on environmentally assisted cracking of austenitic nuclear materials (DEFSPEED)
  - Renewal of active materials research infrastructure (AKTUS)

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Construction safety

- Three projects in 2010, all run by VTT:
  - Service Life Management System of Concrete Structures in Nuclear Power Plants (SERVICEMAN)
  - IMPACT 2010
  - Structures under Soft Impact (SUSI)
- The IMPACT2010 and SUSI are a project-pair with strong coupling between the experiments and calculation methods.

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Probabilistic safety analysis

- Three projects in 2010:
- Challenges of risk-informed safety management (CHARISMA, VTT)
- Implementation of quantitative fire-risk assessment in PSA (FIRAS, VTT)
- Extreme weather and nuclear power plants (EXWE, FMI)