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**Beyond the Fukushima nuclear power plant accident:
experimental and computational activities
for increasing nuclear power plant safety**

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R&D on NUCLEAR TECHNOLOGY & NUCLEAR REACTORS @ POLIMI

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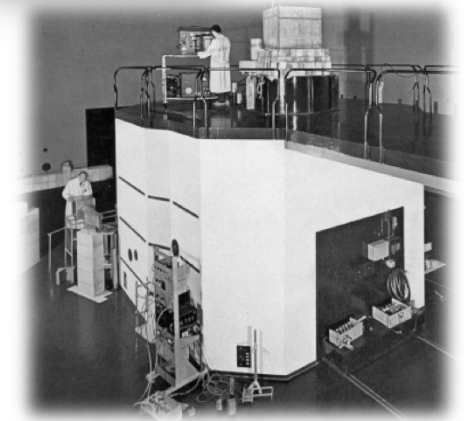
NUCLEAR REACTORS GROUP

www.nuclearenergy.polimi.it



■ History

- First educational programme in Nuclear Engineering (1956)
- First research nuclear reactor in Italian Universities (1959)
- Still first MSc & PhD in Nuclear Engineering in Italy today



■ Strategy

- International projects
- Multidisciplinary groups
- Experimental Labs



NUCLEAR REACTORS GROUP



- Largest NE Division in Italian Universities

Nuclear Reactors group

thermal hydraulics (experim.&modelling), thermal mechanics, fuel performance, dynamics & control, safety analysis, economics

RAMS group

soft methods (fuzzy, neural networks,...) for maintenance/reliability optimization and risk analysis purposes

Radiochemistry group

wet- and pyro-processes for partitioning, confinement in inorganic matrices, methods for waste characterisation

Radiation Protection group

dosimetry, radon, decommissioning processes

Radiation Measurement & Instrumentation group

medical applications, electronics for meas.devices

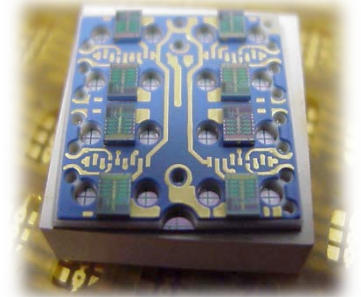
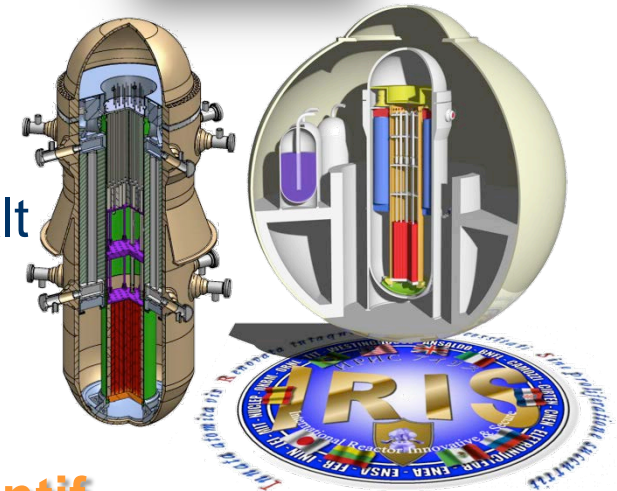
Reactor Physics and Contaminants group

MCNP methods for neutronics and particle transport, contaminant transport in porous media



Main research lines:

- **Innovative Nuclear Reactors:** Small-Modular Reactors, GenIV (lead fast reactors, molten salt reactors)
- MonteCarlo and Artificial Intelligence comput. methods (genetic algorithms, neural networks, fuzzy logic) for **RAMS and fault detection/identif.**
- **Partitioning and transmutation** methods/ molecules for transuranic elements
- **Environmental radioprotection**, personal dosimetry, decommissioning process
- **Nuclear waste management**, surface and deep repositories, contaminant transport
- Silicon **microdosimetry**, neutron spectrometry, gamma and X-ray detectors

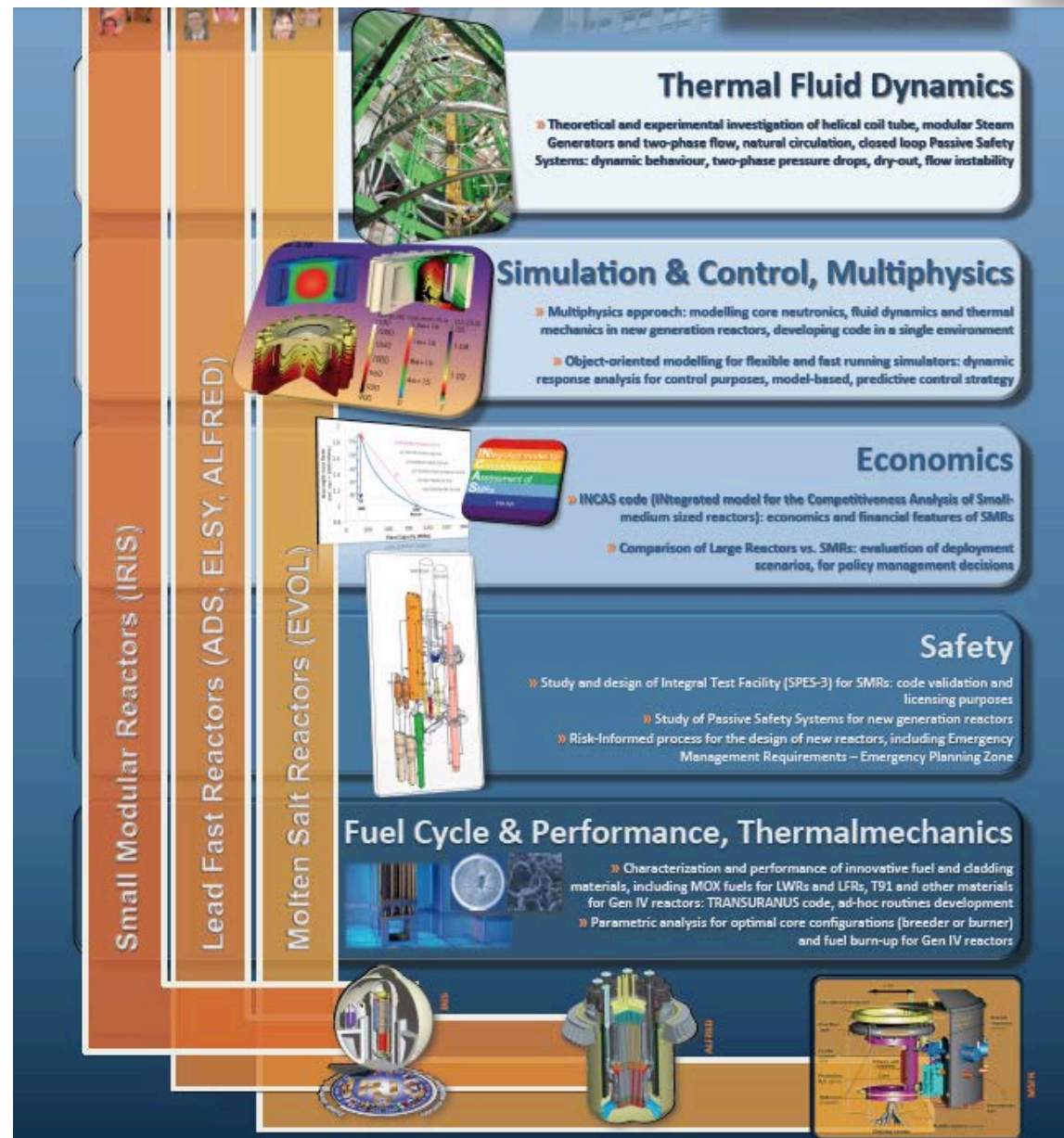




- **New Nuclear Eng. Labs** building:
 - >12 M€ POLIMI investment
 - ~60% for nuclear labs (~40% for chemical processes for energy)
 - 6000 m² built area (+ bunker for radiation source applications)
 - Radiochemistry, Radioprotection, Electronic devices for radiation instrum. & measurements, Calibration and testing

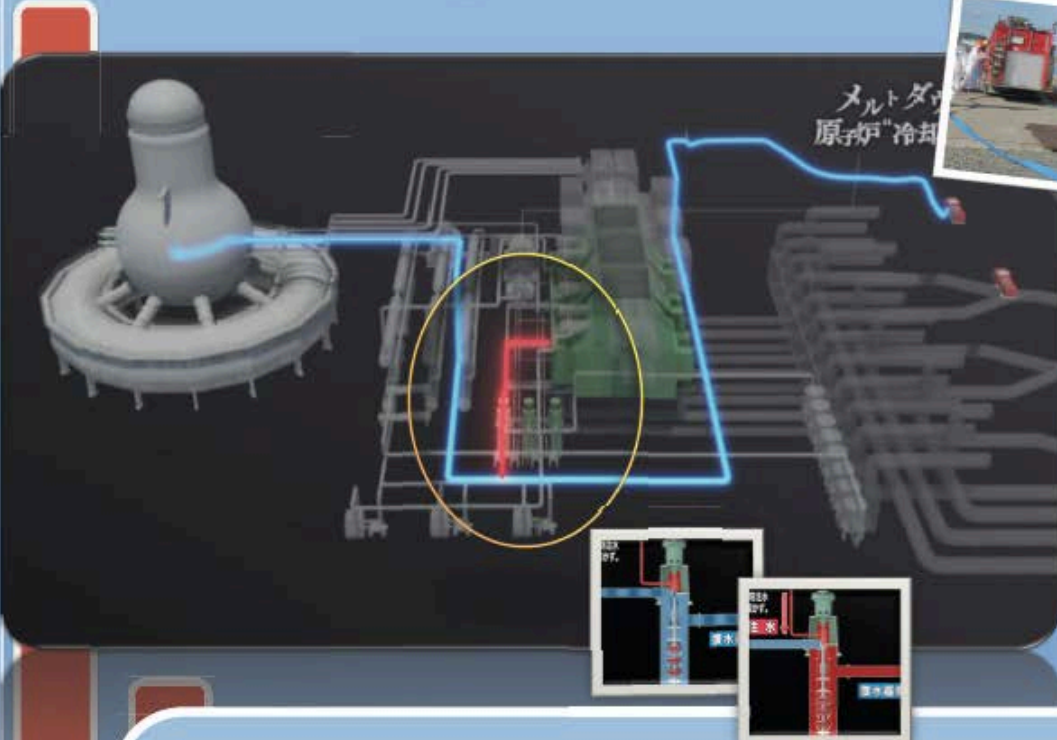


- **World-class experim. labs**, for **large scale** Thermal-Hydraulics / Safety testing on nuclear components and systems: **SIET** labs (Piacenza)





Supporting NHK & IAE on Fukushima investigation

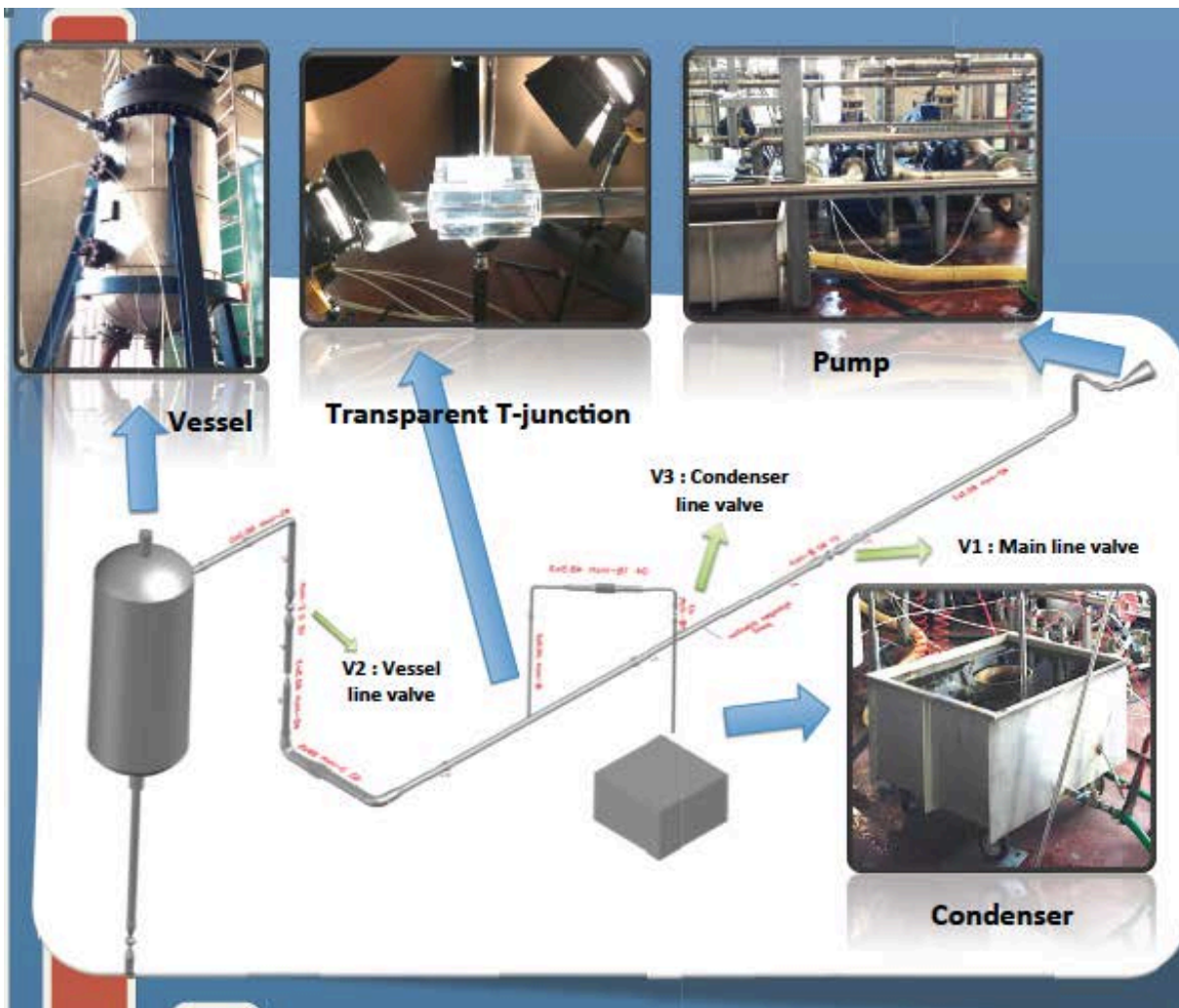


Alternative injection

- » Alternative water injection operations from fire hose starting on March 13th 2011
- » A parasite line was found out in the main line from the fire truck hose to the RPV: not the totality of the water injected by the pump reached the core, but a part of it went to the condenser passing through the Low Pressure Cooling Pump (LPCP)
- » Since the geometry of the LPCP is not completely known, an experimental study was highly helpful to the investigation of the injection process



Supporting NHK & IAE on Fukushima investigation



Scaled Facility

- » Simulation of Unit 3 water injection circuit (scale factor = 1:7)
- » Valves simulating pressure drop on each line
- » Transparent T-junction to visualize the flow
- » Wide range of operative conditions tested