Roadmap GENERATION IV nuclear energy systems

The Generation IV R&D Roadmap Overview

RELAP5 Users Meeting: Park City, UT
September 4, 2002

Objective – Next Generation Nuclear Energy

The Technology Roadmap:

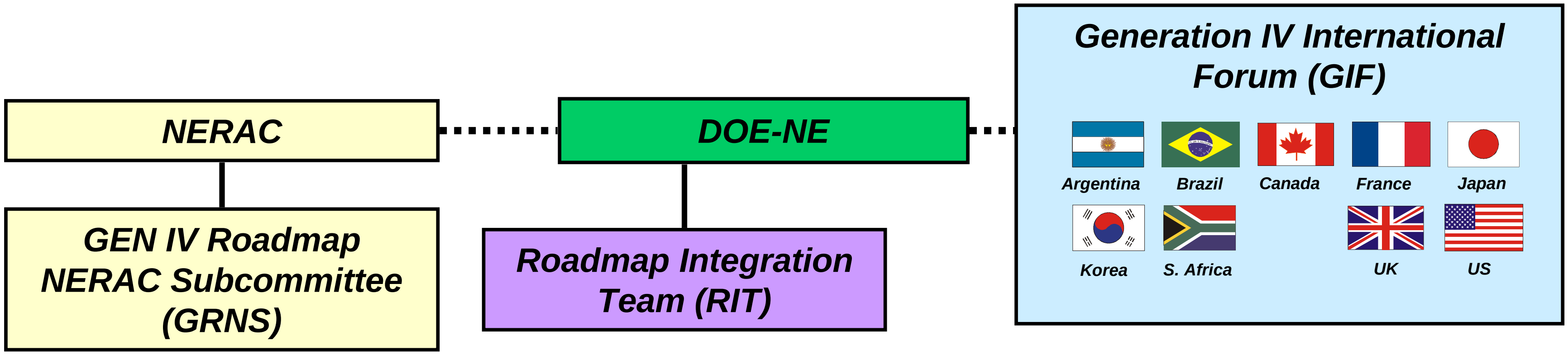
- ***Describes systems deployable by 2030 or earlier***
- ***Determines which systems offer significant advances towards:***
  - ***Sustainability***
  - ***Safety and reliability***
  - ***Economics***
- ***Plans activities for a Generation IV R&D program***

Key Steps to Prepare the Roadmap

- ***Define Technology Goals for Generation IV***
- ***Identify Concepts with Potential***
- ***Evaluate Concepts with a Common Methodology***
- ***Identify R&D Gaps and Needs***
- ***Assemble a Program Plan***

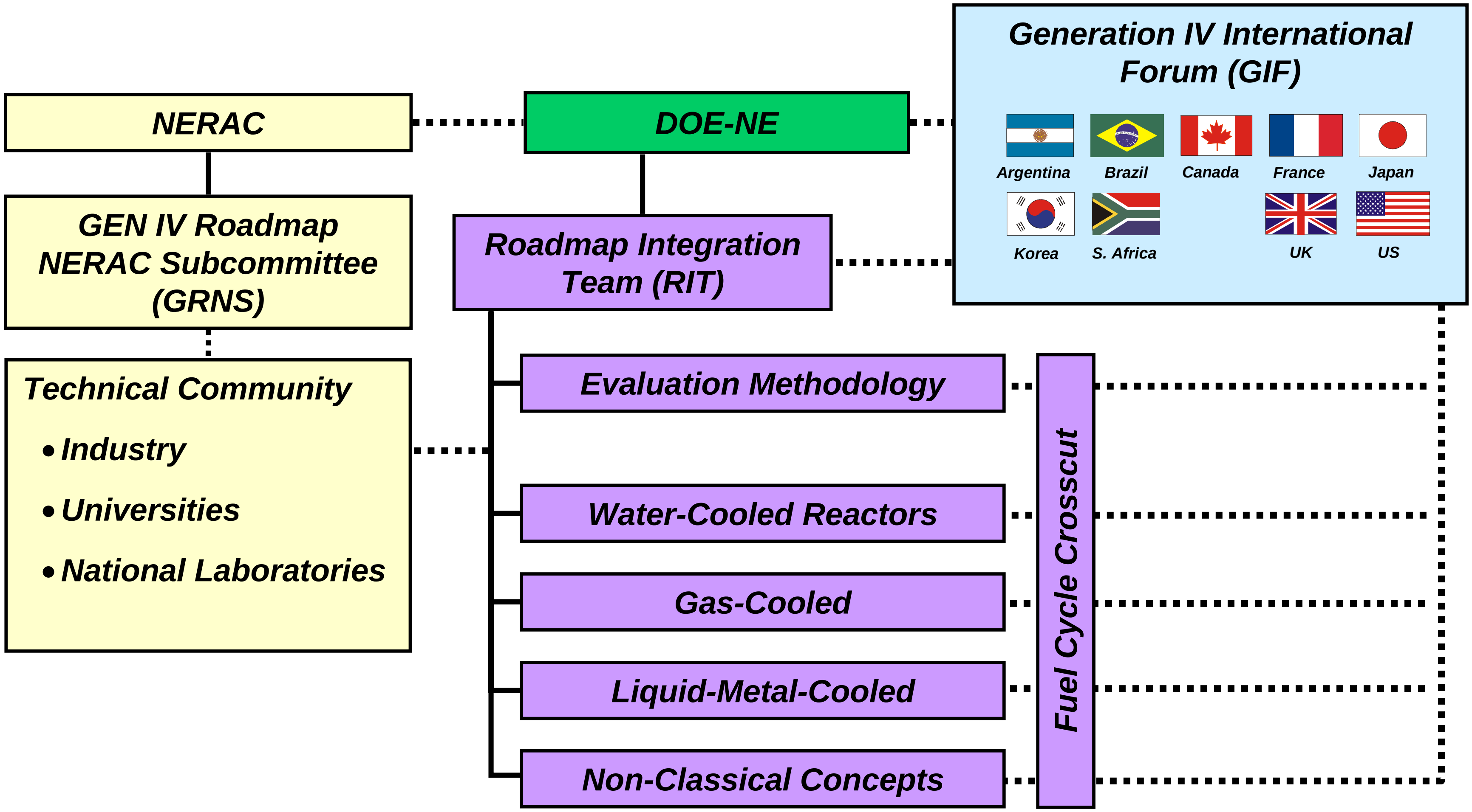
Organizational Evolution

- ***Jan 2000 First Meeting of 9 Countries on Generation IV***
- ***Sep 2000 Creation of NERAC Subcommittee***



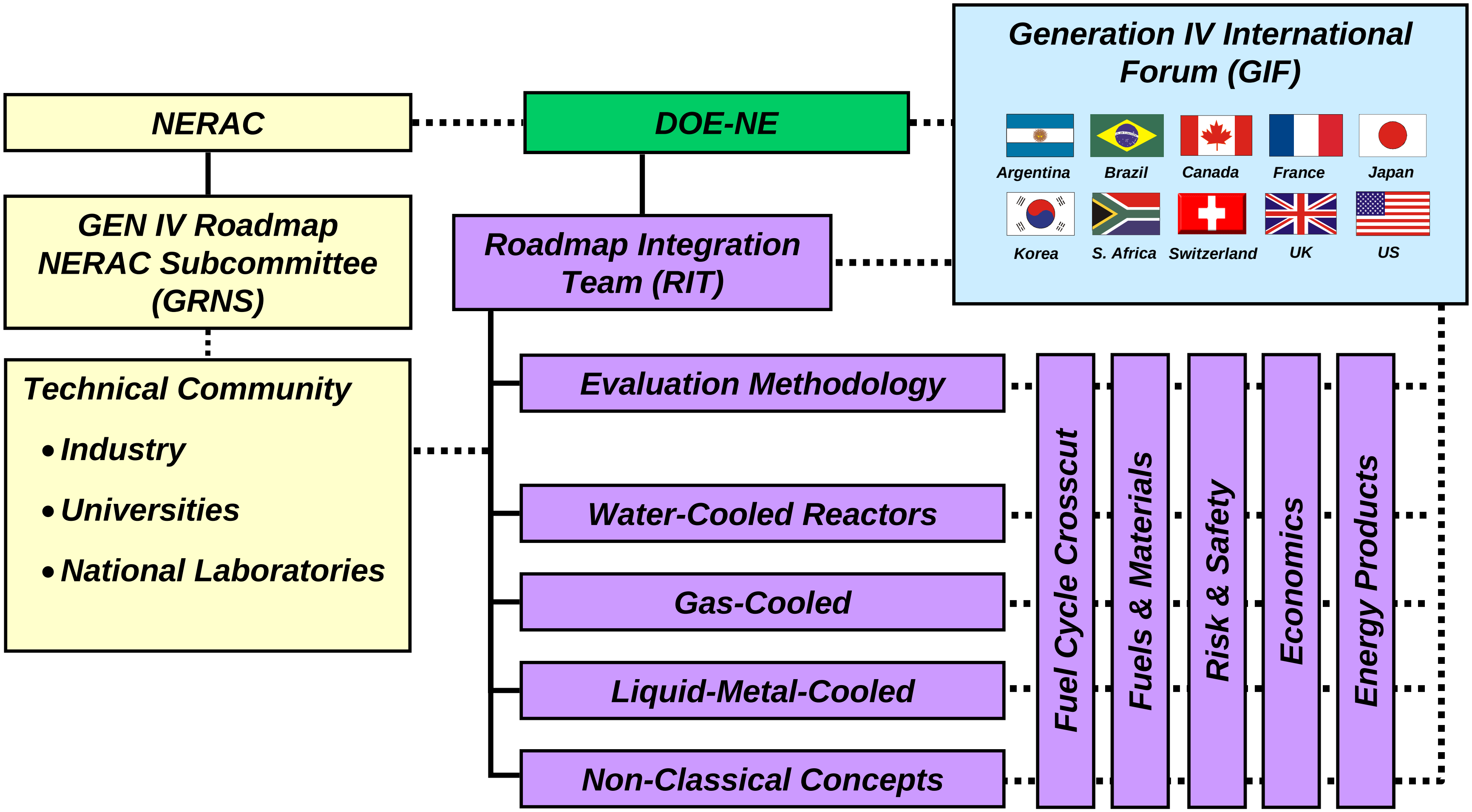
Organizational Evolution

- **Dec 2000 Creation of Working Groups and Fuel Cycle Crosscut**
- **Mar 2001 Incorporation of International Membership**



Organizational Evolution

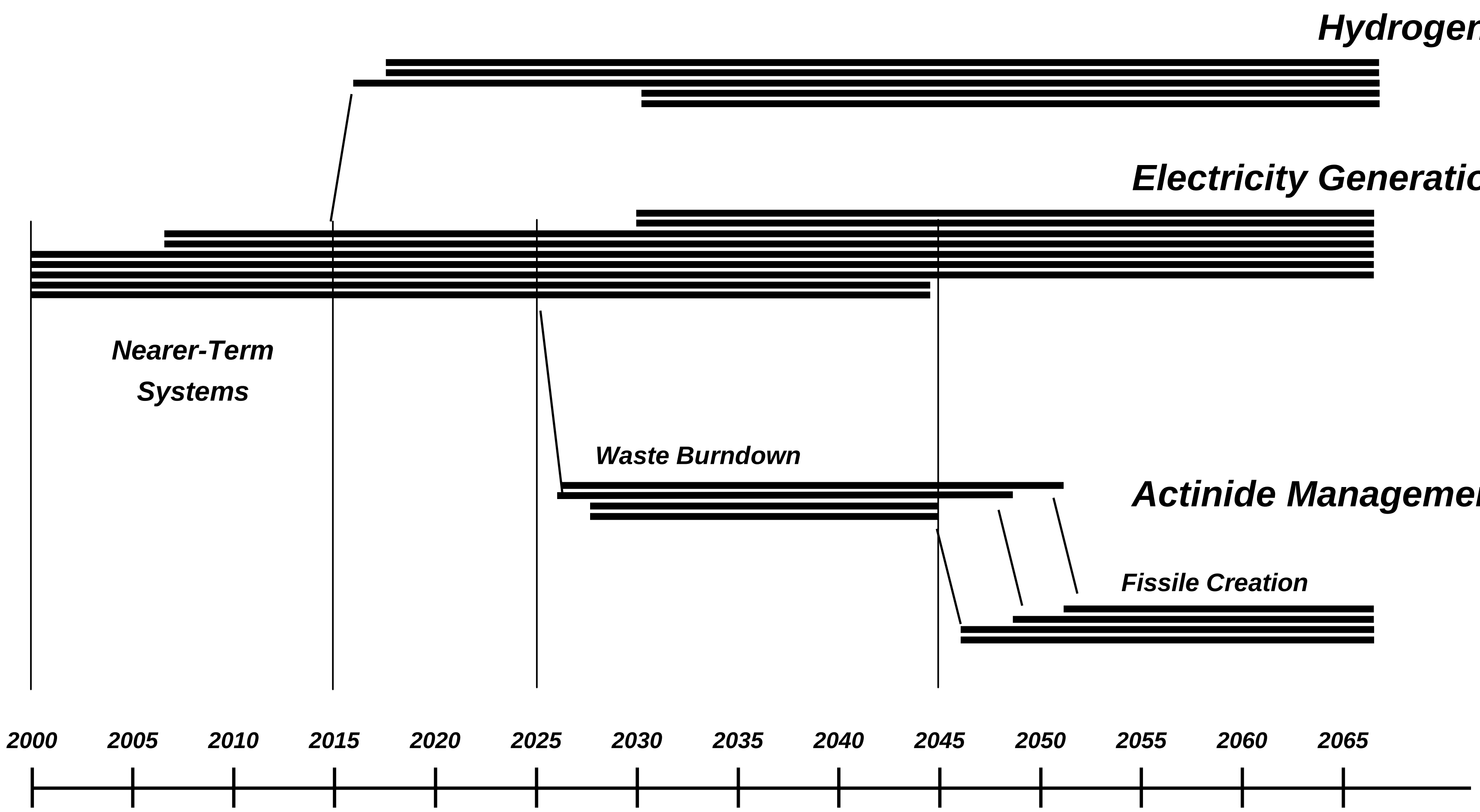
- ***Sep 2001 Organization of Crosscut Groups***
- ***Feb 2002 Switzerland joins the GIF***



GIF Meetings

January 2000	Washington	Countries support Gen IV idea
April 2000	Washington	Experts convened on path forward
August 2000	Seoul	Comment on goals, write charter
March 2001	Paris	Finalize charter, support roadmap
October 2001	Miami	Comment on methodology
February 2002	London	Discuss concepts and selection
April 2002	Washington	Review concept evaluations
May 2002	Paris	Select 6-8 long-term concepts
July 2002	Rio de Janeiro	Review R&D plans
September 2002	Tokyo	Plan R&D collaborations
March 2003	Capetown	Plan R&D collaborations

Important Missions for Generation IV



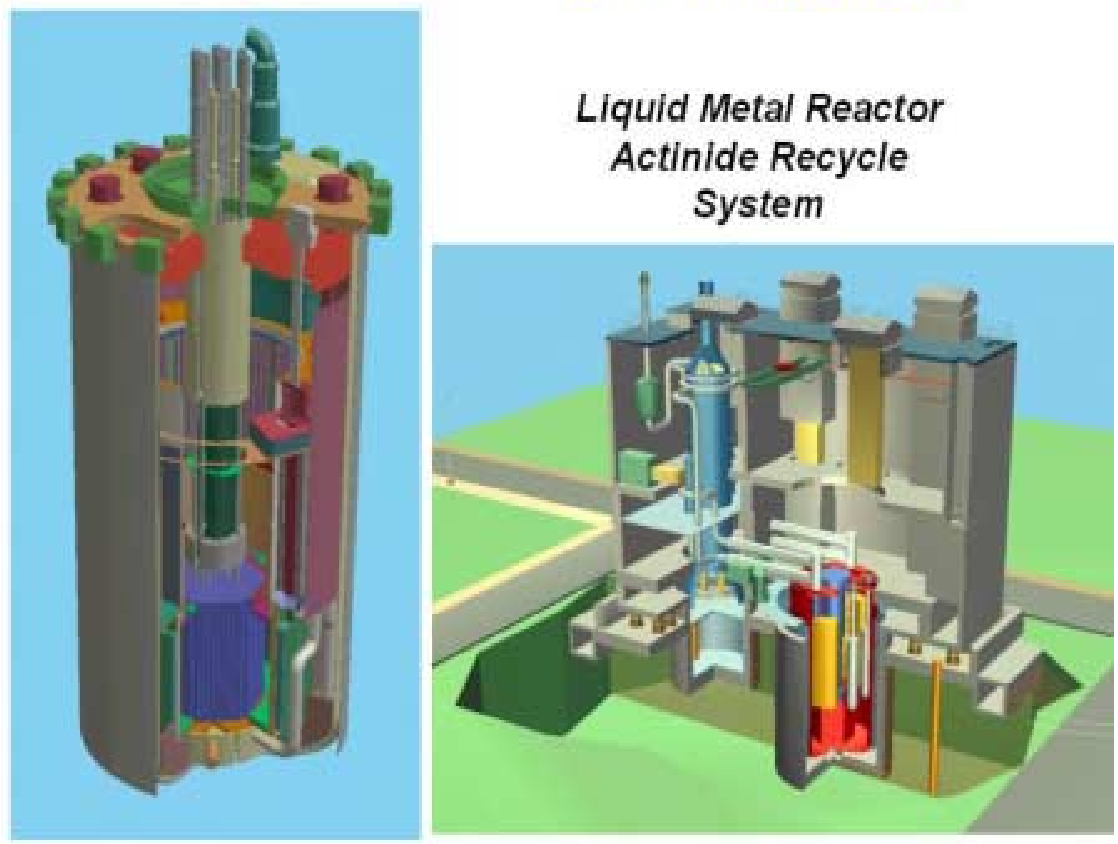
Sodium Liquid Metal-Cooled Reactor (Na LMR)

Characteristics

- ***Sodium coolant, 550°C***
- ***150 to 500 MWe***
- ***Metal fuel with pyro processing / MOX fuel with advanced aqueous***

Benefits

- ***Consumption of LWR actinides***
- ***Efficient fissile material generation***



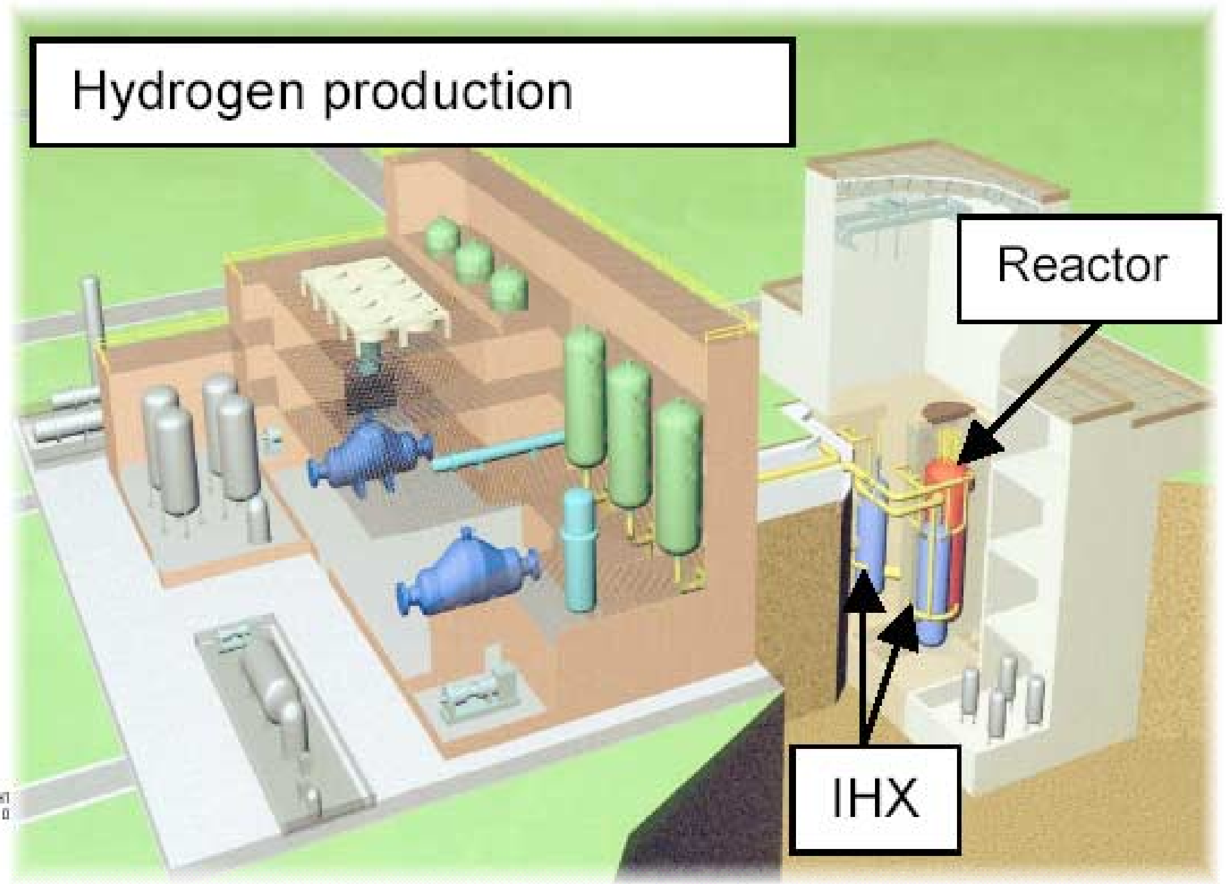
Very High-Temperature Reactor (VHTR)

Characteristics

- ***He coolant***
- ***1000°C outlet temperature***
- ***600 MWe***
- ***Solid graphite block core based on GT-MHR***

Benefits

- ***High thermal efficiency***
- ***Hydrogen production***
- ***Process heat applications***
- ***High degree of passive safety***



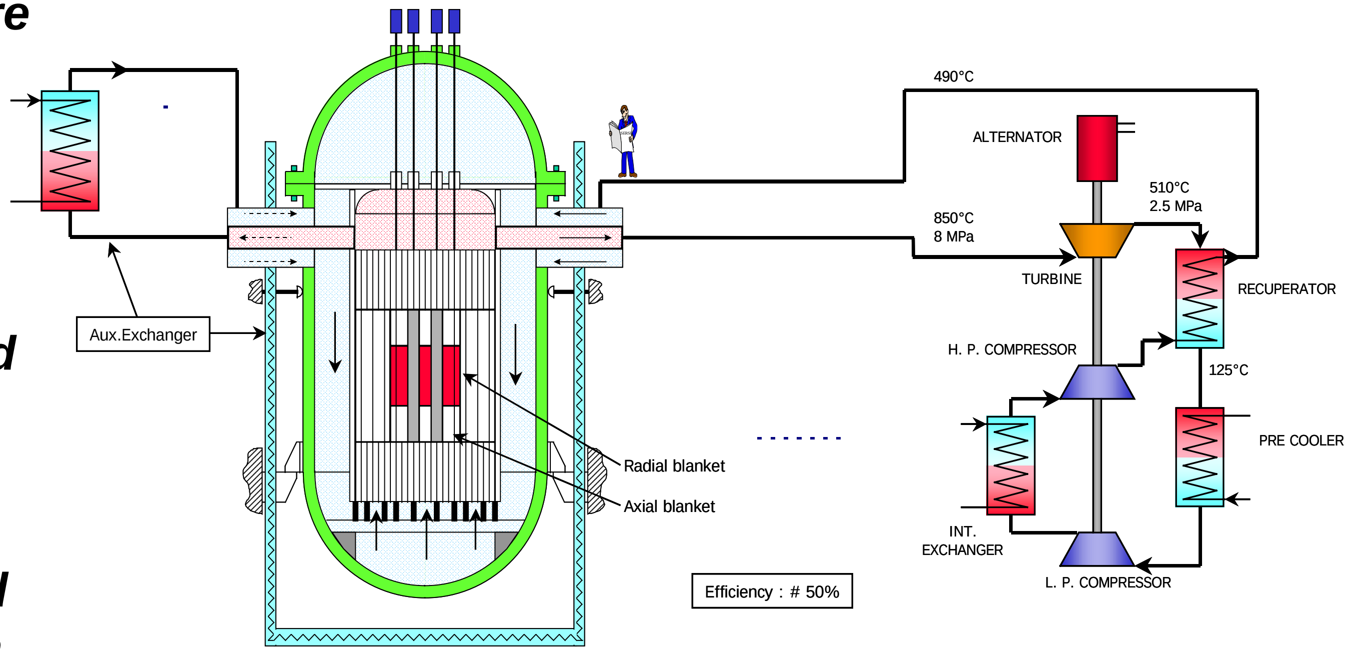
Gas-Cooled Fast Reactor (GFR)

Characteristics

- He coolant
- 850°C outlet temperature
- direct gas-turbine conversion cycle – 48% efficiency
- 600 MW_{th}/288 MW_e
- Several fuel options and core configurations

Benefits

- Waste minimization and efficient use of uranium resources



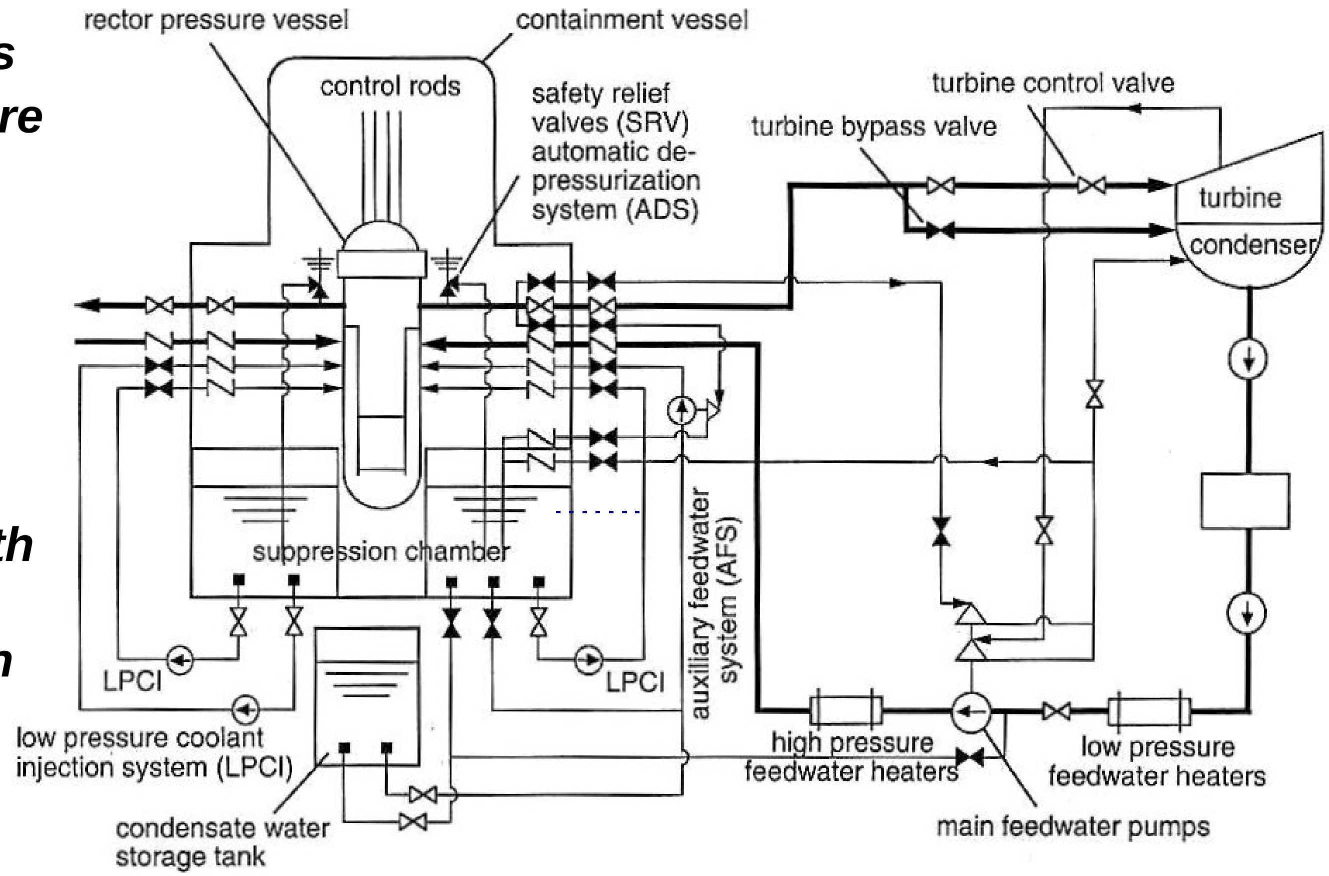
Supercritical Water Reactor (SCWR)

Characteristics

- Water coolant at supercritical conditions
- 550°C outlet temperature
- 1700 MWe
- Simplified balance of plant

Benefits

- Efficiency near 45% with excellent economics
- Thermal or fast neutron spectrum



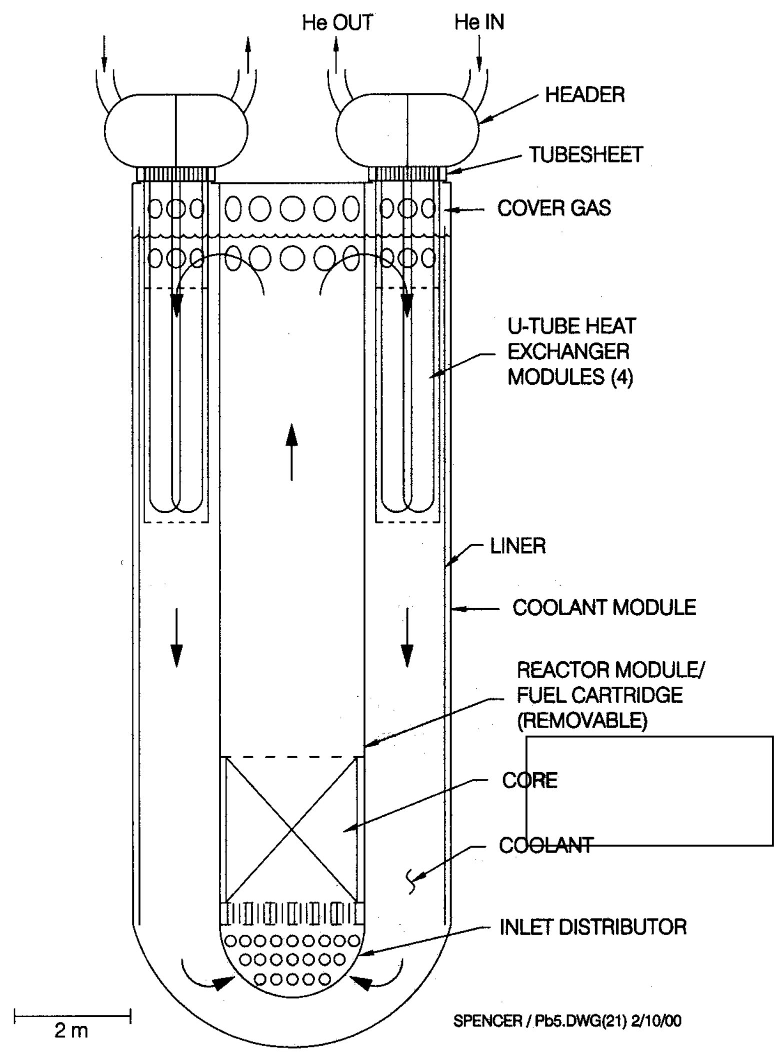
Pb/Bi Reactor – Cartridge Core (Pb/Bi Battery)

Characteristics

- Pb/Bi or Pb coolant
- 550°C to 800°C outlet temperature
- 120-400 MWe
- 15-30 year core life

Benefits

- Distributed electricity generation
- Hydrogen and potable water
- Cartridge core for regional fuel processing
- High degree of passive safety
- Proliferation resistance through long-life cartridge core



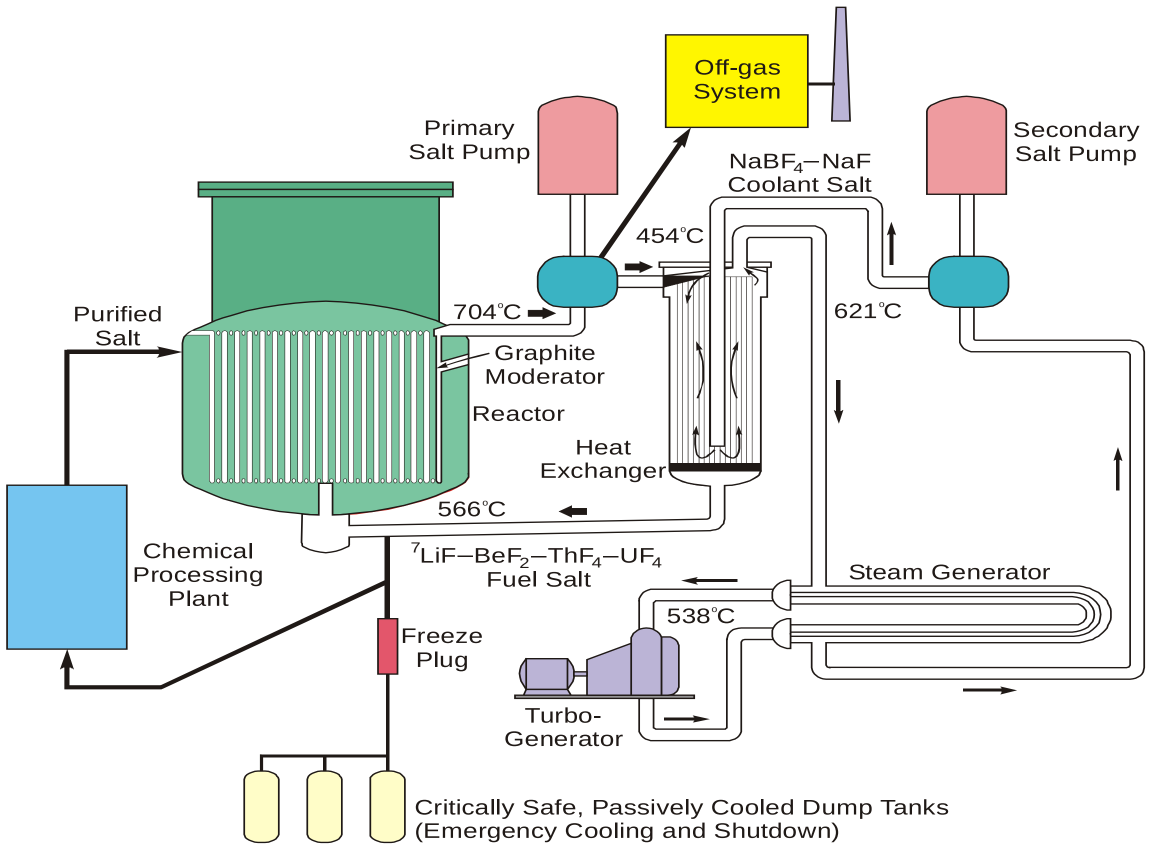
Molten Salt Reactor (MSR)

Characteristics

- Fuel: liquid U, Pu florides,NaF/Zr F_4
- 700 – 800 °C outlet temperature
- 1000 MWe
- Low pressure (<0.5 MPa)

Benefits

- Low source term due to online processing
- Waste minimization and efficient use of uranium resources
- Proliferation resistance through low fissile material inventory



Highlights of System Concept Strengths

Sustainability

- ***Closed cycle fast-spectrum systems***
  - ***Reduced waste heat and radiotoxicity***
  - ***Optimal use of repository capacity***
  - ***Resource extension via regeneration of fissile material***

Safety and Reliability

- ***Many concepts make good advances***

Economics

- ***Water- and gas-cooled concepts***
  - ***High thermal efficiency***
  - ***Simplified balance of plant***
  - ***Large and small plant size***

Hydrogen production and high-temperature applications

- ***Temperatures above 700-800°C***

Selected Highlights of the R&D Challenges

- ***Fuels and materials for higher temperatures***
- ***Increased corrosion/erosion in alternative coolants***
- ***Design for inherent safety***
- ***Recycling technology and methods***
- ***Fuel fabrication methods***
- ***Hydrogen thermochemical processes***
- ***Manufacturing and constructability***
- ***Component technologies***