The Next Generation Nuclear Plant (NGNP)

RIC 2006

Session W4BC: Advanced Reactors – GEN IV

Trevor Cook

United States Department of Energy

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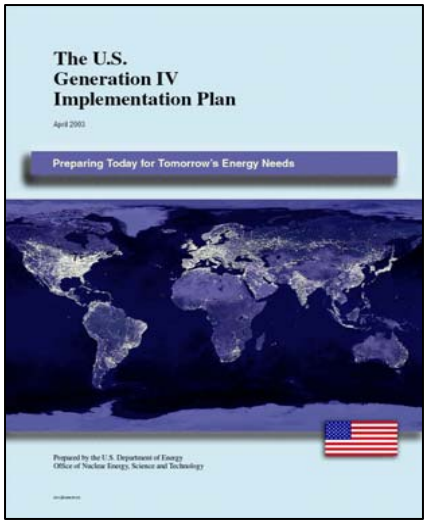
Generation IV Implementation



U.S. Top Priority

Next-Generation Nuclear Plant - VHTR

- **Combines high temperature operation with passive safety systems for improved economics and safety**
- **Demonstrates H_2 and electricity production**
- **Collaborative with international community**
- **Collaborative with industry**
- **Result in a commercially viable plant design**

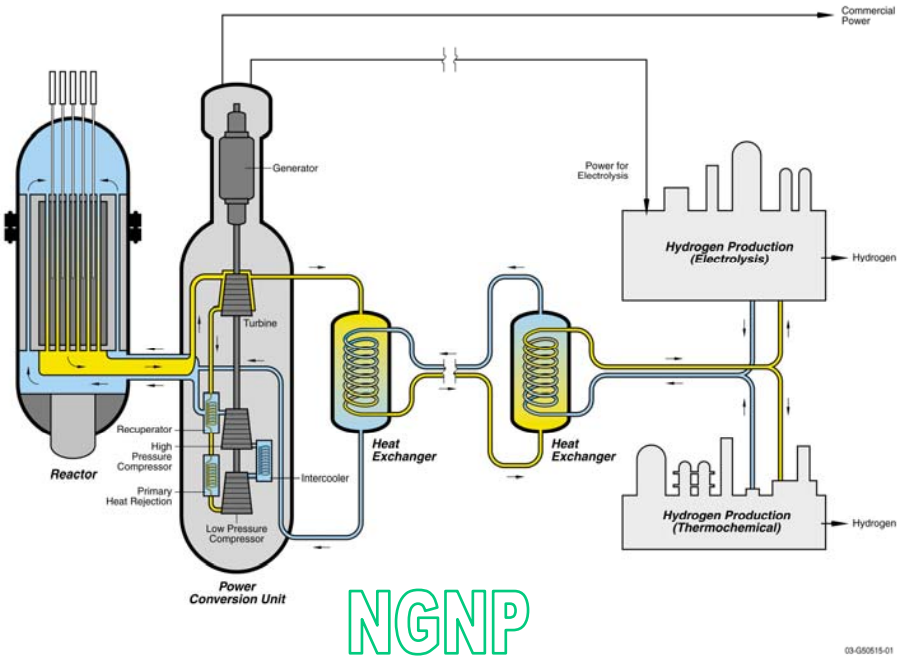
Generation IV International Forum (GIF) Collaboration

There are currently four active Project Management Boards working for the GIF VHTR Steering Committee:

- *Materials and Components;*
- *Fuel and Fuel Cycle;*
- *Hydrogen Production; and*
- *Design, Design Methods, and Safety*

Very-High-Temperature Reactor

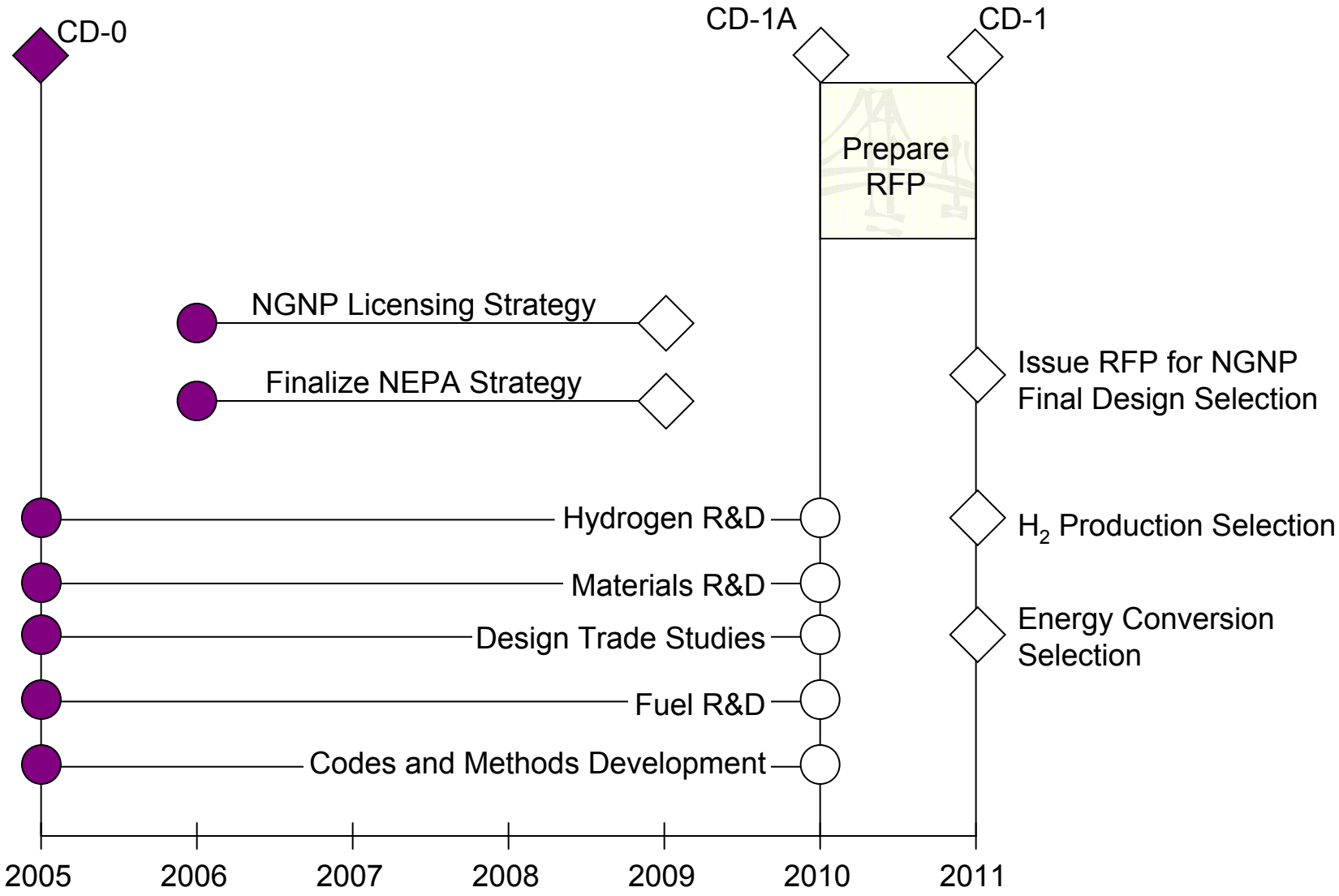
- Benefits
  - Improved Safety
  - Improved Fuel Utilization
  - Helium Brayton cycle conversion with high electricity production efficiency
  - Clean and efficient hydrogen production
- Attributes
  - Helium coolant up to 1000ºC
  - Modular 300-600 MWTh
  - Prismatic block or pebble bed core
  - TRISO-coated particle fuel
- Key R&D Issues
  - High-temperature materials
  - Fuel performance and reliability
  - Hydrogen production technologies
  - Intermediate heat exchanger
  - Waste generation



Energy Policy Act of 2005

- *Authorizes NGNP Project and associated Funding*
- *Establishes two Project Phases – Phase I as R&D and Phase II as Design and Construction*
- *Sets overall project schedule for 2021 completion*
- *Names the Idaho National Laboratory as the site of construction and charges INL with responsibility for integrating the project R&D and procurements*
- *Directs the Department to undergo periodic review*
- *Requires a Licensing Strategy be developed with NRC*

EPACT Phase I



NGNP Implementation – Phase 1

- *In Phase 1 the following tasks will be completed :*
  - *Develop a technology neutral licensing strategy for the NGNP*
  - *Develop and implement a NEPA Strategy*
  - *Develop codes and methods that can be used to assess the safety and performance characteristics of the reactor system*
  - *Develop materials data needed to fill the gaps required for ASME Codification*
  - *Develop fuel performance data that envelopes anticipated reactor conditions*
  - *Conduct trade studies for energy conversion system configuration*
  - *Conduct hydrogen production R&D leading to the selection of the hydrogen production technology*
  - *Prepare a Request for Proposal for a design competition leading to the selection of the NGNP final design*

NGNP Research and Development
Work Accomplished to Date

Nuclear Hydrogen Technology

- ***Completed final designs for the thermo-chemical and high-temperature electrolysis lab-scale systems***
- ***Demonstrated sustained high-temperature steam electrolysis at the Idaho National Laboratory***

High-Temperature Reactor Fuels

- ***Produced kernels and demonstrated TRISO coating fabrication process***
- ***Consolidated existing computer fuel performance models***
- ***Completed installation of coating, characterization and compacting laboratories***
- ***Completed design of test capsule for initial fuel testing in the Advanced Test Reactor***

High Temperature Materials

- ***Established External Oversight Committee and implemented NGNP QA Program***
- ***Began graphite irradiations***
- ***Completed production of Alloy-617 weld joints for microstructural analysis***
- ***Entered into a cooperative agreement with ASME***

Design Methods Development and Validation

- ***Completed the upgrade to RELAP thermal hydraulics code for high-temperature gas-cooled and salt-cooled reactor analysis***
- ***Developed alternative reactor physics methodologies for both prismatic-core and pebble-bed type gas-cooled reactors***
- ***Completed the point design of the gas-cooled and salt-cooled very-high temperature reactors***

Generation IV Nuclear Energy Systems Initiative

Budget Summary

$ in millions

Program Element	FY 2006 Adjusted Approp.	FY 2007 Request
Generation IV R&D	10.2	6.1
NGNP	40.0	23.4
I-NERI	3.0	1.0
SBIR	1.2	0.9
Total	**$ 54.4**	**$ 31.4**

FY 2007 Planned Accomplishments

- *Initiate the irradiation of advanced coated particle fuel in the new Advanced Test Reactor multi-cell capsule test train at the Idaho National Laboratory.*
- *Develop models to predict the behavior of candidate very high-temperature reactor pressure boundary materials and very high-temperature component materials under expected operating conditions.*
- *Complete preliminary high-flux irradiations of high temperature metallic alloys at the Oak Ridge National Laboratory and initiate post-irradiation examinations.*
- *Complete engineering design assessments of high-temperature Brayton cycle and supercritical-carbon dioxide cycle for converting heat to electricity for Generation IV reactor systems.*