

The Next Generation Nuclear Plant (NGNP)

RIC 2006

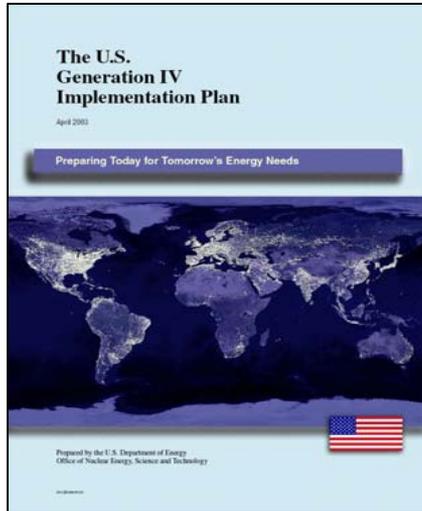
Session W4BC: Advanced Reactors – GEN IV

Trevor Cook

United States Department of Energy

March 8, 2006

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 H₂ and electricity production**
- **Collaborative with international community**
- **Collaborative with industry**
- **Result in a commercially viable plant design**

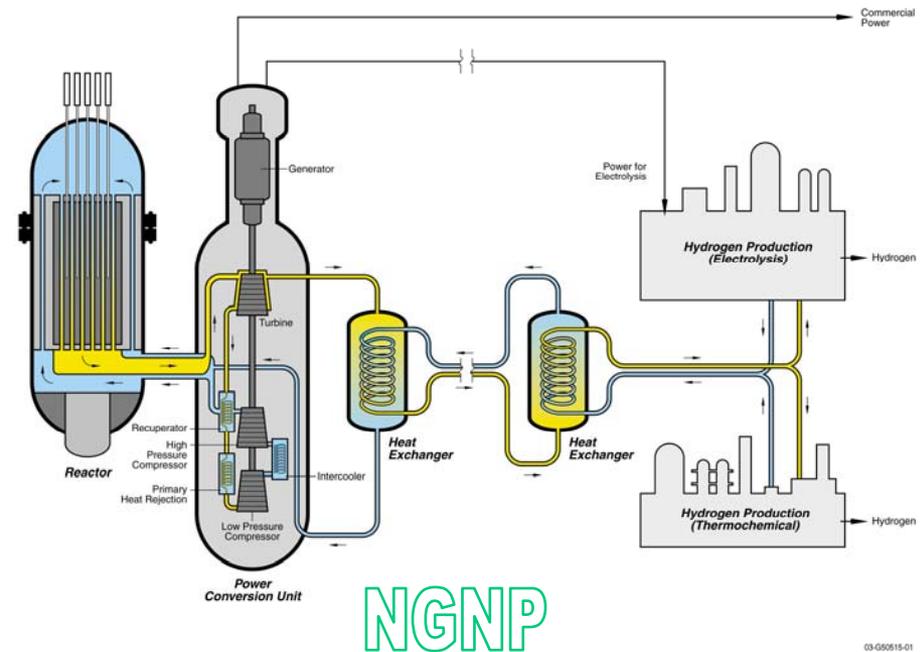
Generation IV International Forum (GIF) Collaboration

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 1000°C
 - 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

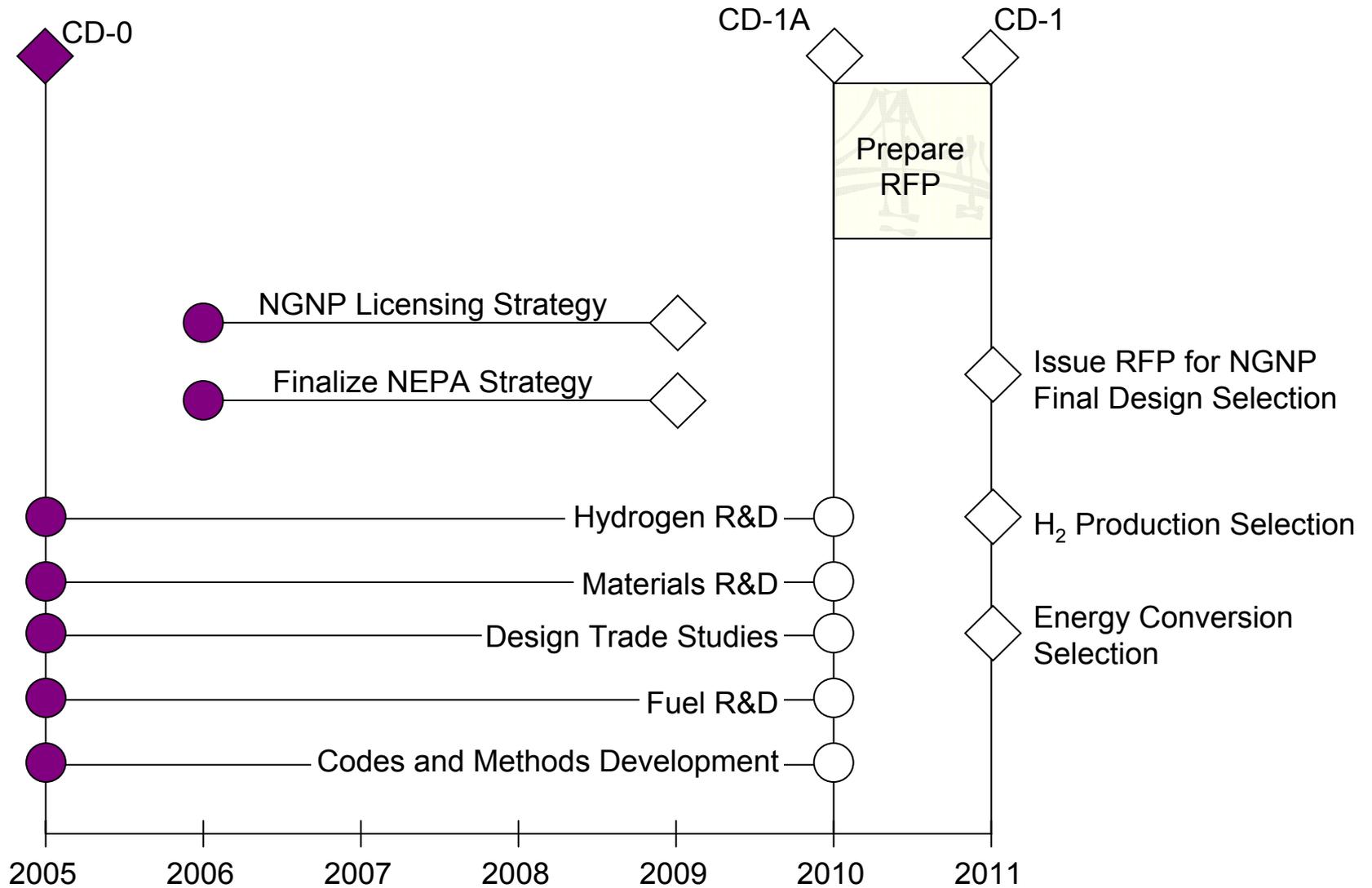


03-000515-01

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	<u>1.2</u>	<u>0.9</u>
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.*

