

Future of Nuclear Engineering

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11 June 2010

Idaho Society of Professional Engineers
Boise, Idaho

www.inl.gov



Idaho National Laboratory — Vision

Develop world-class nuclear energy capability

ATR
NATIONAL SCIENTIFIC CAPABILITY

INL
Idaho National Laboratory

Foster education, research, industry, government and international collaborations to produce the needed investment, programs and expertise

CAES
Center for Advanced Energy Studies

>Welcome
Center For Advanced Energy Studies
Dedication
February 12, 2008

Become the Preeminent Internationally-Recognized Nuclear Energy RD&D Laboratory

INL Wireless
TEST BED

ACE

Battery Testing Lab

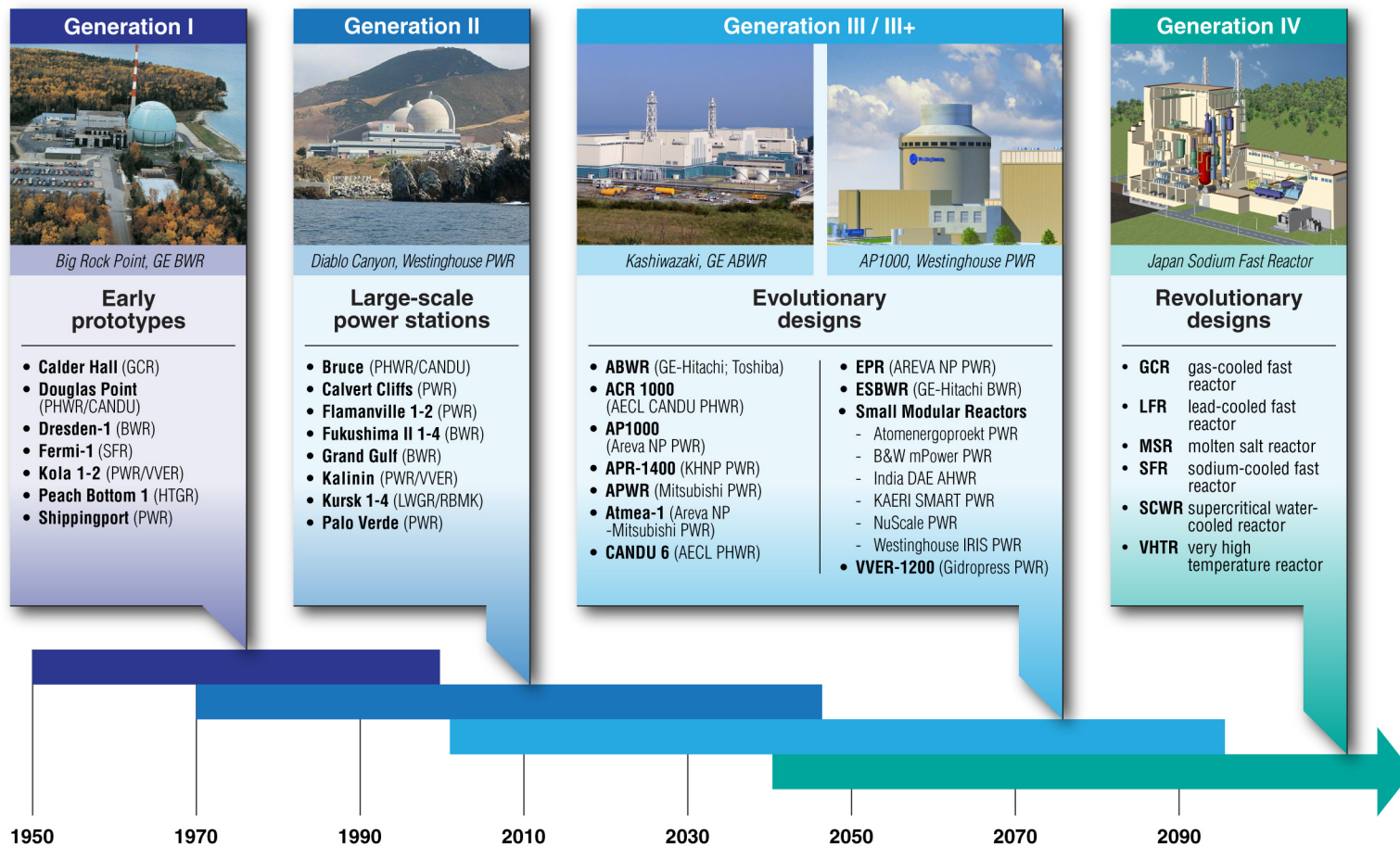
Become a major center for national and homeland security technology RD&D

Become a leading clean energy systems RD&D laboratory and a regional resource

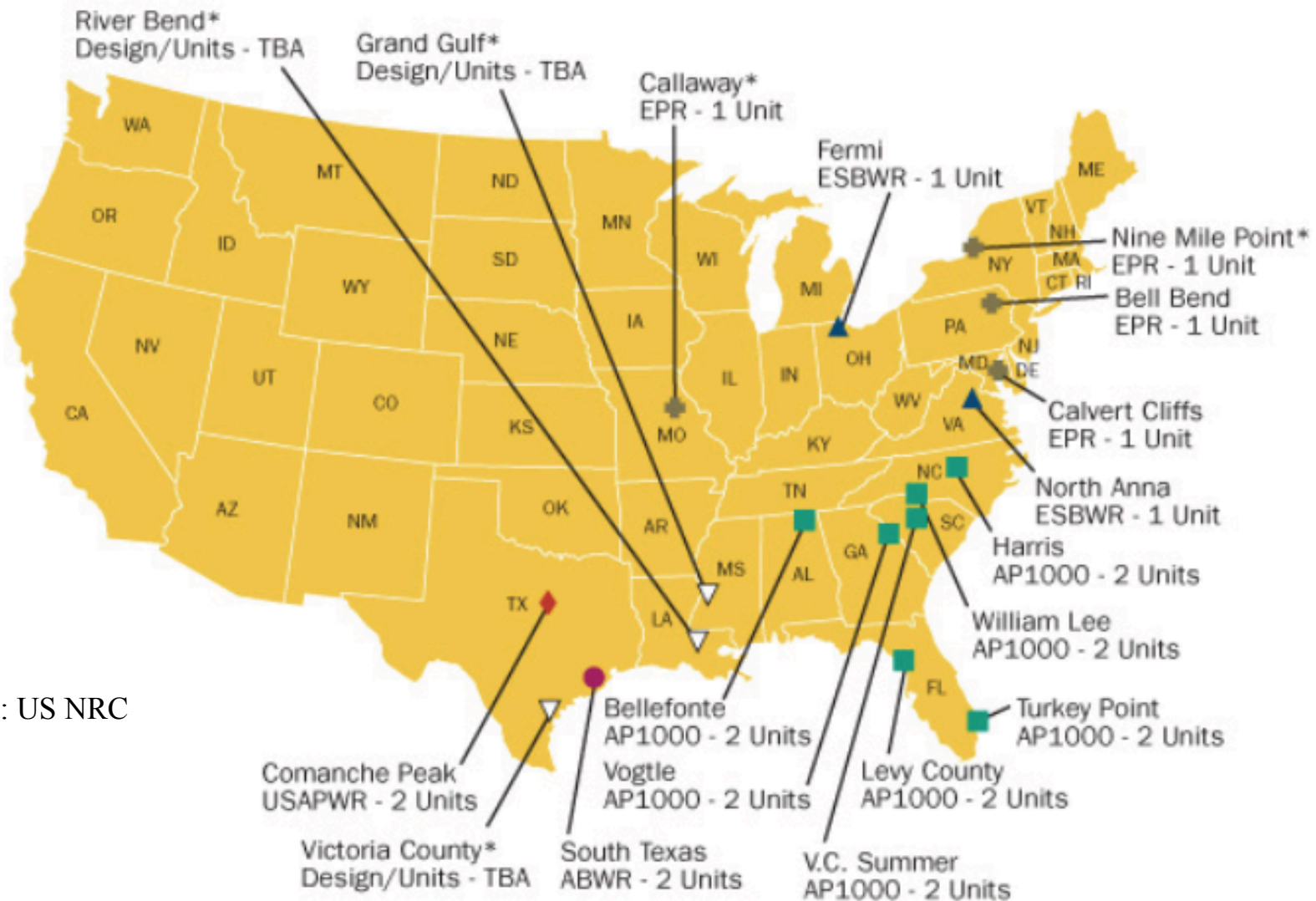
The National Nuclear Laboratory with Multi-Program Capabilities

The nuclear energy mission is the reason INL exists

The Nuclear Future (and Past)



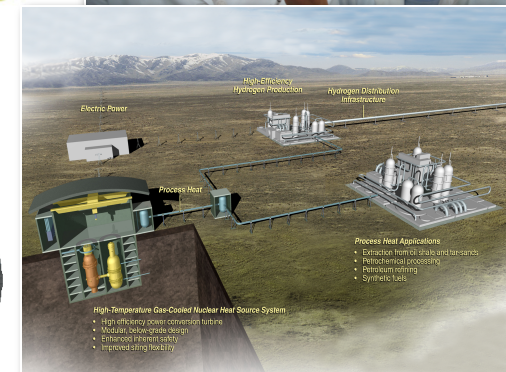
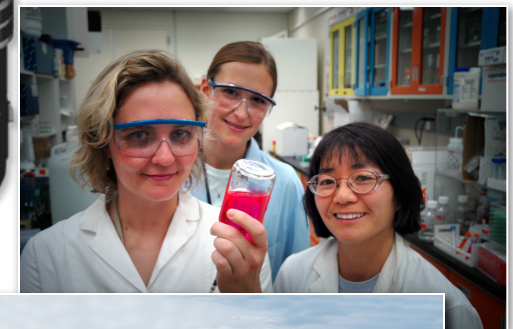
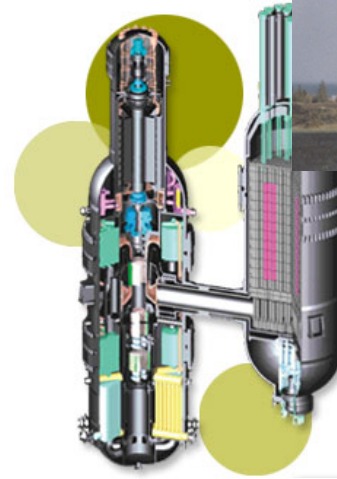
New nuclear plant applications in US



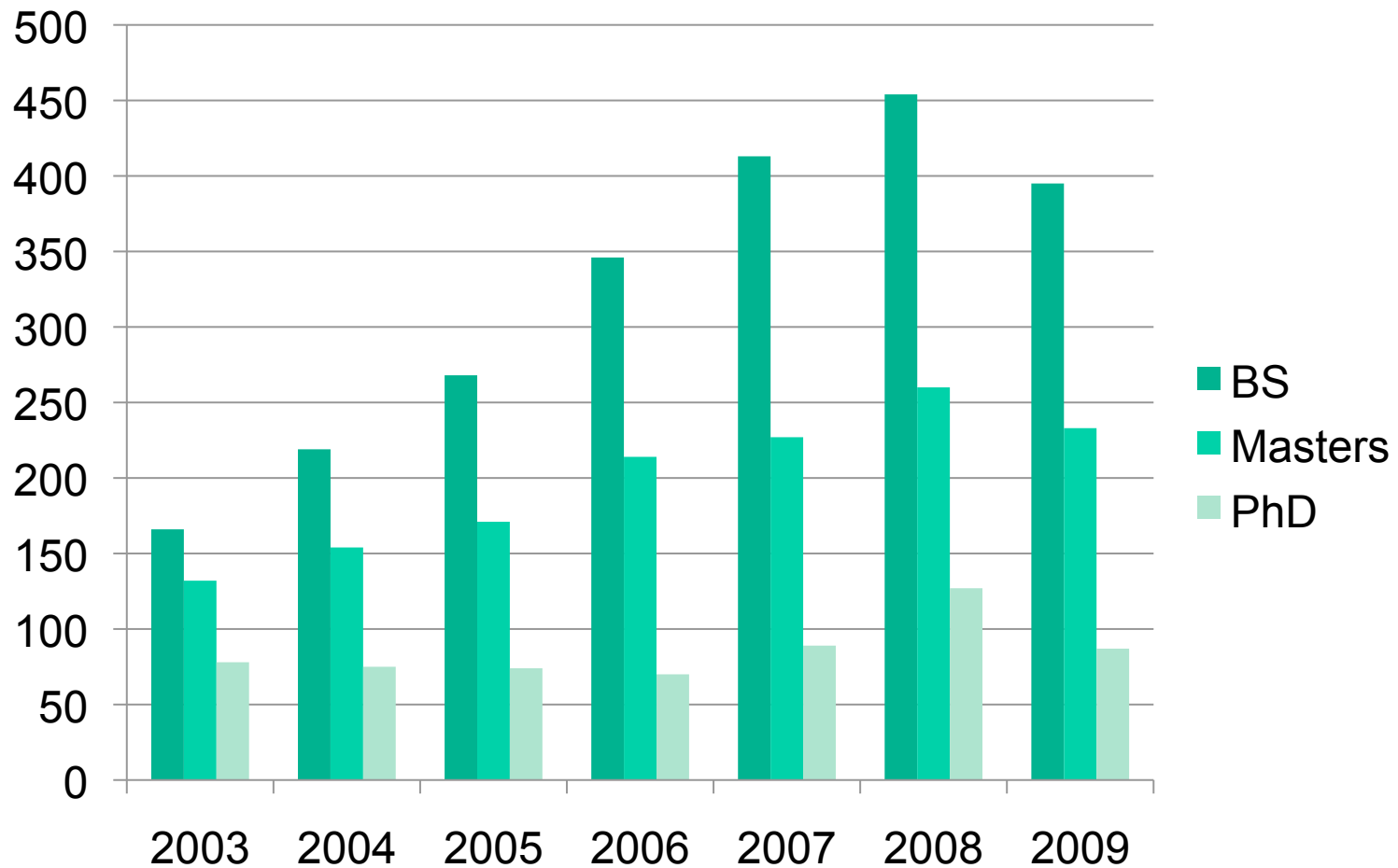
Source: US NRC

The Nuclear Renaissance is upon us...

- Increased public understanding & acceptance of nuclear energy's role
- License extensions
- Enabling new reactor construction
- Exploring advanced reactor concepts and fuel cycles
- Growing enrollments in nuclear science and engineering at universities

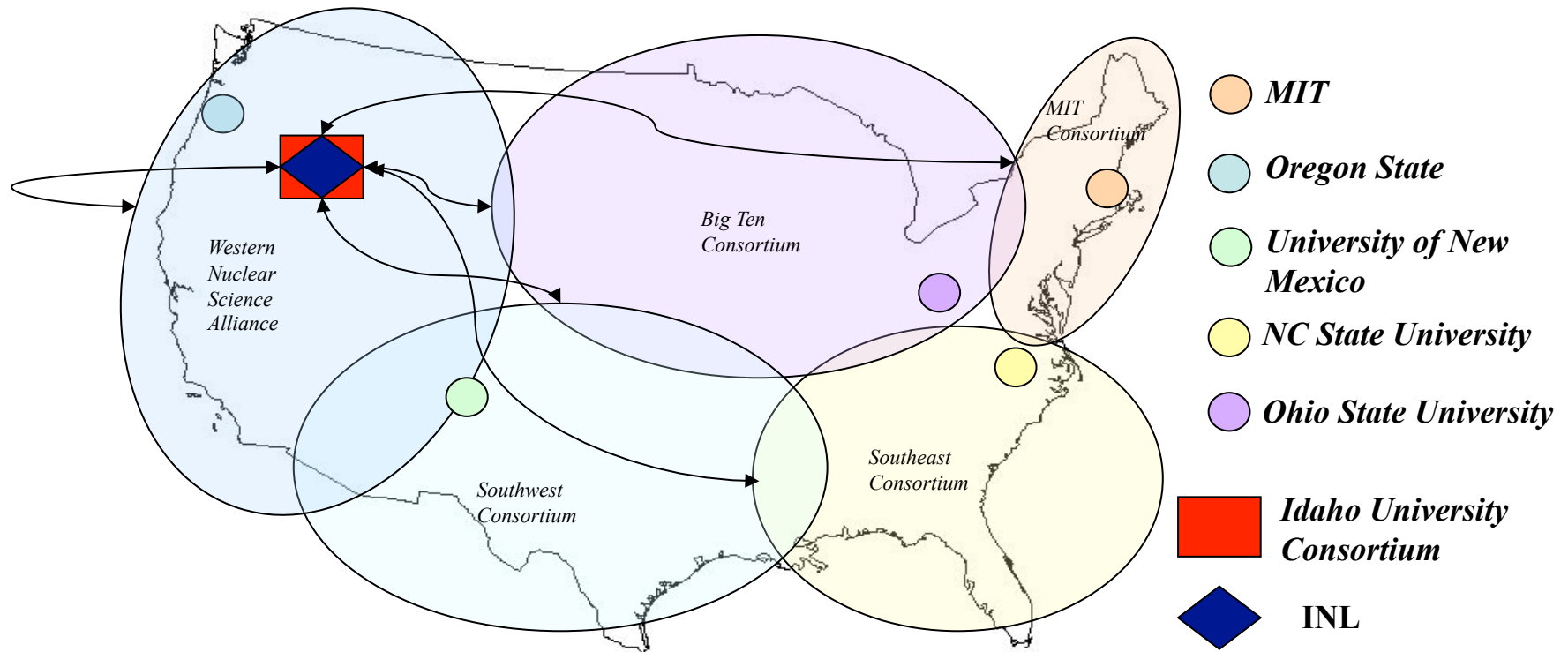


Nuclear Engineering degree trend



Hub-Node University Network

Regional focus to enable university access



Special schools to prepare nuclear engineers of the future



July 20, 2010 — July 29, 2010



Special schools, cont'd.



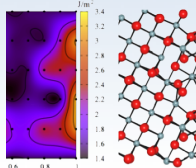
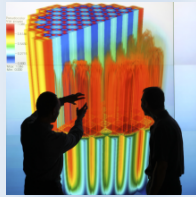
World Nuclear University Summer Institute
Oxford

Energy Innovation Hub – Modeling and Simulation for Nuclear Reactors

CASL: The Consortium for Advanced Simulation of Light Water Reactors Overview

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U.S. DEPARTMENT OF
ENERGY

**Nuclear
Energy**



CASL mission: Develop and apply the VR to address 3 critical performance goals for nuclear power

1

Reduce capital and operating costs per unit energy by:

- Power uprates
- Lifetime extension



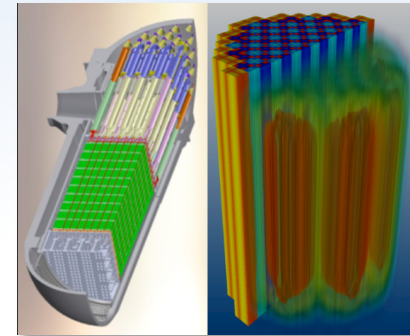
2

Reduce nuclear waste volume generated by enabling higher fuel burnups



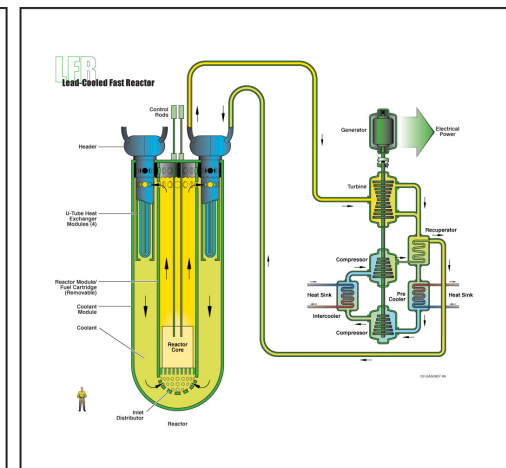
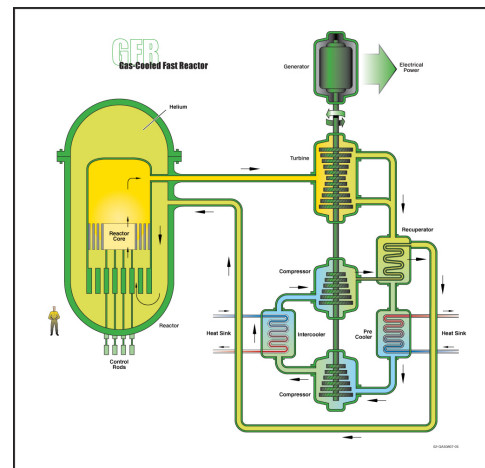
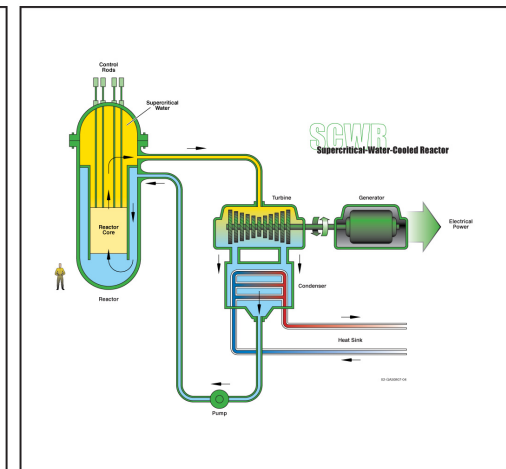
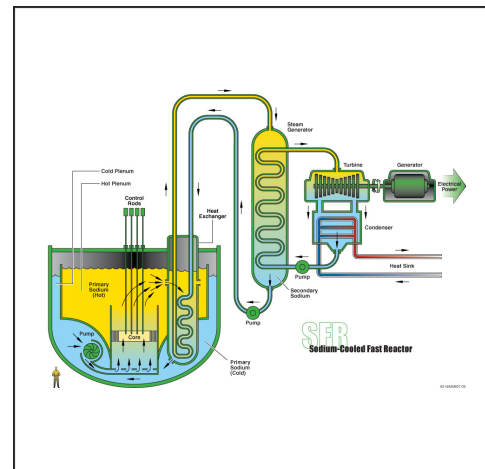
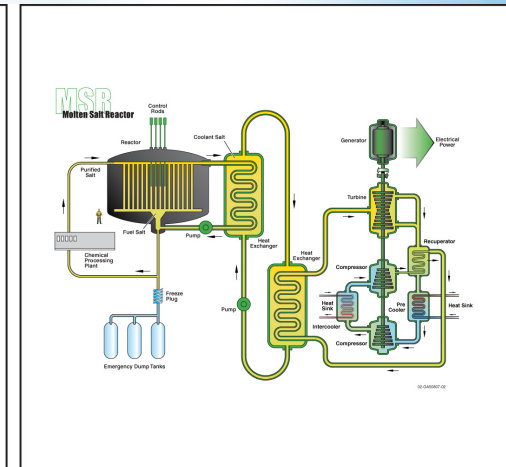
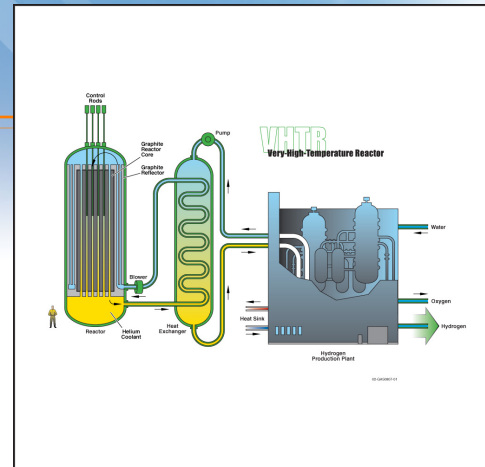
3

Enhance nuclear safety by enabling high-fidelity predictive capability for component and system performance from beginning of life through failure

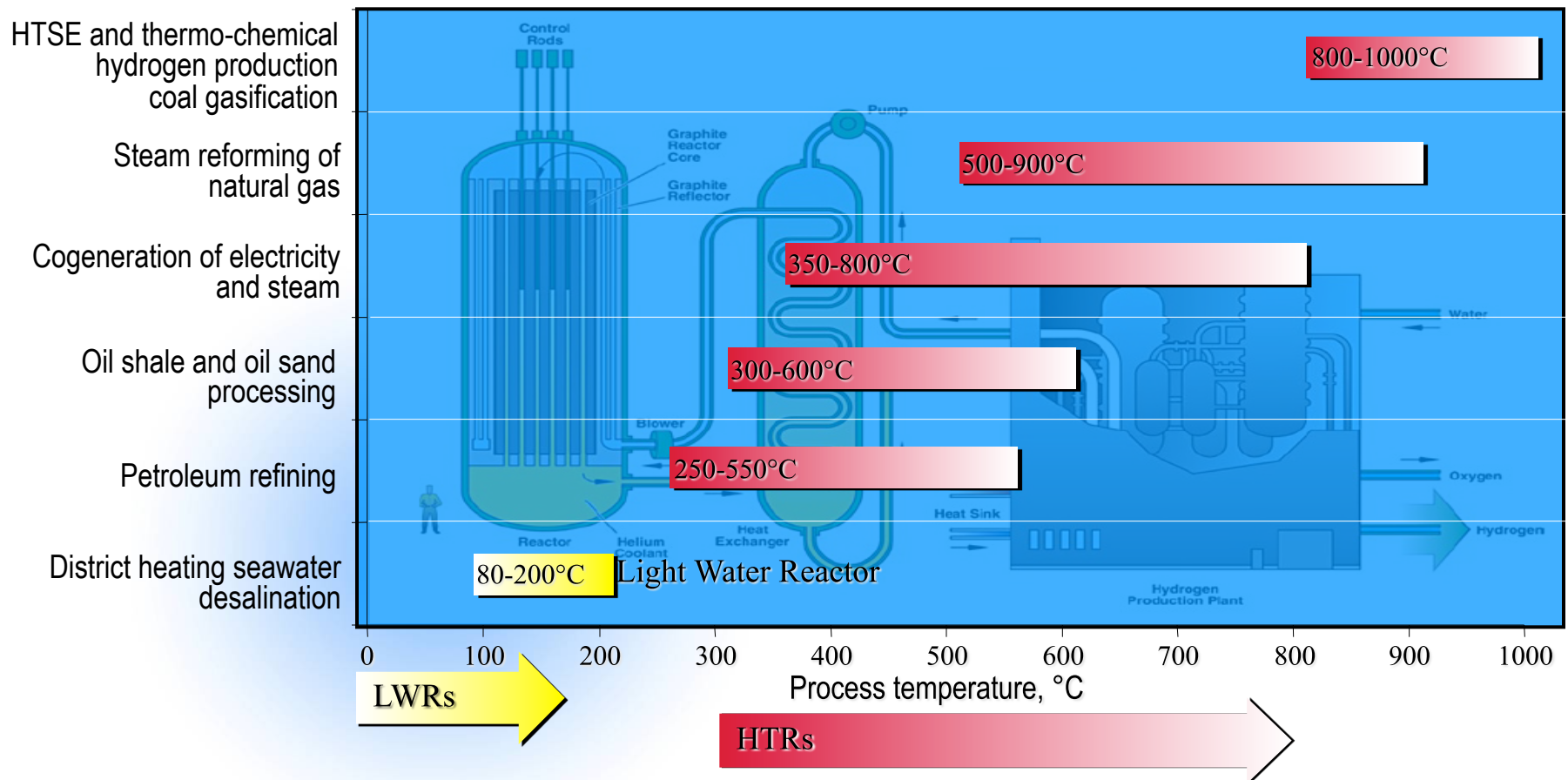


Generation-IV Challenges

High temperature
 Exotic materials
 Helium
 Liquid metals
 Supercritical water
 Supercritical CO₂
 Minor actinides
 Major actinides
 High burnup cores
 nonproliferation

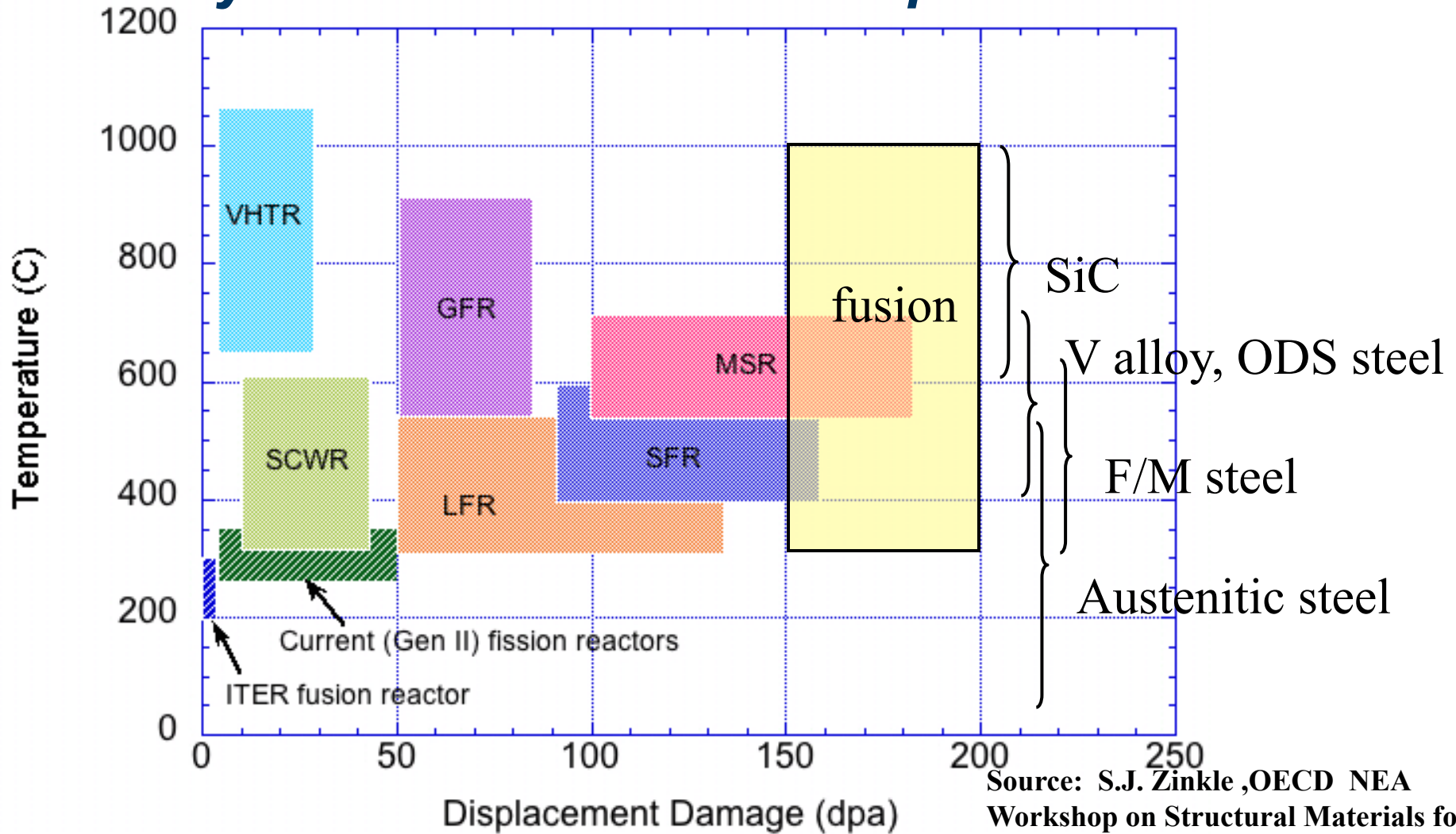


Higher temperature expands the range of applications



There is a role for existing LWRs, advanced LWRs, and small reactors...

Service environments and material choices vary widely between reactor concepts



Source: S.J. Zinkle, OECD NEA Workshop on Structural Materials for Innovative Nuclear Energy Systems, Karlsruhe, Germany, June 2007

***DOE has a new
R&D roadmap***



NUCLEAR ENERGY RESEARCH AND DEVELOPMENT ROADMAP

REPORT TO CONGRESS

April 2010

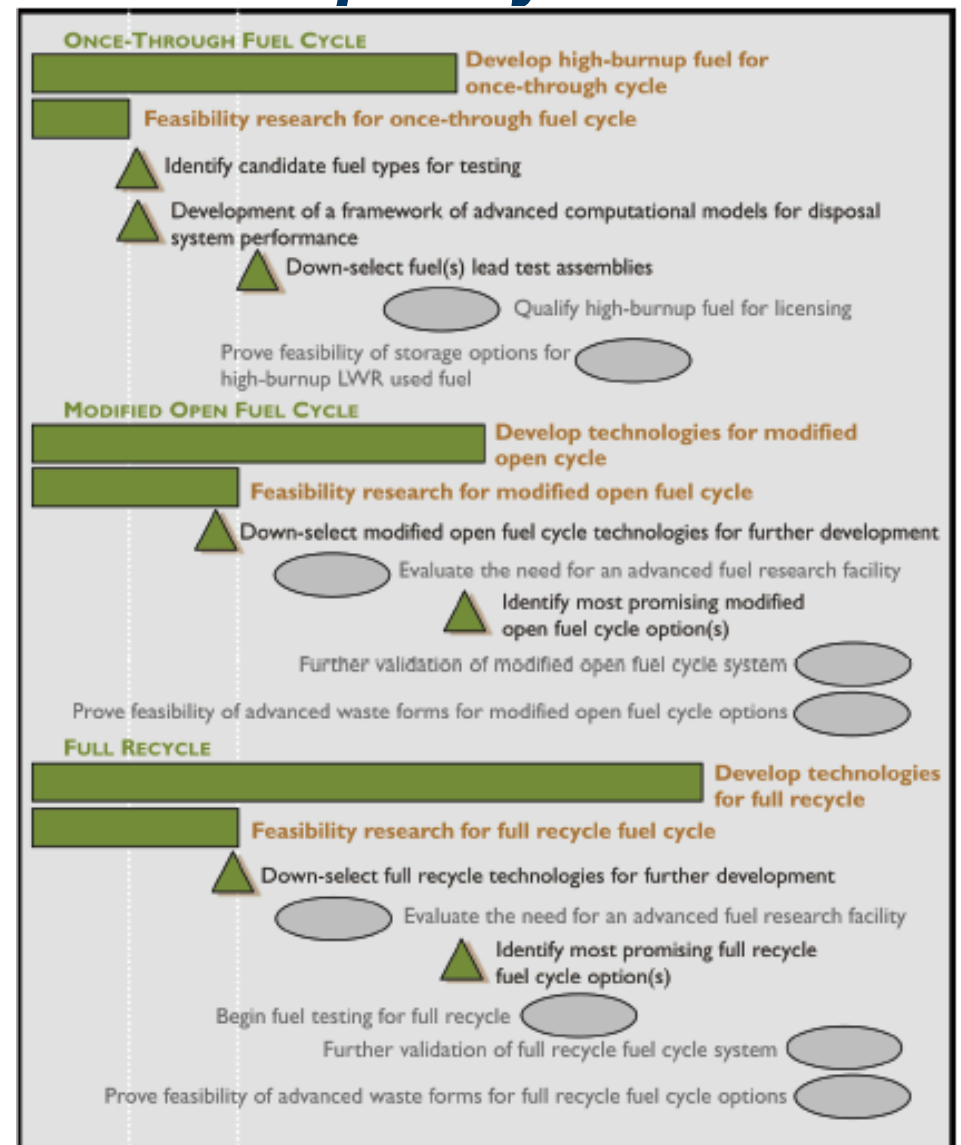


U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

Used nuclear fuel: options for US policy

- Once through cycle (throwaway)
- Modified open cycle (partial recycle)
- Full recycle (reprocessing and engineered waste forms)



Enabling solar system exploration



- Radioisotope power systems
- Nuclear rockets
- Intense scientific exploration
 - Mars Science Lab
 - Multi-kilowatt power requirements

The future of nuclear engineering?

- Applied science
- International alliances
- Large teams
- Increased reliance on high performance computing
- Energy systems integration
- *And the engineers who actually produce the energy!*