U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

Advanced Reactor Program

William D. Reckley

Fuel Cycle Information Exchange

June 30, 2010

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Background

- Pre-application interactions with potential domestic suppliers increasing
- Energy Policy Act of 2005 established Next Generation Nuclear Plant Project
- Significant global interest

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Background

- Established the Advanced Reactor Program
- One of three subprograms in NRO
  - New Reactor Licensing
  - Construction Inspection
  - Advanced Reactors
- Lead licensing project management organization for all advanced reactors

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Advanced Reactor Program

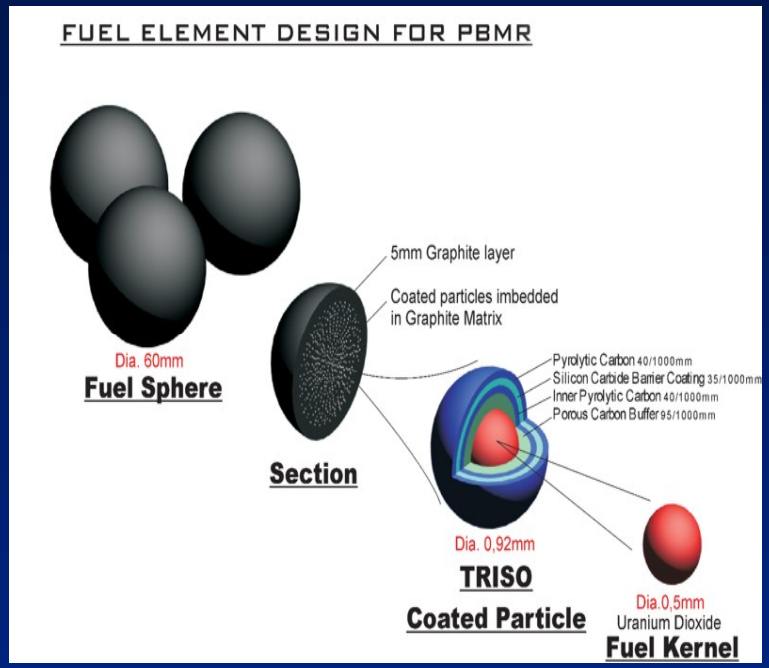
- Program addresses four technology groups
  - High Temperature Gas-Cooled Reactors (i.e., Next Generation Nuclear Plant (NGNP)
  - Integral pressurized water reactors
  - Sodium-cooled fast reactors
  - Other Designs

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

NGNP-Overview

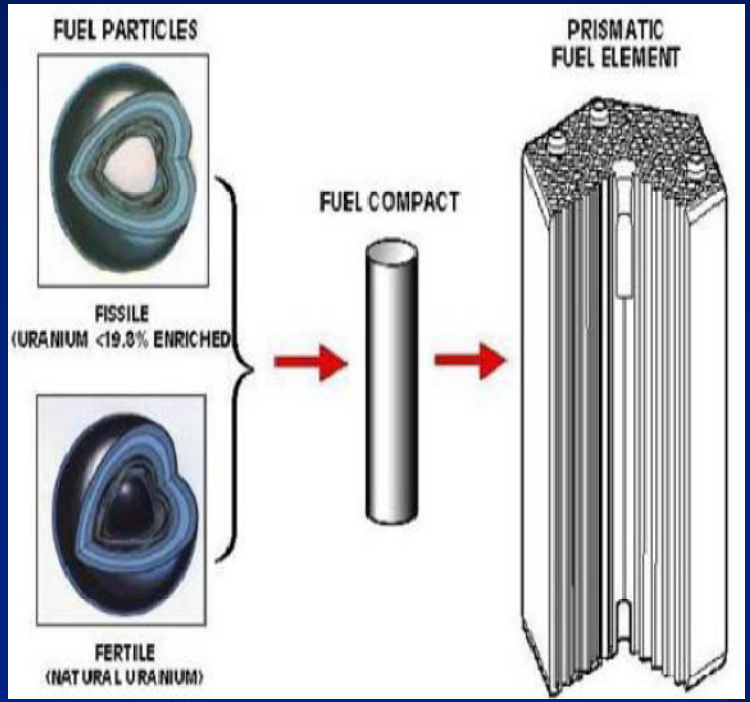
- Energy Policy Act of 2005
  - The NRC shall have licensing and regulatory authority....
  - The DOE and NRC shall jointly submit ...a licensing strategy for the prototype nuclear reactor...
    - August 2008 report states success depends on:
      - Productive use of pre-application period (now to 2013)
      - Meeting major milestones, including supporting research and code development
      - Developing supporting regulatory infrastructure
  - No later than September 2021, complete construction and begin operation...

NGNP - Technology



Prismatic

(e.g., Areva Antares & General Atomics Modular Helium Reactor (MHR)



Pebble

(e.g., Pebble Bed Modular Reactor (PBMR)

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

NGNP Reactor Designs

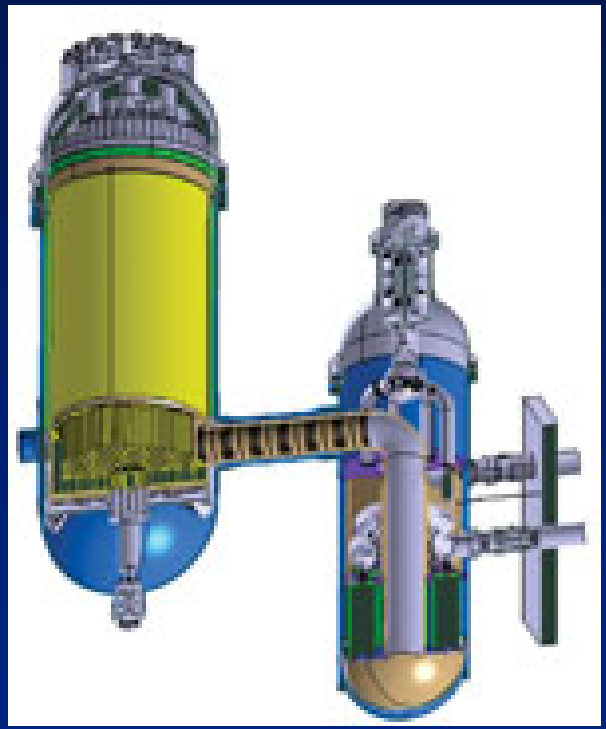
Fuel: Triso Fuel Particles

Power Level: ~ 250 MWt

Outlet Conditions: ~ 750°C

Coolant: Helium

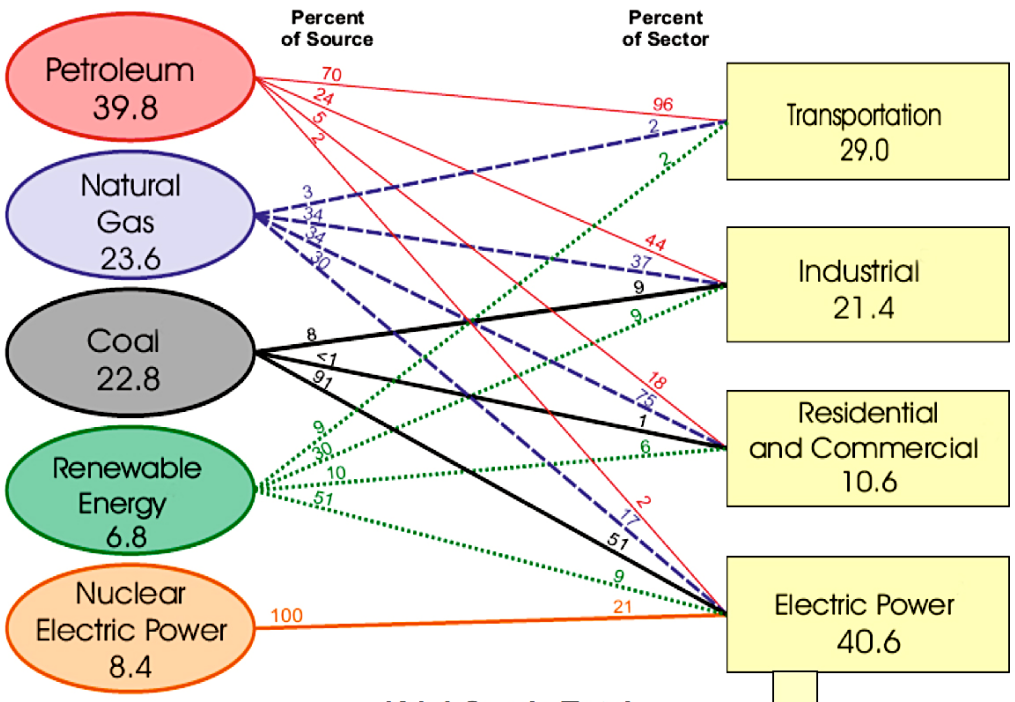
Power Cycle: Steam Turbine



Phase 1 – conceptual designs (Aug 2010)
Phase 2 - decision point – early 2011

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

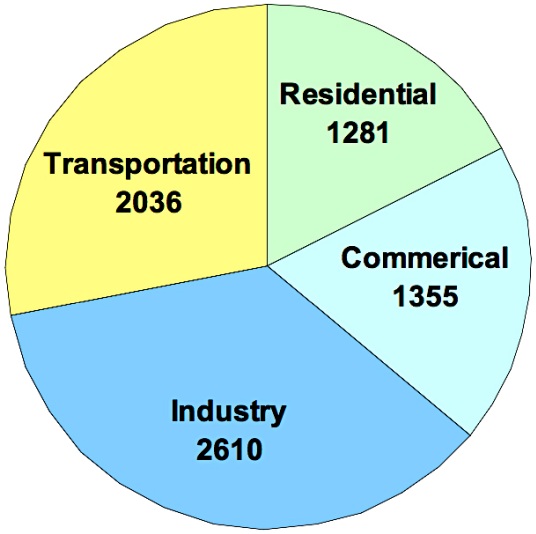
U.S. Primary Energy Consumption by Source and Sector, 2007
(Quadrillion Btu)



101.4 Quads Total

26% to Industrial
35% to Residential
39% to Commercial

U.S. Greenhouse Gas Emissions by Sector, 2007
(Million Metric Ton CO_2-equivalent)



7,282 Total

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

NGNP – Current Activities

- Evaluating existing requirements and guidance to identify needed changes (gaps)
- Identifying significant policy and key technical issues
- Developing overall licensing plan that coordinates:
  - DOE/vendor research and development
  - NRC confirmatory research & development of evaluation tools
  - Required changes to regulations, policies and guidance
  - Development of infrastructure and technical expertise for new technology

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Integral Pressurized Water Reactors

- Technology
  - Pressurized Water Reactors with nuclear steam supply components (e.g., steam generator, control rods, reactor coolant pumps) within the reactor vessel
- Current pre-application discussions regarding:
  - Westinghouse IRIS
  - NuScale
  - B&W mPower

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Westinghouse IRIS

Reactor Power: 1000 MWt

Electrical Output: 335 MWe

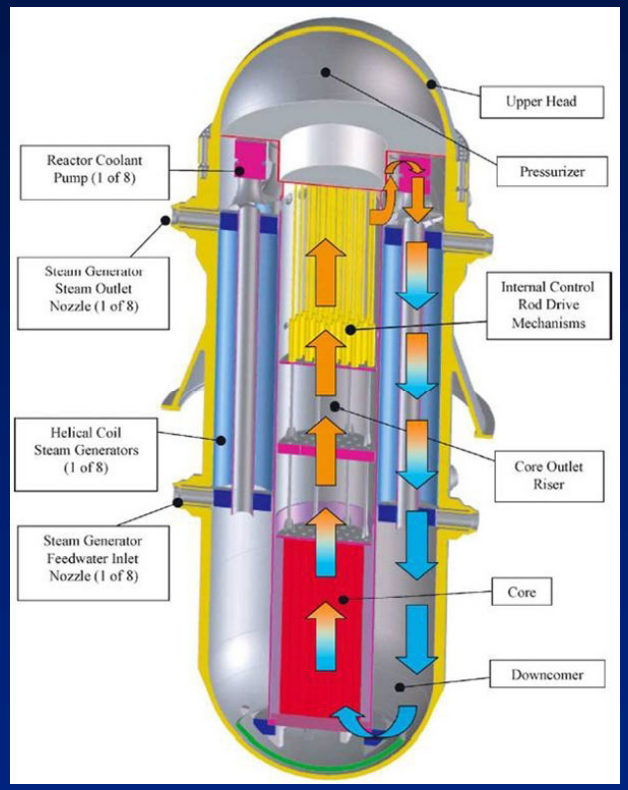
Outlet Conditions: 330°C

Coolant: Light water

Fuel Design: 17 x 17 assemblies
4.95% enrichment UO2

Refueling: 3-3.5 years

Licensing Plan: Design Certification



U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

NuScale

Reactor Power: 150 MWt

Outlet Conditions: 1500 psig, 575°F

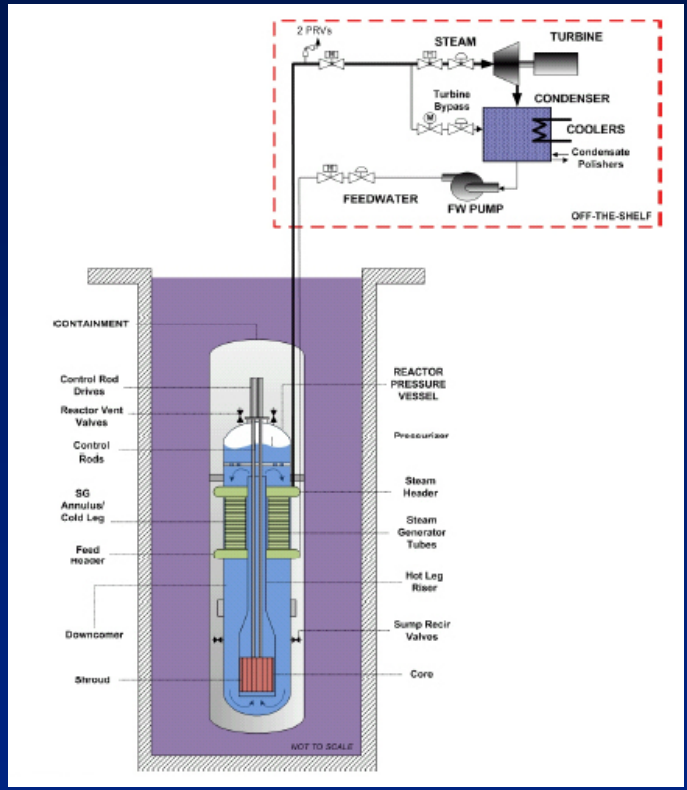
Electrical Output: 45 MWe

Coolant: Light Water

Fuel Design: 17 x 17 fuel bundles, 6', 4.95% enrichment

Refueling: 24 months

Licensing Plan: Design Certification



U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

B&W mPower

Reactor Power: 400 MWt

Electrical Output: 125 MWe

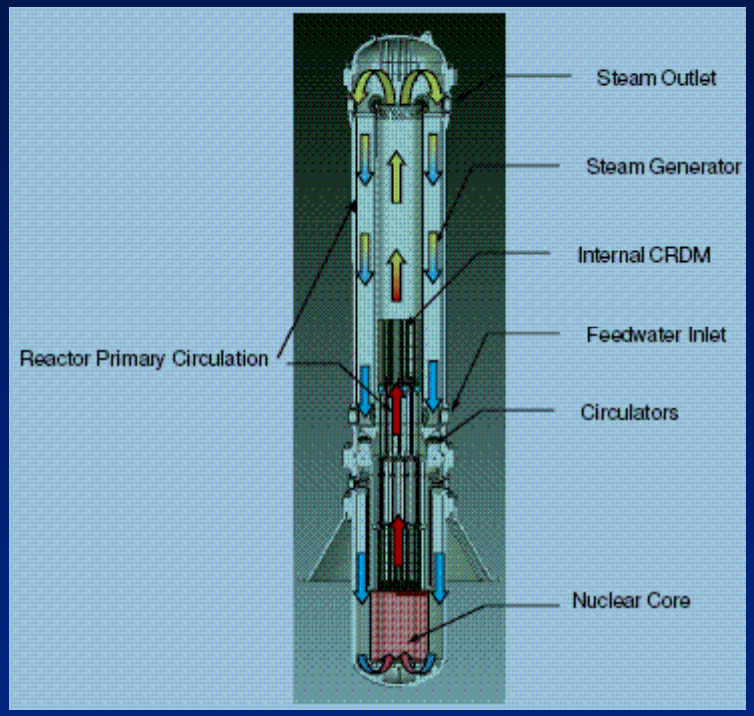
Outlet Conditions: 327°C

Coolant: Light water

Fuel Design: "Standard PWR fuel"

Refueling: 4-5 years

Licensing Plan: Design Certification



U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Integral PWRs – Current Activities

- Evaluating existing requirements and guidance to identify needed changes (gaps)
- Identifying significant policy and key technical issues
- Developing overall licensing plan that coordinates:
  - NRC confirmatory research & development of evaluation tools
  - Required changes to regulations, policies and guidance
  - Development of infrastructure and technical expertise for new technology

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Sodium Fast Reactors (SFRs)

- Limited NRC activities
- Knowledge management
- Some pre-application interactions regarding:
  - Toshiba 4S
  - General Electric PRISM
- International interactions

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Other Technology Groups

- Some interactions and/or aware of efforts related to various other designs:
- Generation IV
  - **Gas-Cooled Fast Reactor (GFR)**
  - **Very High Temp Reactor (VHTR)**
  - **Supercritical-Water Cooled Reactor (SCWR)**
  - **Sodium-Cooled Fast Reactor (SFR)**
  - **Lead-Cooled Fast Reactor (LFR)**
  - **Molten Salt Reactor (MSR)**
- Hyperion Power Module
- Accelerator-Driven System (ADS)
- Fusion & Fission-Fusion Hybrids

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Infrastructure & Generic Issues

- Infrastructure
  - Organization & Staffing
  - Contracting Strategy
  - Training, Tools & Guidance
- Generic Issues
  - Address generic issues identified by NRC, industry, or other stakeholders
    - Generic to SMRs
    - Generic to a technology group or other subset of SMR technologies

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Policy and Technical Issues

- Generic issues
  - Emergency Planning
  - Physical Security
  - Staffing requirements
  - Financial requirements (e.g., fees, Price-Anderson)
  - Modular/expandable facilities
- Technology specific
  - Fuel qualification
  - Materials qualification