



Office of Nuclear Energy

# ***Nuclear Regulatory Commission Public Meeting on New Reactor Issues***

**Dennis Spurgeon, Assistant Secretary  
for Nuclear Energy**  
April 27, 2006





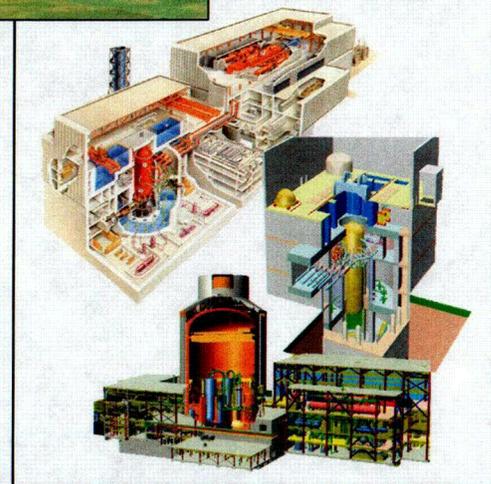
## Presentation Topics

- ◆ **Introduction**
- ◆ **Vision of the Office of Nuclear Energy**
- ◆ **Program Goals**
  - NP2010
  - EPA Act 2005 Incentives for Nuclear Power
  - Generation IV
  - Nuclear Hydrogen Initiative
  - GNEP Update
  - University Nuclear Science and Engineering Support



## Nuclear Power 2010 ... *Program Scope and Goal*

- ◆ Exploring sites for new nuclear plants
- ◆ Demonstrating key regulatory processes
  - Early Site Permit (ESP)
  - Combined Construction and Operating License (COL)
- ◆ Developing new light water reactor designs
  - Design Certification for new reactors
  - First-of-a-kind engineering for new standardized nuclear plant designs
- ◆ Developing concepts to mitigate financial risks

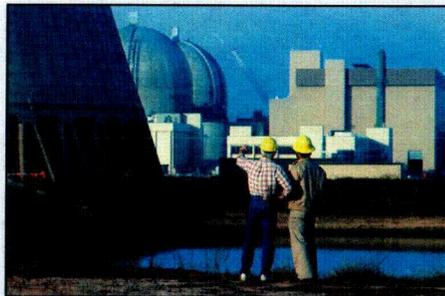


**Program Goal** *Pave the way for industry decisions to build new advanced light water reactor nuclear plants in the United States that will begin operation early in the next decade.*



## Nuclear Power 2010 ... *Early Site Permit Demonstration Projects*

- ◆ **Dominion's North Anna site**
  - Schedule change - ESP supplement submitted for closed cooling water system
- ◆ **Entergy's Grand Gulf site**
- ◆ **Exelon's Clinton site**



<b>Milestone</b>	<b>Dominion</b>	<b>Entergy</b>	<b>Exelon</b>
Early Site permit application submitted to NRC	9/25/2003	10/21/2003	9/25/2003
Draft safety evaluation report (SER) issued	12/20/2004	4/7/2005	2/10/2005
Public meeting to discuss draft EIS	2/17/2005*	6/14/2005	4/19/2005
Final SER issued	6/16/2005*	10/21/2005	2/17/2006
ACRS full committee meeting on final SER	7/6/2005*	12/8/2005	3/9/2006
Final EIS issued to EPA/Issue Notice of Availability	TBD	4/2006	7/28/2006(T)
Atomic Safety and Licensing Board decision	TBD	9/2006(T)	1/2007(T)
Commission decision	TBD	1/2007 (T)	5/2007(T)

T – tentative date \* -- Needs to be reissued due to supplement



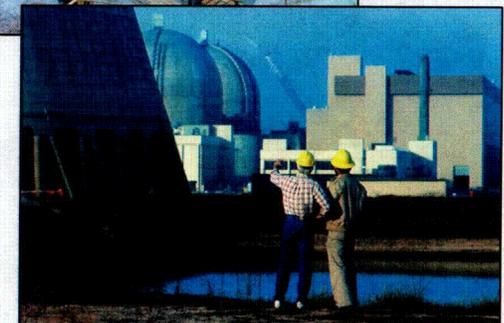
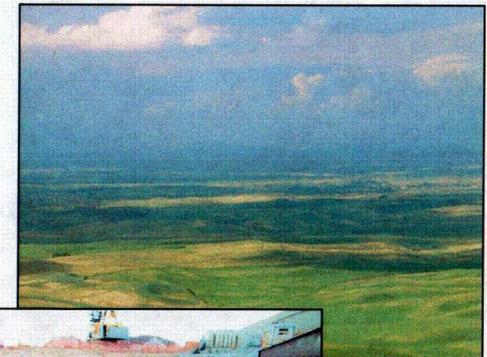
## **Nuclear Power 2010 ... *New Plant Licensing Demonstration Projects***

### **◆ Dominion Energy - COL for ESBWR at North Anna Site**

- COL Application preparation and NRC review
- ESBWR design certification and first-of-a-kind engineering for standard plant design
- Site deployment planning: financial, legal, and risk assessment

### **◆ NuStart Energy LLC - COL for single site/technology yet to be selected**

- Design certification and COL Application development for two reactor technologies: AP1000 (Bellefonte site) or ESBWR (Grand Gulf site)
- Funding for one COL and completion of standard plant design for selected reactor technology





## **Nuclear Power 2010 ... *New Plant Licensing Demonstration Project Milestones***

### **◆ Dominion**

- ESBWR Design Certification application to NRC: September 2005
- COL application preparation and submittal to NRC: September 2007
- ESBWR Design Certification: As late as January 2010
- Approved COL issued by NRC: April 2010 (estimated)

### **◆ NuStart**

- AP1000 Certified: December 2005
- AP1000 and ESBWR COL application preparation: October 2006 – February 2008
- ESBWR Design Certification: As late as January 2010
- COL application to NRC: October 2007 (AP1000) or February 2008 (ESBWR)
- COL issued by NRC: AP1000 - July 2010 or ESBWR - November 2010 (estimated)



## **Nuclear Power 2010 ... *Generic COL Guidance and Issues Project***

- ◆ **Cost-shared Cooperative Agreement with Electric Power Research Institute (EPRI) / Nuclear Energy Institute (NEI)**
  - Identify and resolve generic combined COL technical and regulatory issues
  - Develop industry guidance on format and content of COL application
  - Work with NRC to establish Inspection, Tests, Analyses, and Acceptance Criteria (ITAAC) implementation methodology
- ◆ **Key Accomplishments to Date**
  - NEI 04-01, “Industry Guideline for Combined License Applicants”
  - Completion of ITAAC Demonstration Project with NRC – sample of how ITAAC on system and building could be scheduled and satisfied
- ◆ **Remaining Activities**
  - Resolving Seismic Issues
    - Extensive interaction with NRC
    - New ground motion and structural models
  - Industry input to Part 52 revision and COLA Regulatory Guide



## Latest Industry Outlook ... *New Plant Licensing*

- ◆ Three industry teams currently are pursuing new nuclear plant deployment:
  - Dominion – North Anna
  - NuStart – Bellefonte and Grand Gulf
  - UniStar (Constellation, AREVA, Bechtel Power) – Calvert Cliffs or Nine Mile Point
- ◆ Eight U.S. power companies have announced intentions to apply for COLs (Dominion, Entergy, Southern Company, Progress Energy, South Carolina Electric & Gas, Duke Power, Constellation and FP&L).
- ◆ Industry has issued 12 “Letters of Intent” to apply for COLs for a total of 17 new plants.
- ◆ Earliest construction date after COLs are granted is late 2010.
- ◆ Earliest completion date of first plant would be late 2014.



## **Actions to Accelerate Licensing New Nuclear Plants**

COL Project Restructuring – Supports NRC's Design-Centered Review approach

- ◆ Separate current COL projects into four individual cooperative agreements.
  - Two COL demonstration projects with NuStart and Dominion
  - Two reactor technology development projects with Westinghouse and General Electric
- ◆ Focus power companies on activities on COL application preparation and NRC review.
  - Fund NRC review and approval of one reference ESBWR and one AP 1000 reference COL application
- ◆ Focus reactor vendor activities on completion of standardized nuclear plant designs.
  - ESBWR design certification
  - Accelerated closure of AP1000 COL action items
  - Completion of standardized plant design for both AP1000 and ESBWR



## Energy Policy Act of 2005 (EPAAct)

- ◆ **Provides 3 key incentives for construction and operation of new advanced nuclear power plants**
  - Section 638, “Standby Support” – Energy (Part of NP 2010)
  - Section 1306, “Production Credits” – Treasury
  - Section 1703, “Loan Guarantees” – Energy
  - Designed to reduce regulatory and financial uncertainties for “first movers”



## EPAct, Section 638, “Standby Support”

- ◆ **Risk Insurance to cover delays for first six reactors constructed:**
  - Failure of NRC to complete review and approvals on schedule
  - Litigation that delays start of full-power operation
  - Up to three different advance reactors (certified after 12/31/1993)
  
- ◆ **Risk insurance provisions:**
  - 100% of delay costs for first two new plants (not more than \$500 million each)
  - 50% (not more than \$250 million each) for third through sixth plant after initial 180 day period of delay
  
- ◆ **Rulemaking:**
  - Issued Notice of Inquiry – November 2005
  - Held public workshop and received comments – December 2005
  - Publish Interim Final Rule – May 6, 2006
  - Publish Final Rule – August 8, 2006



## **EPAct, Section 1306, “Production Credit” (Section 45J of IRS code)**

- ◆ Treasury lead
  - DOE-NE supporting Treasury in developing process for allocation and approval of production credits
- ◆ Covers advanced nuclear facility placed in service before January 1, 2021
- ◆ Limited to a maximum of \$125 million per 1000 megawatts per year for 8 years (1.8 cents per kilowatt-hour)
- ◆ National megawatt limitation of 6,000 megawatts
- ◆ Treasury to publish IRS bulletin final notice on production tax credit with guidelines for allocation and approval process by May 1, 2006



## EPAct Provisions, “Loan Guarantees”

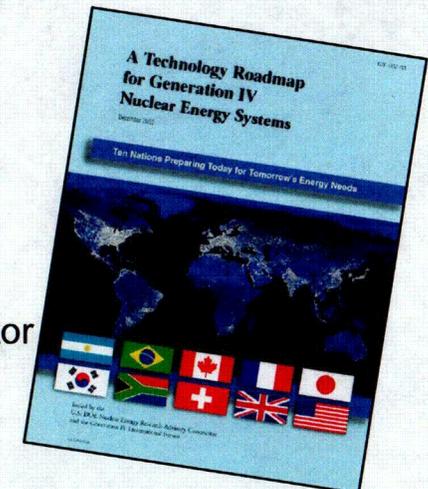
- ◆ Loan guarantees for non-polluting energy technologies (Section 1703)
  - Principal and interest
  - Up to 80% of cost for new nuclear facilities
  - Term shall not exceed 30 years or 90 percent of projected useful life
  - NE providing technical support



## Generation IV Initiative – Mission

- ◆ **International initiative under DOE leadership**
  - DOE and other countries to plan next-generation nuclear technology R&D collectively.
  - Governed by Gen IV International Forum (GIF)
- ◆ **Vision**
  - Develop advanced nuclear technologies for deployment by 2030 in collaboration with GIF partners
- ◆ **Forward-looking technology goals established**
  - Economics, safety, waste/sustainability, proliferation resistance and physical protection
- ◆ **Gen IV Roadmap**
  - Identified fuel cycles and reactors to advance goals and serve future energy markets
- ◆ **GIF selected 6 concepts as most-promising**

GFR -- Gas-cooled fast reactor	LFR -- Lead-cooled fast reactor
VHTR -- Very high temperature reactor	SFR -- Sodium-cooled fast reactor
SCWR -- Supercritical water-cooled reactor	MSR -- Molten salt reactor
- ◆ **U.S. now focused on Very-High-Temperature Reactor (VHTR) and Sodium Fact Reactor (SFR)**





## Generation IV International Forum – U.S. Participation



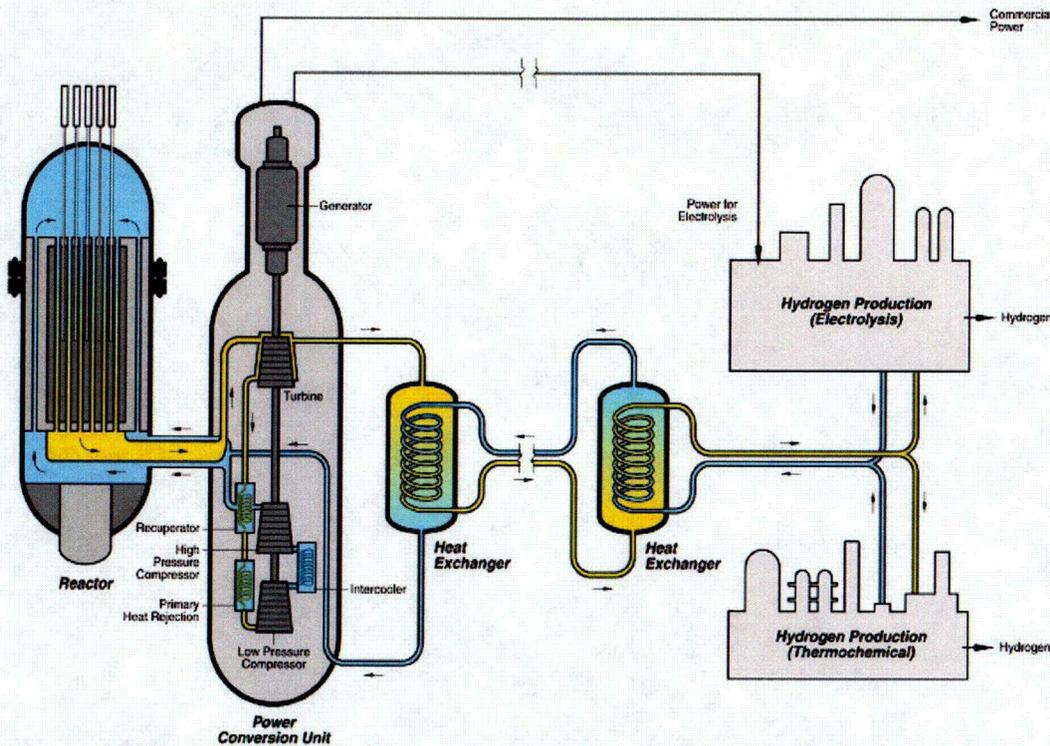
### ◆ U.S. Gen IV program deeply engaged in international collaboration activities

- Bilateral projects with Brazil, Canada, Euratom, France, Japan, Korea (I-NERI)
- GIF R&D planning activities:
  - System Research Plans
  - Project Plans
- GIF Evaluation Working Groups (Proliferation Resistance & Physical Protection, Economics, Safety)

Jul '01	GIF Charter
Feb '05	<u>GIF Framework Agreement</u>
	<u>GIF System Arrangement</u> System Steering Committee System Research Plan
Feb '06 Next:	SFR System Arrangement VHTR System Arrangement
	<u>GIF Project Arrangement</u> Project Management Board Project Plan
Ongoing:	SFR Advanced Fuels VHTR Materials and Components VHTR Hydrogen Production



# VHTR R&D elements



NGNP

**NGNP deployment target -  
2021**

## Design and Licensing

- Point design
- Trade-Off Studies
- Licensing Strategy

## Computational Methods

- Code validation
- Data base for validation

## Fuel and Fuel Cycle

- Fuel fabrication
- Fuel performance

## Materials & Components

- HT Materials development
- Component development
- Design methodology

## Hydrogen Production

- Electro-Chemical processes
- Coupling technology

## Helium Turbine and BOP



## NGNP Licensing Strategy

- ◆ **EPA Act Title VI, Subtitle C - *Next Generation Nuclear Plant Project*, Section 644 requires:**
  - DOE and NRC to develop jointly and submit to Congress a Licensing Strategy for prototype NGNP within 3 years
  - DOE to seek active participation of NRC in NGNP development
- ◆ **NRC-DOE Memorandum of Understanding in development by NRC**
- ◆ **NGNP technology not fixed until 2011 - Licensing Strategy must be flexible**
- ◆ **DOE to provide funding and laboratory support via Idaho National Laboratory**
- ◆ **Strategy due to Congress on August 8, 2008**



# Nuclear Hydrogen Initiative

## ◆ Objective

- Develop hydrogen production technologies compatible with nuclear energy systems and do not produce greenhouse gases (thermochemical and high-temperature electrolysis)

## ◆ Major Program Milestones

- FY 2007: Complete construction of integrated laboratory-scale hydrogen production experiments
- FY 2011: Complete design and construction of pilot-scale hydrogen production experiments and commence testing
- FY 2019: Demonstrate commercial-scale hydrogen production system for use with nuclear reactors

## ◆ Recent Major Accomplishment

- February 2006: Completed 1000-hour production run of >100 liters per hour of hydrogen using laboratory-scale high-temperature electrolysis equipment



## **Global Nuclear Energy Partnership (GNEP) Update**

- ◆ **Since GNEP was announced on February 6, 2006, by Secretary Bodman with the FY 2007 budget request rollout, the following activities have been initiated:**
  - On March 17, DOE issued a request for Expressions of Interest with regard to siting integrated spent fuel recycling facilities for GNEP technology demonstrations. 43 responses were received and are currently under review.
  - On March 22, an Advanced Notice of Intent was issued for GNEP Technology Demonstration Program covering three planned demonstration projects – UREX+ Engineering Scale Demonstration (ESD), Advanced Burner Test Reactor (ABTR), and Advanced Fuel Cycle Facility (AFCF).
  - On March 28, Deputy Secretary Sell was presented with justification for mission need for three GNEP projects and approved initiation of conceptual design activities for the projects.
- ◆ **DOE intends to issue a solicitation this year for detailed site proposals for integrated spent fuel recycling facilities. Up to \$20 million in awards, each no more than \$5 million, will be made.**



## University Infrastructure, Research, and Education Assistance

### ◆ University Programs

- Fuel for university research reactors, reactor improvements, and reactor sharing
- Student fellowships and scholarships in nuclear engineering and health physics
- Matching grant program with industry
- Nuclear and radiochemistry research
- Outreach to students and teachers; minority institution support

### ◆ Nuclear Energy Research Initiative (NERI)

- As of 2006, 36 universities are involved in over 70 NERI projects (over \$24M)
- 24 new university research awards in FY 2006 to 17 universities (\$10M)
  - 13 - Advance Fuel Cycle Initiative
  - 6 - Generation for IV
  - 5 - Nuclear Hydrogen Initiative

### ◆ Advanced Fuel Cycle Initiative (AFCI)

- 33 Fellowships at 18 universities since 2002 (\$600k)
- UNLV Transmutation Research Program (\$3M)
  - 23 faculty-student projects involving 42 graduate students