

# Fuel Cycle Strategies and National P&T Programs

## U.S. Advanced Fuel Cycle Strategy



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# Abstract

- The current state of Fuel Cycle Strategies and National Programs for the United States at the moment cannot be separated from the emerging U.S. Global Nuclear Energy Partnership program.
- As part of President Bush's Advanced Energy Initiative, Secretary of Energy Samuel W. Bodman announced on February 6, 2006 a \$250 million Fiscal Year (FY) 2007 request to launch a Global Nuclear Energy Partnership (GNEP). This new initiative is a comprehensive strategy to enable the expansion of emissions-free nuclear energy worldwide by demonstrating and deploying new proliferation resistant technologies to recycle nuclear fuel, minimize waste, and improve our ability to keep nuclear technologies and materials out of the hands of terrorists.
- The Global Nuclear Energy Partnership has four main goals. (1) reduce America's dependence on foreign sources of fossil fuels and encourage economic growth. (2) recycle nuclear fuel using new proliferation-resistant technologies to recover more energy and reduce waste, (3) encourage prosperity growth and clean development around the world. And (4) utilize the latest technologies to reduce the risk of nuclear proliferation worldwide.

# Abstract (continued)

- One near-term effort to implement GNEP is a Technology Demonstration Program. The GNEP Technology Demonstration Program is based on a five-year technology plan, which is currently being developed in consultation with scientists from DOE's national labs. This detailed roadmap for GNEP technology development and demonstration process is focused on technologies that will:
  - Separate the high-energy elements of spent nuclear fuel that can be recycled.
  - Develop "fast burner" reactors that can convert these high-energy elements into electricity and shorter-lived isotopes, dramatically reducing the volume, heat load, and toxicity of the waste.
  - Integrate modern nuclear materials management concepts into each step of the fuel cycle to increase safeguards confidence.
  - Close the nuclear fuel cycle through research and technologies for recycling fuel and fabricating fuel suitable for recycling.
  - A parallel effort under consideration is how to involve industry, both national and international, in partnership with the Technology Demonstration effort. Toward this end we have sought this year expressions of interest from industry on participating in our program and hope soon to pursue requests for proposals.
  - In summary, it should be obvious that pursuit of fuel cycle strategies and programs in the U.S. cannot be separated from the emerging GNEP program. We look forward to pursuing GNEP as an international effort which can not only further nuclear power development as a safe, economic, environmentally friendly, and proliferation resistant resource in the United States, but also worldwide.

# GNEP Benefits

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- Reduce America's dependence on fossil fuels
- Provide abundant energy without generating carbon emissions or greenhouse gases
- Recycle used nuclear fuel to minimize waste and curtail proliferation concerns
- Safely and securely allow developing nations to deploy nuclear power to meet energy needs
- Assure maximum energy recovery from still-valuable used nuclear fuel
- Reduce the number of required U.S. geologic waste repositories to one for the remainder of this century

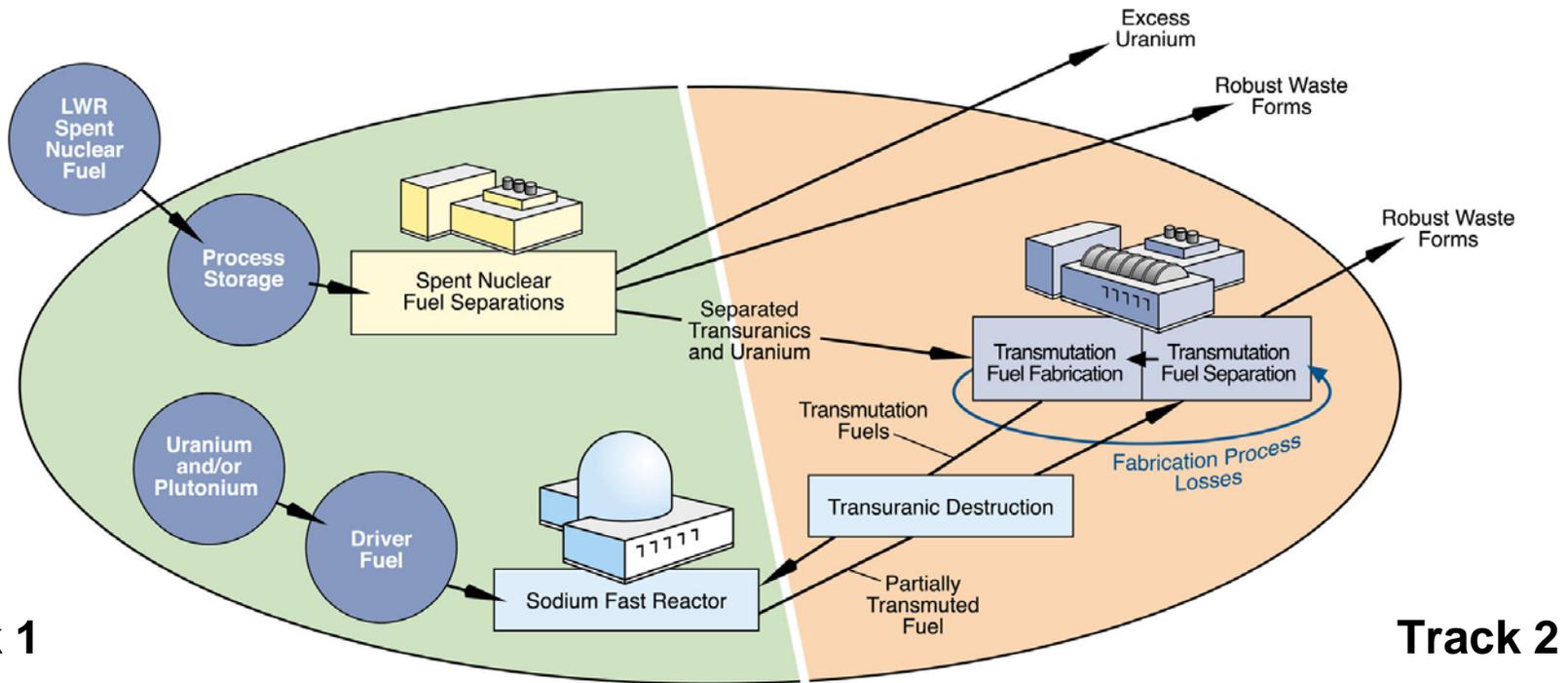


# Key U.S. Fuel Cycle Related Program Elements

- Expand nuclear power (NP2010)
- Manage & minimize spent fuel (Yucca Mountain)
- Demonstrate advanced recycle technology (no separated Pu)
- Demonstrate Advanced Burner Reactors (Sodium FR)
- Establish reliable fuel services (Leasing, Backup)
- Demonstrate small, exportable reactors (Robust, Secure)
- Enhance nuclear safeguards technology (Advanced Design )



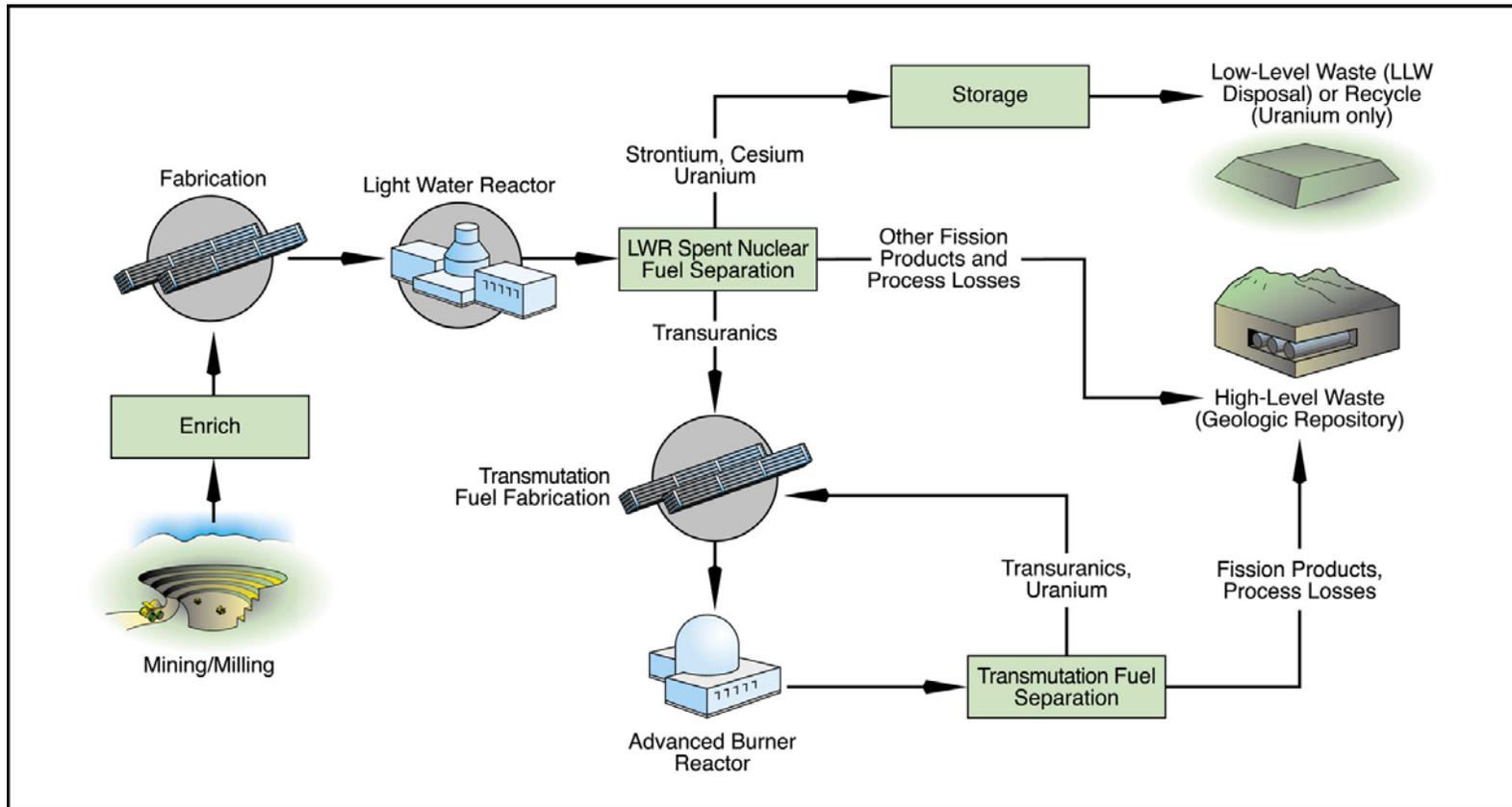
# GNEP Fuel Cycle Concept – U.S. Dual Tracks



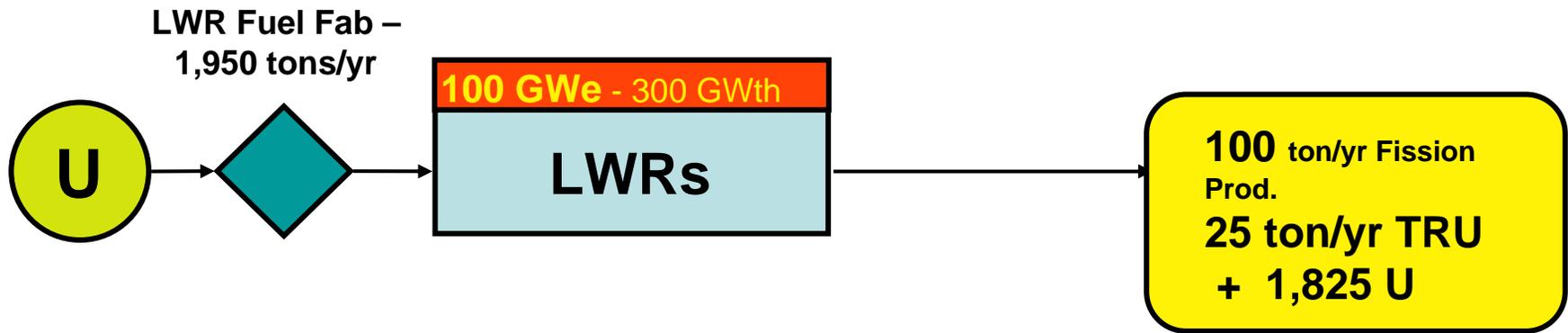
- Enlist industry to build commercial scale to United States Government specs
- SNF would be processed into acceptable disposable waste forms and transuranics/lanthanides
- Transuranics/Lanthanides would be stored for future conversion into fast reactor fuel

- Enlist foreign partners on R&D to resolve key uncertainties
- Transuranics/Lanthanides could be vitrified in unlikely case Track 2 proves too difficult
- Host site not at risk of becoming de facto repository

# US Technology: Recycle & Fast Reactors



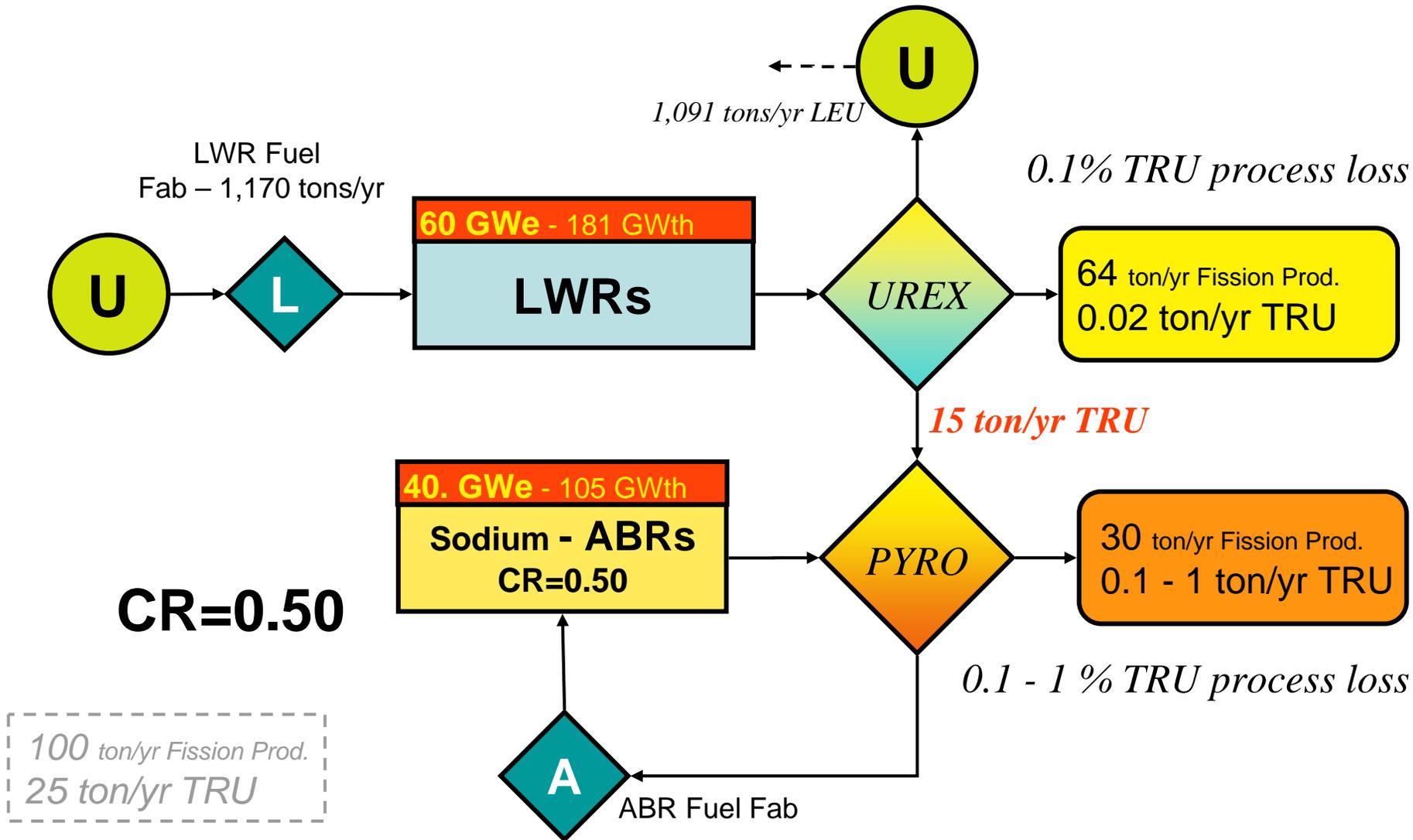
# 100 GW(e) LWR once-through option - U.S. Base Case



*33% efficient power conversion*  
*50,000 MWD/MT*

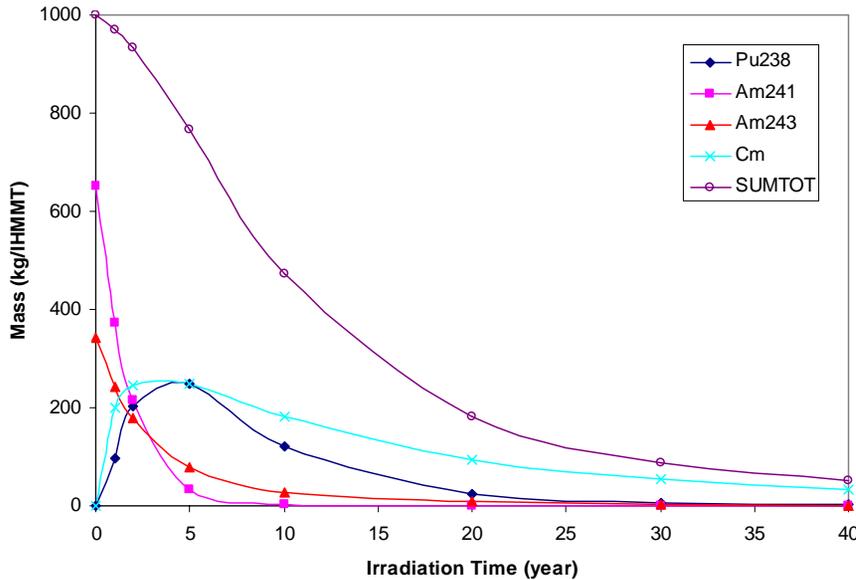
# Equilibrium Example: ABRs for a 100 Gw(e) System

## Bottom Line – SENDS MUCH LESS TRU to Repository

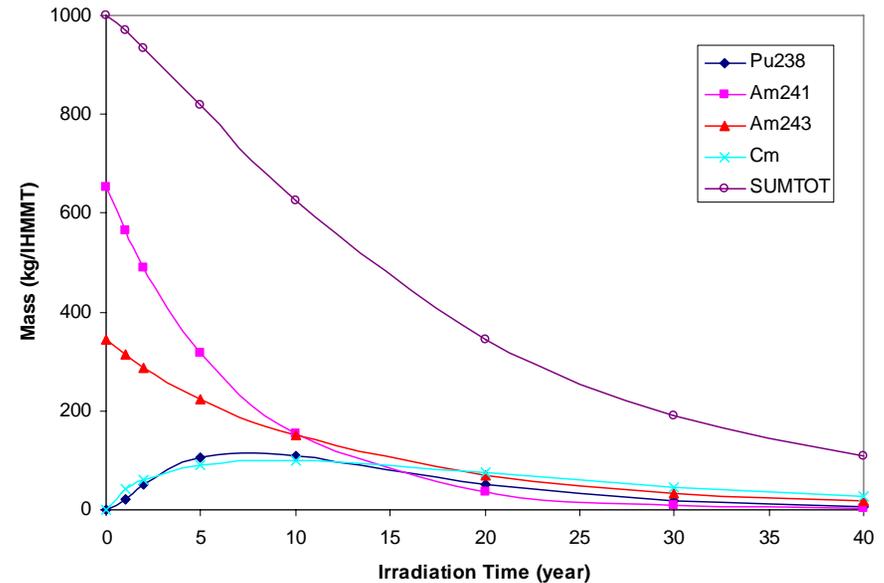


# Am Target Behavior in Fast and Thermal Systems

Am Target in Thermal System



Am Target in Fast System



- Am transmuted more quickly in a thermal spectrum
- For either system, multi-recycle will be required
- A thermal region in a fast reactor may combine benefits of both systems

# Technology Approach Under Consideration for U.S.

- **Build on proven capabilities of fuel cycle nations in lieu of engineering demos**
  - Use international experience with existing and previous facilities that have been constructed and operated
  - Use U.S. technological base enhanced by international collaborative applied research and technology development
- **Operate advanced recycling and reactor prototype in the U.S. as early as possible**
  - Early industrial emphasis to build commercial prototypes of separations and fast reactor facilities

# Domestic Actions

- **Engage domestic and international industry & potential hosting sites**
  - Request for Expressions Of Interest issued August 7, 2006; Responses received September 8, 2006
    - Industry Information Meeting took place August 14, 2006
    - Consolidated Recycle Treatment Facility
    - Advanced Burner Reactor
  - Evaluate responses to determine path forward
- **Detailed Siting Studies**
  - Financial Assistance Funding Opportunity Announcement released August 3, 2006
  - Applications received September 7, 2006 and anticipate issuing awards later in the year
  - Announcement includes potential for hosting commercial-scale operations
- **National Environmental Protection Act (NEPA) process to be completed during Summer 2008**
  - Coverage for all aspects of GNEP
- **June 2008 Secretarial decision**

# International Actions

- Pursue Development of international high-level GNEP strategy
  - Analyze individual national strategic plans
  - Analyze potential for international fuel leasing regime
- Use existing agreements for near-term cooperation
  - Efforts currently ongoing via GIF, AFCI, and I-NERI
- Develop specific R&D tasks to be accomplished with specific nations over the near-future
- Address country-specific opportunities/challenges to partnership

# Summary

- **GNEP vision appears vibrant with significant interest**
  - Making progress in addressing challenges
- **Propose adapting GNEP technology acquisition**
  - Industrial emphasis to commercial scale, Track 1
  - Federal and foreign R&D to tackle undemonstrated technologies, Track 2
  - Requires careful implementation, however gains exceed risks
- **International partnership essential for technology path**
  - Success of U.S. program more dependent on R&D at foreign facilities in bypassing engineering demos
  - Interest by countries in partnering bilaterally with US
- **Need International mechanisms to support GNEP goals**
  - Enlist partners in GNEP
  - Define incentives and means for partner participation
- **It should be obvious that pursuit of fuel cycle strategies and programs in the U.S. cannot be separated from the emerging GNEP program. We look forward to pursuing GNEP as an international effort which can not only further nuclear power development as a safe, economic, environmentally friendly, and proliferation resistant resource in the United States, but also worldwide.**