The Global Nuclear Energy Partnership

Status of Industry Engagement

Nuclear Energy Advisory Committee (NEAC)

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Outline

- **Industry Engagement Activities**
- **Funding Opportunity Announcement (FOA)**
  - Scope, Design Requirements, Selection Criteria
- **Industry Teams Awarded Cooperative Agreements**
- **DOE Evaluation of Industry Deliverables**
  - Overview, initial facilities, approaches, issues and summary
- **Next Steps**

GNEP Industry Engagement Activities

- **Expressions of Interest (2006)**
  - Requested August 2006
  - Received responses in September 2006
  - Description:
    - *Confidence that large facilities could be deployed by 2020 (using mature technologies)*
    - *Submittals were "proprietary"*
- **Siting studies (2007)**
  - Communities volunteer to host GNEP facilities
  - Many communities "partnered" with industry teams
- **Funding Opportunity Announcement (FOA) (2007 – 2009)**
  - Issued May 2007 (Up to $60M)
  - Received applications June 2007
  - Four teams selected for negotiations July 2007
  - Four cooperative agreements awarded September 2007
    - *September 2007 – February 2008 (FY2007$ -- approx. $16M)*
    - *March 2008 – September 2008 (FY2008$ -- approx. $18M)*
    - *October 2008 – September 2009 (FY2009$ -- up to $26M)*

Funding Opportunity Announcement (FOA)

- **Scope**
  - **Conceptual Design Studies**
    - *Contains engineering design concepts and their associated scope, cost and schedule information for the initial nuclear fuel recycling center and initial advanced recycling reactor*
  - **Business Plan**
    - *Details how the marketplace will facilitate DOE in developing and commercializing the needed advanced fuel cycle technologies and facilities to meet GNEP goals*
  - **Technology Development Roadmap**
    - *Describes the state of readiness of the proposed technology and describes methods and plans to acquire needed technologies to support GNEP deployment*
  - **Communications Plan**
    - *Contains scientific, technical and practical information relating to nuclear energy and the closing of the nuclear fuel cycle packaged in such a manner that costs and benefits can be easily understood by the public and other key stakeholders*

- **Integrated applications sought**
  - Recipients should develop conceptual design studies for a nuclear fuel recycling center, an advanced recycling reactor or both
  - The business plan, technology development roadmap and communications plan shall address the overall long-term GNEP goals
  - An integrated technical and business approach will be given preferential consideration

FOA Design Requirements (Initial GNEP Facilities)

- Commercial facilities will be licensed by the NRC and eligible for IAEA safeguards
- The nuclear fuel recycling center will not separate pure plutonium
- The advanced recycling reactor will be fast spectrum, sodium-cooled with ability to consume transuranics in fuel
- The advanced recycling reactor shall produce electricity
- The design effort shall identify products and their characteristics that are assumed to generate revenue in their business plan
- The nuclear fuel recycling center shall reduce the burden on the geologic repository
- All GNEP facilities shall meet applicable environmental and safety regulations

FOA Selection Criteria

- **Merit Review Criteria**
  - Applicant's organization and technical expertise
  - Commercial Experience
    - *Design, construction and operation of large-complex industrial facilities*
    - *Nuclear fuel design, qualification and fabrication*
    - *Generation and sale of electricity*
    - *Licensing and regulation of nuclear facilities*
    - *Obtaining internal and/or external financing for large capital projects*
  - Business Modeling and Planning
  - Technology Development
  - Approach
  - Schedule and Budget

- **Other Selection Factors**
  - Cost sharing
  - Integrated technical and business approach
  - Potential to enhance U.S. nuclear infrastructure

Industry Teams Awarded Cooperative Agreements

- **Energy Solutions, LLC**
  - Principles: The Shaw Group and Westinghouse Electric Company
  - Additional members: AECL; BoozAllenHamilton; Nexia Solutions; NFS; Toshiba
- **GE-Hitachi Nuclear Americas, LLC**
  - Burns and Roe; Ernst and Young; Fluor Corporation; International Business Machines (IBM); KAERI; Lockheed Martin
- **General Atomics**
  - CH2M Hill; United Technologies Corporation – Hamilton-Sundstrand Rocketdyne Division; Russian consortium led by Kurchatov Institute; KAERI; Potomac Communications Group; LISTO
- **International Nuclear Recycling Alliance (INRA)**
  - Principle team members: AREVA and Mitsubishi Heavy Industries (MHI)
  - Additional primary team members: Japan Nuclear Fuel Limited (JNFL); Battelle Memorial Institute; BWX Technologies Inc.; Washington Group International

Evaluation of Industry Deliverables – Overview

- **Expectations exceeded – information enormously beneficial**
  - Seven feet of reports
  - Built upon large prior investment and extensive experience
- **Fast Reactors**
  - Technology development is needed to demonstrate safety, reliability and economics
  - Government-funded demo reactor could be deployed in 2020-2025 timeframe
- **Separations**
  - Technologies exist that do not separate pure plutonium that can be deployed in the 2020-2025 timeframe producing fuel for existing light water reactors (LWRs)
- **Business Plans**
  - Integrated recycling and waste management approaches suggested
  - Utility waste fund pays, requiring minimal U.S. government investment
  - Requires substantial legislative and regulatory changes
- **Technology Development Plans require additional work**
  - Range of risk in proposed cost, schedule and projected performance vary significantly

Initial Advanced Recycling Reactor

- Sodium-cooled fast reactors; one team included gas-cooled reactors
- Designs of fast reactors range in size from 300 MWe to 500 MWe
- Technology readiness levels vary broadly
- Deployment between 2020 and 2025
- Costs range from $2 billion to $4.5 billion

Initial Nuclear Fuel Recycling Center

- Various separations technologies – aqueous and electro-chemical
- Two teams proposed the initial separations facility co-extract uranium with plutonium while two propose group transuranic separations
- Initial facility capacities range from 50 to 2000 MT/year
- Technology readiness levels vary broadly
- Deployment between 2020 to 2028
- Costs range from $400M to $20B (not an apples to apples comparison)

Approaches

- **Multiple paths to closing the fuel cycle described**
  - Some small-scale distributed system with integrated FR and separations
  - Some large-scale centralized separations facilities
  - All teams support two tier approaches using thermal reactors and fast reactors

- **Submissions suggested that government take a fresh look at nuclear waste management – an integrated approach including recycling and repositories**
  - All suggested that the establishment of a government corporation with access to the nuclear utility waste fund could result in effective management of the construction and operation of recycle facilities and repositories
  - Would substantially reduce investment required by the U.S. government
  - Actions would require significant changes to legislation and regulations

Potential Regulatory, Legislative and Programmatic Issues Presented by Industry

- **Legislation**
  - NWPA amendments for new disposal strategies, waste forms, and NWF modifications
  - Enabling legislation to create a government entity similar to TVA
- **Regulation**
  - NRC updating of 10 CFR 70 to support one-step licensing of reprocessing facilities
  - Revision of 10 CFR 50/52 for fast reactors
  - Modifications to EPA standard 40 CFR 190
    - *Reconsideration of gaseous/aqueous emission standards for the entire fuel-cycle taking into account the impacts of commercial recycling*
- **Programmatic**
  - Recycle of U/Pu or U/Pu/Np in commercial LWRs
  - Reconsideration of TRU limits for GTCC wastes following a risk-based approach
  - Revaluation of NRC categories and safeguards classification of actinide mixtures
  - Export licensing for U and possibly Am/Cm targets in CANDU reactors

Summary

- **Meaningful incremental steps can be taken in the near-term to fully close the fuel cycle in the United States**

- **Fast Reactors**
  - Government-funded prototype reactor can be deployed in the 2020 – 2025 timeframe and is needed to demonstrate safety, reliability and economics before wide-spread commercial deployment of fast reactors is possible

- **Nuclear Fuel Recycling Centers**
  - Technologies exist that do not separate pure plutonium and can be deployed in 2020-2025 timeframe producing fuel for existing light water reactors (LWRs)

- **A business case has been made where recycling can begin with reduced cost to the taxpayer, using the nuclear waste fund**
  - All teams support establishing a new government entity with access to the nuclear waste fund to manage used nuclear fuel

Next Steps

- **Continuation 1 funding (March – September 2008)**
  - Energy Solutions - $5.9 million (Total $10.2M)
  - General Electric-Hitachi - $5.5 million (Total $10.3M)
  - General Atomics - $1.3 million (Total $2.9M)
  - INRA - $5.7 million (Total $11.3M)
- **Received updated summaries April 11, 2008**
  - Will be posted on Web Site in late April or early May
- **Continuation #2 funding decision September 2008**
  - FY2009 total funding target for industry up to $26 million
  - Will focus on maturing conceptual designs and technology development roadmaps
- **DOE developing acquisition plans in 2008 and 2009**