Report to Congress

Spent Nuclear Fuel Recycling Program Plan

U.S. Department of Energy
May 2006

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May 2006

EXECUTIVE SUMMARY

The Department of Energy (DOE) has prepared this Spent Nuclear Fuel Recycling Program Plan Report in response to Conference Report 109-275, which accompanied H.R. 2419, a bill "Making Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 2006, and For Other Purposes" which contains a provision on accelerating efforts to consider recycling of commercial spent nuclear fuel. The Conference Report also includes provisions specifying that the Secretary submit two reports on spent nuclear fuel recycling to the House and Senate Committees on Appropriations. DOE is responding to the Conference Report by providing this report which documents DOE's currently-planned fuel cycle technology development activities.

DOE has proposed a spent nuclear fuel recycling technology development and demonstration program (Technology Demonstration Program) within the Global Nuclear Energy Partnership (GNEP) initiative. This Spent Nuclear Fuel Recycling Program Plan Report describes the capabilities that the Department anticipates could be developed to implement spent nuclear fuel recycling, the technical options to provide these capabilities, and the activities necessary to make informed decisions on recycling. This Report represents DOE's current analysis, which may evolve as a result of further research and other programmatic activities, as well as public comment.

To maximize participation of the public and private sector in developing the best options to achieve the program objectives, and in accordance with the provisions in the Conference Report, work being performed in FY 2006 has been divided into three parts:

1. Developing a comprehensive technology development plan that will identify, define and organize essential research, development and demonstration activities related to recycling technologies (e.g., storage and separations of spent fuel, fuel qualification, fuel fabrication, and fast reactor design), including an acceleration of the spent nuclear fuel recycling technology development within the Advanced Fuel Cycle Initiative (AFCI).
2. Promoting the consideration of alternative sites suitable for development of integrated recycling facilities, including storage of spent nuclear fuel to be processed in the recycling facilities.[a]
3. Investigating all reasonable alternatives to assure that construction projects needed to demonstrate the spent nuclear fuel recycle technologies minimize technical, cost, and schedule risk.

Implementation of the GNEP Technology Demonstration Program (GNEP-TDP) is currently expected to follow a phased approach, depicted in the figure below, which reflects current estimated costs and time frames associated with the phases. During the first and second phases, the mission descriptions, functional requirements, conceptual designs and life cycle cost estimates will be developed for each of the proposed demonstration projects. The environmental impacts of alternatives will be analyzed through the National Environmental Policy Act (NEPA) process. This information will provide the basis for the Secretary of Energy to make an informed decision, expected by the end of FY 2008, on whether to proceed with construction and operation of the demonstration facilities.

[a] This storage of commercial spent nuclear fuel would be an integral part of the recycling activity and limited to spent nuclear fuel awaiting separation into various component parts. Unlike facilities primarily for the interim storage of commercial spent nuclear fuel pending its disposal in a geological repository, incidental facilities limited to the storage of commercial spent fuel pending its recycling would not be subject to the restrictions on storage in the Nuclear Waste Policy Act or the requirements in section 202 of the Energy Reorganization Act.

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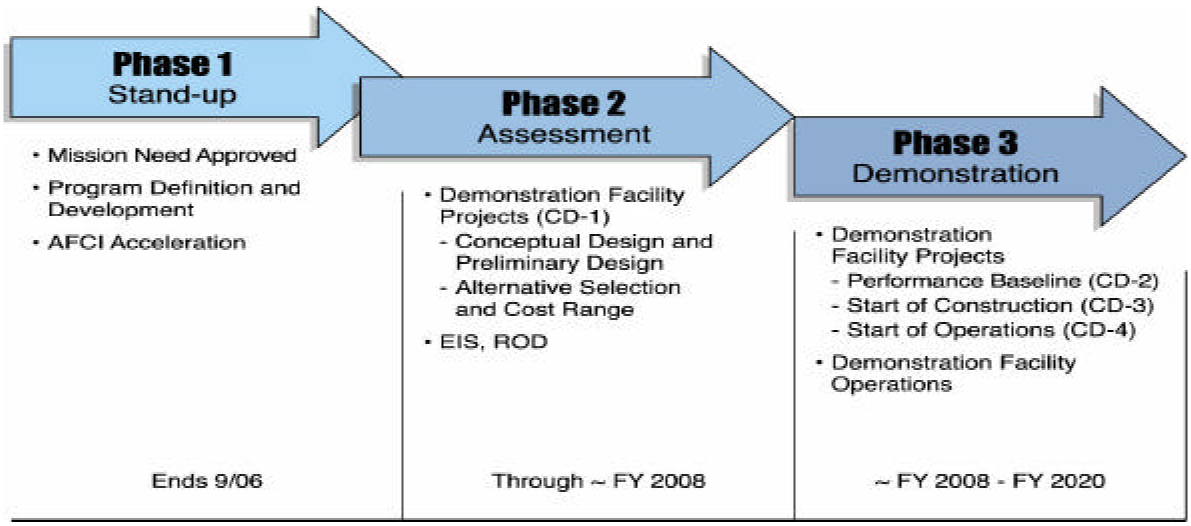


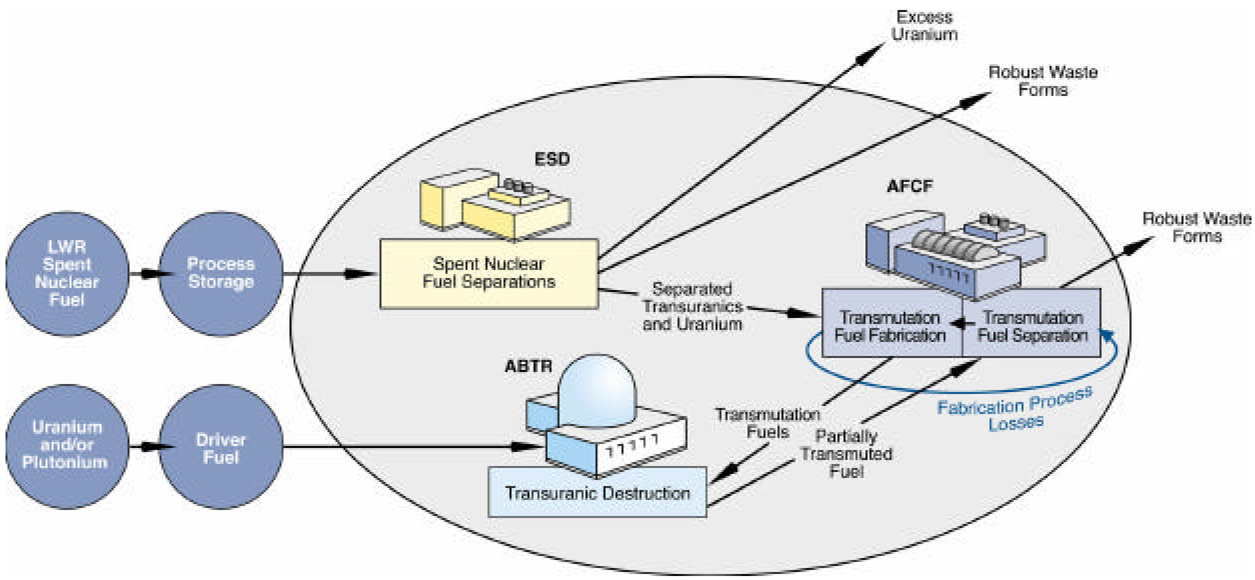
For the GNEP-TDP, the Department has identified the following three capabilities and associated facilities to accelerate spent nuclear fuel recycling:

- A Spent Fuel Separations Engineering-Scale Demonstration (ESD) facility that would provide proof of the feasibility of an integrated separations process using spent nuclear fuel from commercial light water reactors and include the storage of spent nuclear fuel that would be required as input for the separations process.
- An Advanced Burner Test Reactor (ABTR) that would provide a fast neutron flux environment for testing and qualifying fast reactor transmutation fuels for a commercial Advanced Burner Reactor (ABR) and, eventually, other advanced reactor fuels in support of the Generation IV program.
- An Advanced Fuel Cycle Facility (AFCF) that would provide the ability to develop and demonstrate advanced aqueous and pyroprocessing separations technologies, transmutation fuel fabrication technologies, and state-of-the-art safeguards instrumentation and monitoring systems. The AFCF would be used to fabricate the transmutation test fuels needed for qualifying these fuels, as well as to provide the experience needed to design and operate the commercial scale fuel fabrication and separations facilities.

The final selection of the technologies and a determination of the size, scope, and location(s) of the demonstration facilities would be made during the initial two phases of the GNEP-TDP.

The materials flow amongst these facilities is shown in the figure below[b].

[b] The anticipated range of years for commencing operations at the ESD is 2011-2015; for the ABTR, 2014-2019; and for the AFCF, 2016-2019.



Each demonstration facility design and construction project would be managed in accordance with the requirements of DOE Order 413.3, "Program and Project Management for the Acquisition of Capital Assets," and would be supported by focused technology development efforts. Additional advanced long term fuel cycle research and development to keep future options open as well as cross cutting activities including systems analysis, simulation and modeling, and safeguards, security, and nonproliferation would be continued. Universities would be included in the integrated teams that are supporting the facility and technology development. Industry and international collaborations would be sought at the outset to help ensure program success. These activities support and integrate the demonstration efforts.

Implementation of this plan could enable commercial-scale demonstration of the closed fuel cycle within 20 – 25 years, supporting the anticipated global expansion of nuclear energy. The result would be the recovery of the energy value in spent nuclear fuel by consuming recycled uranium and transuranic elements in an advanced burner reactor that generates electricity, as well as a reduction in the volume and heat content of materials to be disposed of at the proposed geologic repository[c]. Through this program, the United States would be able to offer strong influence and leadership in the management of nuclear materials throughout the world and, with the help of partner nations, reduce proliferation risks while promoting the growth of nuclear energy.

[c] Because of the time frames involved and the uncertainties as to the ultimate deployment of the advanced technologies under consideration, the repository to be constructed at Yucca Mountain will continue to be needed for disposal of spent nuclear fuel already generated, as well as spent nuclear fuel that will be generated over the next several decades. The potential effect on how the repository would be utilized in the future would depend on which technologies are successfully developed and ultimately deployed commercially.

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FIGURES

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ACRONYMS

ABR	Advanced Burner Reactor
ABTR	Advanced Burner Test Reactor
AFCF	Advanced Fuel Cycle Facility
AFCI	Advanced Fuel Cycle Initiative
ANOI	Advance Notice of Intent
CD	Critical Decision
DOE	Department of Energy
DOE-NE	DOE Office of Nuclear Energy
EIS	Environmental Impact Statement
EOI	Expression of Interest
ESD	Engineering Scale Demonstration
GFR	Gas-cooled Fast Reactor
GNEP	Global Nuclear Energy Partnership
GNEP-TDP	GNEP Technology Demonstration Program
IAEA	International Atomic Energy Agency
LWR	Light Water Reactor
LFR	Lead-cooled Fast Reactor
MOX	Mixed oxide
MT	Metric ton(s)
NEPA	National Environmental Policy Act
NERI	Nuclear Energy Research Initiative
NOI	Notice of Intent
NPT	Non-Proliferation Treaty
NRC	Nuclear Regulatory Commission
PUREX	Plutonium-URanium Extraction
R&D	Research and Development
RFP	Request for Proposals
ROD	Record of Decision
SFR	Sodium-cooled Fast Reactor
SNF	Spent Nuclear Fuel
TRU	Transuranic elements
UREX+	URanium EXtraction plus

SPENT NUCLEAR FUEL RECYCLING PROGRAM PLAN

MAY 2006

1.0 OVERVIEW

Congressional Language

The Department of Energy (DOE) has prepared this Spent Nuclear Fuel Recycling Program Plan Report in response to Conference Report 109-275, which accompanied H.R. 2419, a bill "Making Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 2006, and For Other Purposes." The relevant language from the Conference Report is included in full in Appendix A.

This Report documents DOE's currently-planned fuel cycle technology development activities, consistent with the provisions in the Conference Report on accelerating efforts to consider recycling commercial spent nuclear fuel (SNF) and on reporting to Congress on these efforts. This Report represents DOE's current analysis, which may evolve as a result of further research and other programmatic activities, as well as public comment.

Development Approach

SNF recycling is central to the Global Nuclear Energy Partnership (GNEP). The GNEP Technology Demonstration Program (GNEP-TDP) provides the context for the SNF recycling program, and would be the vehicle for demonstrating the critical SNF recycling technologies.

The GNEP-TDP is currently expected to be conducted in three phases, with some degree of overlap, focused on the development and demonstration of fuel cycle and reactor technologies leading to a commercialization decision. Figure 1 shows the three phases and the related activities.

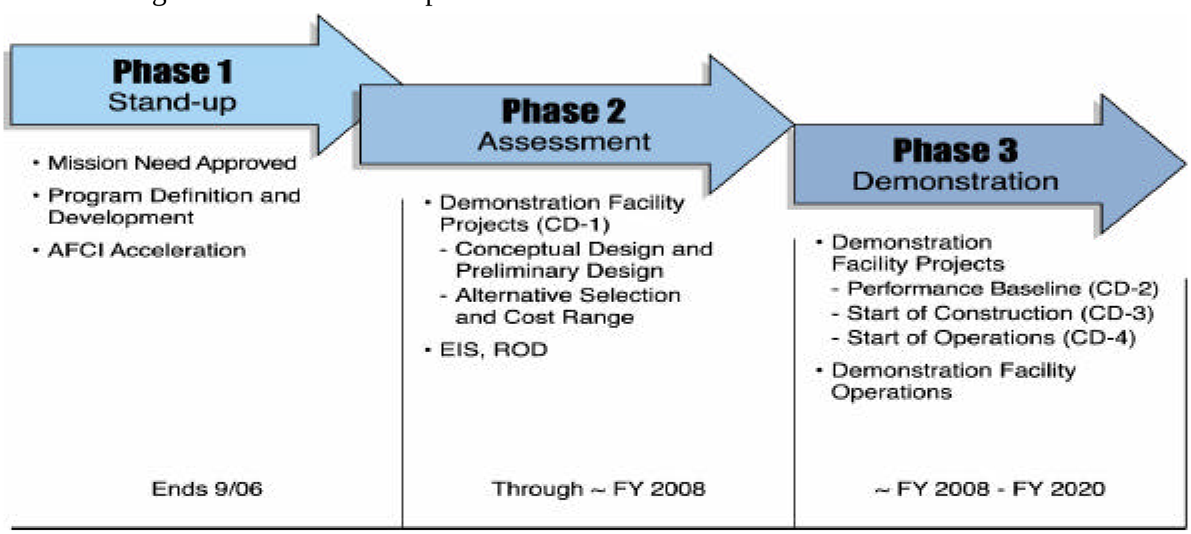

Figure 1 – GNEP Technology Demonstration Implementation Approach

During the Stand-up, or Initiation, Phase (Phase 1), the initial organizational structure and plans will be introduced and the intellectual foundation for the demonstration technology system will be established.

During the Assessment or Planning Phase (Phase 2), the GNEP-TDP projects would be better defined and developed and the National Environmental Policy Act (NEPA) process will evaluate the environmental impacts of alternatives and options. As part of this phase, DOE will evaluate alternative sites and technologies for the demonstration projects. This phase will conclude with a Secretarial decision on whether to proceed to construct the demonstration projects based on the NEPA process and the technical, cost and schedule baselines established for the demonstration projects. If DOE decides to proceed, DOE also would decide where the projects would be located. The completion of Phase 2 represents the first potential off-ramp for the project.

During a subsequent Demonstration or Execution Phase (Phase 3), the GNEP-TDP projects would be constructed and operated to demonstrate such technologies as the integrated closed nuclear fuel cycle, transmutation fuel performance, proliferation-resistant recycle at engineering scale, remote fuel fabrication techniques, reactor transmutation coincident with power generation, and other associated activities. If successful, these activities could then lead to commercialization.

Each of the GNEP-TDP projects will be managed according to the Department's directive which provides project management direction for the acquisition of capital assets that are delivered on schedule, within budget, and fully capable of meeting mission performance and environmental, safety, and health standards. Under this directive, *DOE Order 413.3 - Program and Project Management for the Acquisition of Capital Assets*, the projects will follow the Critical Decision process. A Critical Decision is a formal determination or decision at a specific point in a project phase that allows the project to proceed to the next phase and commit resources. Critical Decisions are required during the planning and execution of a project; for example, prior to commencement of conceptual design, commencement of construction, or start of operations. Each Critical Decision is a potential off-ramp for the project.

Report Organization

The remaining sections of this report are organized as follows:

- Section 2 discusses the key elements, overall schedule and rationale for the recycling technology development and demonstration effort.
- Section 3 provides background information on recycling issues, including information on spent nuclear fuel quantities and compositions and how recycling could modify them.
- Section 4 presents the capabilities required for a working recycling system and initial identification of the options being considered for engineering scale demonstration.
- Section 5 provides an overview of the GNEP-TDP.
- Appendix A is the pertinent Congressional language from the Conference Report.

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2.0 GNEP-TDP

2.1. Introduction

GNEP is a major initiative that aims to reduce America's dependence on foreign sources of fossil fuels and encourage economic growth; to recycle spent nuclear fuel (SNF) using new proliferation-resistant technologies to recover more energy and reduce waste; to encourage prosperity, growth and clean nuclear energy development around the world; and to employ the latest technologies to reduce the risk of nuclear proliferation worldwide.

The GNEP-TDP described in this Report constitutes DOE's response to the Conference Report language regarding integrated spent fuel recycling. SNF recycling is a central component of GNEP. Through the GNEP-TDP, the Department would demonstrate recycling of SNF using new, proliferation-resistant technologies to recover more energy and reduce waste. Figure 2 highlights the SNF Recycling Program's scope within GNEP.

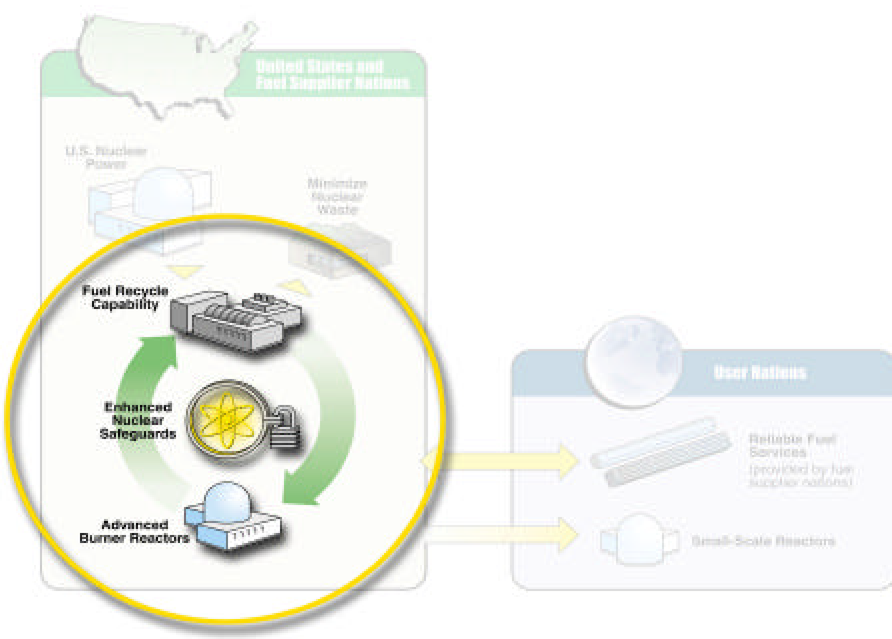

Figure 2 – Global Nuclear Energy Partnership Main Elements, with SNF Recycling Program Elements (or GNEP-TDP) Highlighted

The Department is using FY 2006 appropriations to execute the first or stand-up phase of the GNEP-TDP. Program implementation to meet strategic objectives will build on and accelerate existing DOE programs, especially the Advanced Fuel Cycle Initiative (AFCI). The successful demonstration of SNF recycling technology is a critical element that would further the other elements of the GNEP initiative.

The proposed GNEP-TDP would consist of three capabilities to be demonstrated in three facilities:

- A Light Water Reactor (LWR) SNF separations demonstration facility (the Engineering Scale Demonstration, or ESD) to remove transuranics (TRU) from commercial LWR SNF in a form that minimizes proliferation risk and includes the storage of SNF that would be required as input for the separations process. Under current planning, operations would begin between FY 2011 and FY 2015.
- A fast spectrum test reactor (the Advanced Burner Test Reactor, or ABTR) that could be used to demonstrate the conversion of TRU into shorter-lived isotopes while simultaneously generating power. Operations would begin between FY 2014 and FY 2019.
- A research and demonstration facility (the Advanced Fuel Cycle Facility, or AFCF) to fabricate TRU removed from the LWR SNF into fuel elements suitable for irradiation in a fast reactor, and additionally to recycle fast reactor fuel to ensure more complete conversion of the TRU. The first module of this multipurpose facility would commence operations between FY 2016 and FY 2019.

In addition to these three facilities, various crosscutting activities and an ongoing long-term research and development program are envisioned as part of the proposed GNEP-TDP.

To maximize participation of the public and private sector in developing the best options to achieve the program objectives, work being performed in FY 2006 is anticipated to be carried out in three parts:

- Developing a comprehensive technology development plan that will identify, define and organize essential applied R&D activities related to the GNEP-TDP technologies (e.g., separations, fuel qualification, fuel fabrication, and fast reactor design) including an acceleration of the SNF recycle technology development already underway in the AFCI program;
- Promoting the consideration of alternative sites suitable for development of integrated recycling facilities;
- Investigating all reasonable alternatives to assure that construction projects needed to demonstrate the spent nuclear fuel recycle technologies minimize technical, cost, and schedule risk.

Furthermore, to ensure that future decisions are taken with the best available information, a program milestone has been established that supports a decision by the Secretary of Energy by the end of FY 2008 on whether to proceed with one or more technology demonstration projects starting in FY 2009 and if so, where to locate the facilities. That decision will be informed by the Environmental Impact Statement (EIS) on the GNEP-TDP and readiness evaluations for the line item construction projects. As indicated above, this Secretarial decision represents the first major decision point and off-ramp for the GNEP-TDP.

2.2. Description of FY 2006 Program Tasks

DOE would execute the following project activities in FY 2006 designed to meet the objectives described above.

Task 1—GNEP-TDP Plan

Implementation of the GNEP-TDP will require close integration of technology demonstration and technology development schedules. The scale up of the LWR SNF separations technology (including storage of LWR SNF prior to separations), TRU conversion, transmutation fuel fabrication and recycle, and waste management and minimization are examples of areas that require accelerated effort to achieve the GNEP-TDP's objectives and enable demonstration facilities in order to assess commercial-scale deployment. The technology development work must lay out the specific priority and magnitude of applied research or pilot scale activity needed to support the program milestones and provide the necessary feedback to the technology demonstration program. These activities will call on the resources of the national laboratories as well as the academic community and industry where they can provide relevant expertise.

Task 2—Detailed Site Studies

DOE issued a request for Expressions of Interest (EOI) in the *Federal Register* on March 17, 2006, announcing its intention to initiate a competition to conduct site evaluations to aid in selecting one or more sites suitable for development of integrated recycling facilities. The EOI sought information to assist in the preparation of a solicitation for proposals to prepare site evaluation reports. A total of 43 responses to the EOI were received.

The solicitation, planned for spring 2006, will be open to domestic sources, public and private, and will encourage teaming and community involvement. Proposals will be evaluated for 90 days, followed by the selection of those proposals for which funding will be provided to prepare a site evaluation report. Each of the resulting site evaluation reports will be reviewed for potential inclusion as an alternative in the EIS analysis for the GNEP-TDP. DOE currently intends to solicit proposals only for non-DOE sites, given that information relating to the identification of DOE sites for potential inclusion as alternatives in the GNEP-TDP EIS is already available to the Department. The potential sites will be evaluated in connection with the EIS process, and DOE currently anticipates that it will make site location decisions in the summer 2008 following completion of the EIS.

Task 3—Environmental Impact Statement (EIS)

To evaluate the potential environmental impacts at candidate sites for the demonstration facilities, DOE has taken steps to initiate the preparation of an EIS for the GNEP-TDP. This process began with a March 22, 2006 Advance Notice of Intent (ANOI) which requested comments from interested parties on the scope of the EIS, reasonable alternatives, and other relevant information. Comments received will be used to develop the Notice of Intent (NOI) and to assist DOE in completing the EIS.

The Draft EIS is scheduled to be completed by late spring, 2007 and the Final EIS by late spring, 2008. A Record of Decision (ROD) is expected to be issued by the end of FY 2008.

2.3. Accelerated Design Activities

In accordance with the DOE project management directive[d] and good industry practices, DOE believes it is necessary to go through an appropriate discovery and analysis process before proceeding with preliminary design of the GNEP-TDP facilities[e]. Reasonable questions arise with respect to the sizing, location, and scaling options for such facilities. DOE will accomplish this in conjunction with the NEPA process using input received in response to the ANOI, NOI, public scoping meetings, and the Draft EIS, as well as through other programmatic activities.

DOE prepared a Mission Need Statement for Critical Decision-0 (CD-0) to formally approve the need for the SNF recycling demonstration facilities. DOE is currently proceeding with the conceptual designs and work necessary for Critical Decision-1, Approve Alternatives Selection and Cost Range, to consider options, alternatives, risks, cost ranges, and acquisition strategies.

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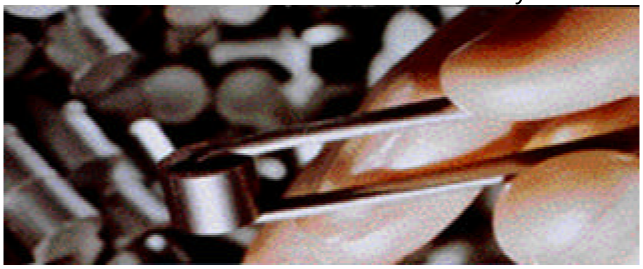
d. DOE Order 413.3, Program and Project Management for the Acquisition of Capital Assets.

e. At the time that the appropriations language was written, the term "Engineering Scale Demonstration" referred to those recycling facilities that might be needed rather than the specific LWR SNF Separations Facility discussed in this Report. Accordingly, DOE will pursue accelerated design activities for all proposed GNEP-TDP facilities.

3.0 SNF BASICS

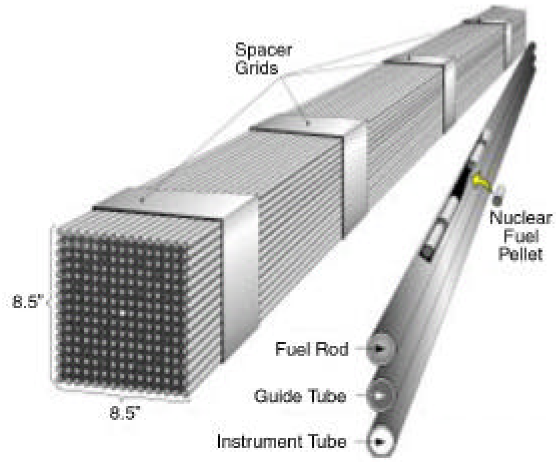
3.1. What Is Nuclear Fuel?



Nuclear Fuel Pellets

Commercial nuclear fuel is comprised of uranium oxide pellets stacked in long tubes made from an alloy of zirconium metal ("cladding") to form fuel rods. The fuel rods are bundled together and structurally reinforced to form a fuel assembly. Hundreds of fuel assemblies are placed in the reactor to form the reactor core.

U.S. commercial LWRs use fresh fuel that is enriched to an average of three percent[f] of the isotope[g] uranium-235, the remaining 97 percent being uranium-238. The uranium-235 provides the fissile material that sustains the nuclear reaction.



Fuel Rod Assembly

Most of the uranium-235 splits (fissions) into a range of lighter elements collectively called fission products, while also giving off large quantities of heat energy used to generate electricity and neutrons used to sustain the reaction.

Some of the neutrons given off during fission are absorbed by the uranium-238. This results in transmutation of uranium into heavier TRU elements (neptunium, plutonium, americium and curium).

Some of the fission products also absorb neutrons but are themselves too light to fission. Thus, they only interfere with the nuclear reaction. Over time, the build up of these fission products and the consumption of fissile isotopes combine to shut down the reaction. At this point the fuel is "spent."

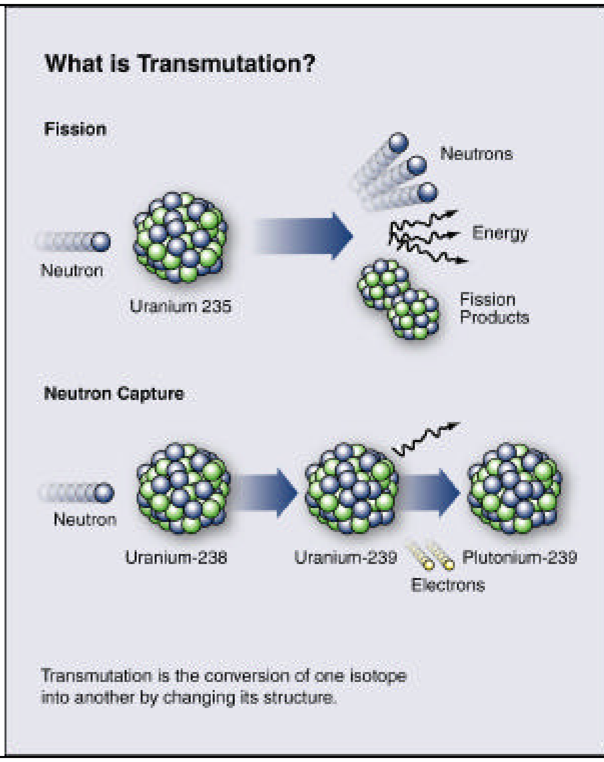
3.2. What Is In SNF?

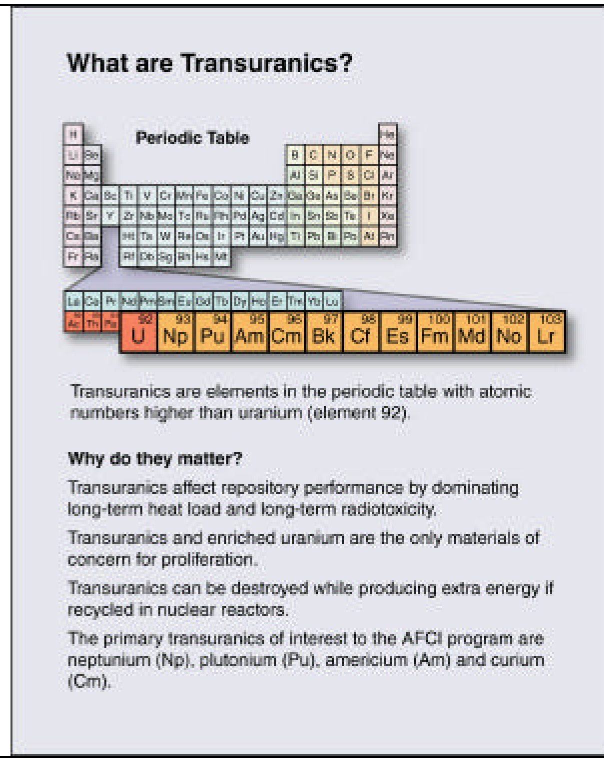
The SNF that comes out of a power plant is only partially consumed. It has three major components:

- Almost ninety-six (96) percent is uranium. The fraction of uranium-235 has fallen to 0.8 percent.
- About one (1) percent is TRU elements, mostly plutonium (see sidebar).
- The rest, more than three (3) percent, is fission products.

f. Fresh fuel and SNF values in the background section of this report are based on the average burnup of stored SNF (~33 gigawatt days/metric tons of heavy metal (GWDt/MTHM)). Burnup has steadily increased as technology has improved and is now about 50 percent higher than this historic average (~50 GWDt/MTHM).

g. Isotopes are versions of elements that have different numbers of neutrons. Uranium-235 has 92 protons and 143 neutrons while uranium-238 has 92 protons and 146 neutrons.





Taken together, the components of SNF are highly radioactive, give off large amounts of decay heat, and remain highly radiotoxic for many thousands of years. For these reasons, SNF must be isolated from the environment in a deep geologic repository if it is disposed of as waste. However, most of these negative properties derive from only a small portion of the SNF. If the constituents of SNF are separated, most of the material is only slightly radioactive.

3.3. *How Much SNF Do We Have?*

As of December 2005, commercial utilities and nuclear power plant owners in the United States were storing 187,000 SNF assemblies totaling approximately 53,000 metric tons (MT)[h] of SNF. Almost all of the SNF was at the reactor sites in cooling pools or dry storage. On average, an additional 2,100 MT of SNF is added to this total annually. By 2010, stored commercial SNF is expected to exceed 63,000 MT, which is the amount of commercial spent nuclear fuel that can be disposed of at the proposed Yucca Mountain repository under current law.[i]

In 2005, the AFCI program provided a report to Congress[j] that included an assessment of the amounts of SNF that would be produced through the end of the century based on a range of scenarios for the U.S. nuclear industry. Based on these scenarios, the amounts of SNF generated by 2100 may range from approximately 100,000 to 1,400,000 MT.

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h. SNF is typically accounted for in units of metric tons initial uranium, which excludes the cladding and other components of the fuel assemblies. Some of the initial uranium has been converted into transuranics and fission products in the SNF.

i. The total legislated capacity limit in the Nuclear Waste Policy Act is 70,000 MT. Of this amount 7,000 MT has been planned for government spent nuclear fuel and high level waste.

j. "Advanced Fuel Cycle Initiative—Objectives, Approach, and Technology Summary," DOE, May 2005.

Since its 2005 report on this research and development, a number of events have occurred that necessitated a reassessment of the likely rate of growth of nuclear energy.[k] Based on current industry interest, nuclear power for electricity generation appears most likely to continue at its current twenty (20) percent market share or grow in market share over the next several decades. This would result in the need for additional federal repositories with the existing once-through fuel cycle approach.

3.4. What are the Options for Managing SNF?

There are two basic options for managing SNF; it can either be disposed of or recycled. Direct disposal of SNF is referred to as "once-through" or "open fuel cycle", while recycling is referred to as "multi-pass" or "closed fuel cycle."

In recent years, DOE's AFCI program evaluated both the open and closed fuel cycles, including variations of recycling. Recycling of SNF can improve repository performance because a portion of the TRU can be destroyed during each recycle. Transmutation is the primary method for destroying TRU by recycling. In this process, the TRU are consumed and converted into fission products and additional energy is produced.

3.5. Accelerator-Driven Systems, Thermal Reactors, or Fast Reactors?

Work completed by the AFCI program (then called the Advanced Accelerator Applications Program) in 2001 demonstrated that stand-alone accelerator-driven systems were not an economically acceptable solution to deal with spent fuel.[l]

Reactor-based transmutation options include thermal or fast reactors using fuel recycled from commercial LWRs. Recycled fuel can be used in any type of reactor, but the number of times the fuel can be recycled with current commercial LWRs is limited when compared with fast reactors. Too many cycles in a thermal reactor leads to an undesired buildup of TRU.

On the other hand, fast burner reactors result in a larger portion of TRU being destroyed than created during each recycle, theoretically enabling an unlimited number of recycles until the TRU are fully fissioned and destroyed. Given the benefits of continuous recycling, at this time GNEP-TDP is focused on the development of fast reactor technologies, recognizing that fast reactor operating experience is much more limited than thermal reactor operating experience, and that fast burner reactor fuels, or transmutation fuels, are not fully developed.

3.6. What about Proliferation?

Proliferation risk reduction is the systematic and comprehensive effort to prevent the spread of nuclear weapon materials and/or technologies. Safeguards are the basic building blocks of international nonproliferation programs—accounting for nuclear materials, control of technology, transparency in the use of technology and materials to validate peaceful uses, and the ability to inspect and verify compliance with international agreements and obligations. International safeguards have been an effective deterrent against the spread of nuclear technology and materials.

If nuclear energy plays an expanded role in the global energy market, innovative approaches would be necessary to address concerns about potential proliferation risk. Any program or project aimed at nuclear energy must properly address proliferation risk reduction for the overall system within which the technologies will be deployed. Consequently, proliferation risk assessment and reduction are major goals of the GNEP initiative.

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[k] These events include passage of the Energy Policy Act of 2005 that provides significant assistance for initial new nuclear plant construction and the announcement by the nuclear industry of plans for multiple new plant construction and operating license applications as, well as the announcement of the GNEP program.

[l] Van Tuyle, Gregory J. et al.; "Candidate Approaches for an Integrated Waste Management Strategy – Scoping Evaluation." September 2001

To provide a higher standard of proliferation risk reduction, SNF technologies and the structure of the overall fuel cycle must provide a less attractive path to weapons proliferation than current nuclear fuel cycle technologies such as uranium enrichment or plutonium separation technology (Plutonium-URanium EXtraction or PUREX). The GNEP vision is to provide new fuel cycle technologies to “create a safe, orderly system to field civilian nuclear plants without adding to the danger of weapons proliferation.”[m]

The challenge arises from the fact that any nuclear reactor fuel can, with varying levels of difficulty, theoretically be used as a source of weapons material. One source is uranium and weapons-usable uranium can be created by enriching uranium to a higher percentage of uranium-235 than is required for nuclear power plants. The other source of weapons-usable material is extraction of the plutonium contained in SNF.

Meeting this challenge requires addressing both the enrichment of uranium and the extraction of plutonium through an improved international regime for safeguards, technology export controls and improved technology that incorporates past lessons-learned and supports the Non-Proliferation Treaty (NPT) and its new Additional Protocol. One of GNEP’s goals is to supply technology to reduce the proliferation risk in the fuel cycle. In combination, enhanced international strategies and advanced technologies must address four threat strategies: theft of material (by terrorists or other sub-national groups), clandestine diversion of material in declared facilities by owner-nation states, clandestine production in undeclared facilities, and production in national facilities following withdrawal from or abrogation of the NPT.[n]

In 1977, the United States decided to discontinue the recycle of spent commercial nuclear fuel and to discourage civilian reprocessing internationally. This was based on the premises that reprocessing presented the greatest proliferation risk in the nuclear fuel cycle and that U.S. leadership would shape the international nuclear fuel cycle. Both premises have been called into question.

First, at that time, uranium enrichment occurred primarily in large gaseous diffusion plants, which are very large industrial facilities. These facilities were considered to be a low risk for clandestine production of highly-enriched uranium, so SNF reprocessing appeared to provide the more important route toward production of weapons material. Today, however, it is improvements in and dispersion of centrifuge uranium enrichment technology, rather than reprocessing, that has created a significant proliferation risk.

Second, in the international arena the United States has not succeeded in discouraging other countries from engaging in reprocessing of SNF for civilian purposes. At present, the United States maintains the once-through approach, under which SNF is to be disposed of directly in geological repositories. Although no additional countries started reprocessing programs after 1977, the existing reprocessing programs of countries such as France, the United Kingdom, Russia and Japan have grown. These programs use the PUREX process, in which plutonium is separated from SNF for eventual recycle in nuclear power plants. At the same time, U.S. programs and capabilities for fuel cycle research and development have atrophied, creating a challenge for sustaining U.S. leadership in the international arena.

Almost 30 years later, it is clear that the current international nonproliferation regime could be improved by reducing the motivation for countries with smaller nuclear programs to develop either uranium enrichment or SNF reprocessing capabilities. Economy-of-scale savings associated with large facilities should make it less expensive for countries with smaller programs to outsource their fuel supply services, provided those services

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m. Remarks by President G. W. Bush on Weapons of Mass Destruction Proliferation, National Defense University, Washington DC, February 11, 2004.

n. In his speech, “Nuclear Non-Proliferation and Arms Control: Are We Making Progress,” to the Carnegie International Non-Proliferation Conference on November 7, 2005, Dr. ElBaradei, Director General of the International Atomic Energy Agency, proposed four “yardsticks” that correspond to these four threat strategies: protection of nuclear material, effectiveness of nuclear verification, control of sensitive nuclear technology, and compliance with NPT commitments. His prescription for further progress emphasizes multilateral management, control, and supply of services of uranium enrichment, fuel fabrication, spent nuclear fuel reprocessing, and waste disposal.

are reliable. The United States and other countries with large nuclear programs could achieve this by ensuring that they remain reliable, economical international suppliers of fuel cycle services.

A complete approach to proliferation and physical protection of weapons-usable material requires addressing the range of threat strategies. Proliferation risk reduction must focus on fuel cycle technologies that achieve high levels of proliferation risk reduction through optimization of intrinsic[o] barriers to materials misuse, including superior safeguards systems for monitoring and materials accountancy. Safeguards embedded into the system design are a major component of the intrinsic proliferation risk reduction characteristic. Consistent with the Generation IV program, proliferation measures should address the quantity and quality of material, as well as the time needed to divert material versus the time needed to detect irregularities. A comprehensive approach to proliferation risk reduction would provide earlier warnings to enable an international response and increase the time (difficulty) to proliferate, and decrease the time required to detect irregularities. The potential benefits of new fuel cycles, compared with both current once-through and PUREX fuel cycles, could lead to a new international consensus and an improved global nuclear fuel cycle that is more resistant to material diversion and undeclared production (increasing time required to proliferate) and that enables easier detection of irregularities (decreasing the time required to detect).

There is now broad recognition that both enrichment and reprocessing technologies entail proliferation risks that can be best reduced by avoiding the dispersion of enrichment and reprocessing capabilities to states that do not already have substantial, well-established fuel cycle activities. In countries that already have comprehensive nuclear fuel cycle capabilities, including uranium enrichment, GNEP technologies would not increase proliferation risk and would reduce such risk if adopted. By creating incentives for countries to refrain from developing enrichment and reprocessing capabilities, the reliable fuel services regime contemplated under GNEP will further reduce the proliferation risk associated with international development of nuclear energy.

o. "Intrinsic" proliferation resistance features, as defined in the International Atomic Energy Agency Department of Safeguards STR-332, "Proliferation Resistance Fundamentals for Future Nuclear Energy Systems," include (but are not limited to) technical features that: (a) reduce the attractiveness for nuclear weapons programs of nuclear material during production, use, transport, storage and disposal; (b) prevent or inhibit the diversion of nuclear material; (c) prevent or inhibit the undeclared production of direct-use materials; and (d) facilitate verification, including continuity of knowledge.

May 2006

4.0 SNF RECYCLE SYSTEM & TECHNICAL REQUIREMENTS

4.1. SNF Recycle Goals

The GNEP-TDP provides the pathway to the long-term goal to "[r]ecycle nuclear fuel using new proliferation risk reduction technologies to recover more energy and reduce waste." Specific SNF Recycle System goals are to:

- Reduce the current and future burden related to geologic disposal of spent nuclear fuel in terms of waste volume, heat load, radiotoxicity, and number of repositories needed.
- Recover the energy value contained in spent nuclear fuel for future energy production needs.
- Reduce the proliferation risk associated with the use of nuclear energy globally.

To achieve these goals, the GNEP-TDP will focus on early development and demonstration of capabilities needed to support a closed fuel cycle that dramatically reduces long-lived radioactive waste while reducing proliferation risk.

4.2. GNEP-TDP System Architecture

Unlike many other advanced nuclear countries, the United States does not currently possess a commercial plutonium and uranium mixed oxide (MOX) fuel infrastructure and adheres to the policy of not separating plutonium. Consequently, DOE is initially evaluating the SNF Recycle System shown in Figure 3.

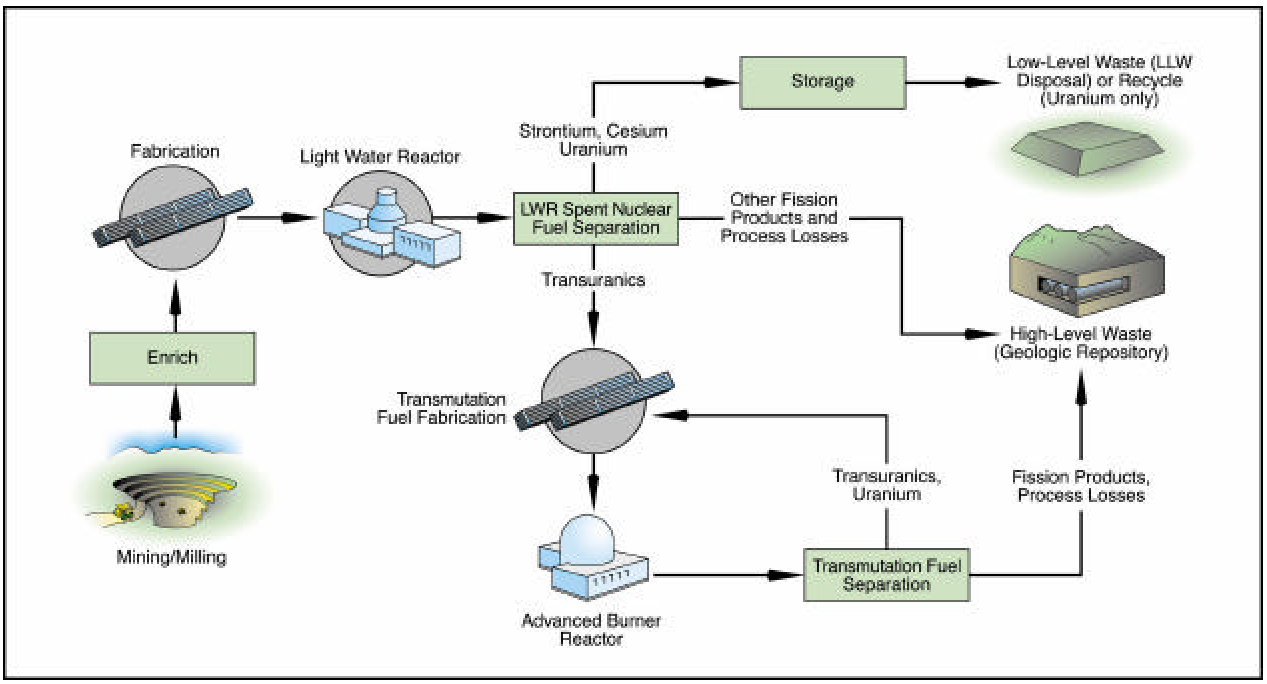

Figure 3 – Spent Nuclear Fuel Recycle System Initially Identified for the GNEP-TDP Program

Its essential elements would comprise the following:

- U.S. commercial LWRs currently produce SNF at a rate of approximately 2000 MT per year.
- The storage of LWR SNF would be associated with the separations process.

- A LWR SNF separations plant would separate the constituents of that SNF into a series of product and waste streams that facilitate waste management: short-lived fission products for storage and eventual low level waste disposal; structural materials and long lived fission products for ultimate disposal in a geologic repository; uranium for reuse or storage; and TRU elements destined to be destroyed through transmutation. This process would operate at a very large scale, and must produce products that always remain unattractive for building weapons.
- The TRU elements would then be fabricated into transmutation fuels[p].
- The transmutation fuel would be irradiated in fast reactors. This irradiation results in a partial destruction of the TRU (a fraction of the original TRU remains in the irradiated fuel, along with newly created fission products).
- A separations process, potentially different from the LWR SNF separations process, would then be used to extract the remaining TRU from the transmutation fuel. As with the LWR SNF separations, other constituents, including fission products, processing losses and structural materials, would be encased in specific waste forms suited for ultimate disposal in a geologic repository.
- The separated TRU would then be refabricated into new transmutation fuel and irradiated in a fast reactor again. This closed cycle would continue to destroy the initial TRU while also accepting new TRU from the LWR SNF.

4.3. System Technology Requirements

Based on technical requirements derived from the general goals of the GNEP initiative and other considerations such as U.S. non-proliferation policy, U.S. environmental laws, and good engineering and business practices, the SNF system of technologies should initially seek to meet six technical requirements:

- The system should be protective of public health, safety and the environment.
- The system should maximize the amount of material recovered from spent fuel for use in producing additional energy and minimize the amount that needs disposal in a geological repository.
- The system should make available the energy value of separated materials for future use.
- The system should reduce proliferation risk.
- The system should be deployable within the GNEP-TDP timeframe (20-25 years).
- The system should remain as economical as possible.

4.4. Technology Capabilities

The GNEP strategy to achieve the accelerated implementation of a multi-pass or closed fuel cycle using fast reactors would involve the development of three specific capability areas.

4.4.1. Separations Capability for LWR SNF

Initial identification of a separations technology for an engineering-scale demonstration (ESD) requires consideration of the technical criteria and the long-term objectives for the facility.

Initial Criteria for Separations Process

There are goals which any separations technology should meet to be a candidate for the ESD. The degree of separation should maximize the amount of material recovered from spent fuel for use in producing additional energy, minimize the amount of material that needs disposal in a geological repository (thus minimizing the

p. Transmutation fuels contain a significant amount of TRU elements, along with uranium or a non-fuel matrix material.

need for additional repository space), reduce the proliferation risk, and provide adequate long-term environmental protection. These goals can be achieved by any process that meets the following criteria:

- Separation and recovery of the group of TRU elements (plutonium, neptunium, americium, and curium) at better than 99 percent efficiency
- Separation and recovery of two fission products, cesium and strontium, each at better than 99 percent efficiency
- Separation and recovery of the uranium at high purity and at better than 99.9 percent efficiency[q].

The processes that have been proven at this time (at laboratory scale) to be capable of meeting these criteria is the UREX+ family of separations processes, specifically UREX+1 and UREX+1a. These processes are group extractions in which there is no separation of the individual TRU elements. These two UREX processes differ in only one way, in that UREX+1 keeps the TRU and lanthanides together for extra self-protection through radiation while UREX+1a separates them at some point in the process. Any facility that uses these processes reduces proliferation risk, relative to the PUREX process.

ESD Objectives

The ESD should:

- Provide for process storage of LWR SNF prior to separations
- Conduct engineering scale integrated process demonstrations of SNF treatment using LWR SNF to provide a design basis for future industrial-scale processing plants
- Introduce limited process adjustments, either in the form of relatively minor flowsheet adjustments or limited process equipment alterations, for validation at meaningful scale for the possible industrialization of the separations process
- Provide an environment representative of industrial-scale fuel separations operations that will be used for proof-testing of advanced process monitoring and safeguards instrumentation
- Provide the TRU elements needed for ABTR transmutation fuels.

The scale of the ESD would be chosen to provide useful design and operational information for a future processing plant, serve as a source of TRU for the initial demonstration of TRU burning in a fast reactor, support scale-up to potential industrial scale with a high degree of confidence, and provide reasonable batch size capability for demonstration of byproduct production and management.

Readiness Assessment of the UREX+1 and UREX+1a Processes

A factor in the suitability assessment is to determine whether there are any barriers to scale-up of the process and therefore to meeting the long-term objectives for ESD based on the technical readiness of both the process and much of the needed equipment. The UREX+ separation process chemistry has been demonstrated with SNF. The main equipment components for the UREX + suite of separations processes have been tested at scales sufficient to assure success at the anticipated size of the ESD, including the centrifugal contactors that are at the heart of the separations processing. As such, the UREX+1 and UREX+1a processes are judged to be ready for an integrated demonstration at the engineering scale. Nonetheless there is still technology development to be completed; in particular, some of the ancillary equipment needs testing at larger or full scale, especially for the preparation of the final waste forms.

As would be expected for any process as one moves to an engineering scale or larger demonstration phase, modeling and design of the equipment associated with a facility based on the UREX+1 or UREX+1a process, such as fuel dissolvers, separations equipment, evaporators and solidification units, need to be addressed. In

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q. To enable re-enrichment or low-level waste disposal or future fast reactor use.

addition, some of the key engineering scale-up issues include off-gas capture to meet regulatory limits, technetium recovery processes and characterization of technetium waste form options, cesium/strontium product solidification, characterization of fission product waste forms, characterization of TRU solids and determination of thermal characteristics for product storage systems, and minimization and management of secondary waste streams from process chemicals. Given the maturity of the processing technologies, it is feasible at this time to plan for a larger scale demonstration of either UREX+1 or UREX+1a without undue technical risk.

4.4.2. TRU Transmutation Capability

Once TRU are separated from SNF they must be transmuted into fission products in order to obtain the benefits of the closed fuel cycle, including the recovery of the unused energy content in SNF, the increase in repository capacity, and the destruction (rather than production) of plutonium contained in the grouped TRU from the LWR SNF separations capability. This destruction is performed in a fission reactor called a fast or "burner" reactor.

A general goal for transmutation is the generation of electrical power through the net destruction of all grouped TRU, including the minor actinides that contribute to the long term heat load in the repository as well as plutonium, which is the primary proliferation concern in the SNF materials. In this way, TRU destruction can yield energy, repository and nonproliferation benefits. An additional goal is for the resultant power generation transmutation system to be safe, clean and economical.

Initial Criteria for Transmutation Technology

Based on these goals for power generation, waste management and non-proliferation, a first criterion for the transmutation system is:

- The transmutation system must be capable of supporting safe, clean economical power generation through repeated recycle and net destruction of grouped TRU, with no direct disposal of spent nuclear fuel.

Any new reactor option will require the development of transmutation fuels as covered in the GNEP-TDP fuel development plan. New separations processes must be developed for TRU recycle, and the transmutation fuels must be fabricated and qualified for reactor utilization. Therefore, technical risk and technology maturity is a key consideration for the transmuter technology. A second criterion is:

- The transmutation technology must have reasonable technical risk for startup of a test system in about 10 to 15 years with the potential for early demonstration and deployment.

An initial identification of transmutation technology options identified fast reactor technology for the transmutation system (see section 3.5).

Fast Reactor Technology Options

Regarding fast reactor technology options, three different options are being considered in the Generation-IV advanced reactor program: the sodium cooled fast reactor (SFR), lead alloy cooled fast reactor (LFR), and the gas cooled fast reactor (GFR). As demonstrated in recent AFCI studies, the fuel cycle behavior and burner design constraints are similar for the SFR, LFR, and GFR; the detailed transmutation studies conducted for the SFR should be indicative of general fast reactor closed fuel cycle performance.

Based on the need for low technical risk for the transmuter technology, at this time the only fast reactor option with viable technical maturity is the SFR. The challenges for SFR technology are well understood, and ongoing international R&D activities may help improve performance for both energy and fuel cycle applications. The alternate LFR and GFR technologies offer some advantages, particularly for high temperature applications; therefore, it is prudent to retain a backup fast reactor technology option. This option may be pursued in conjunction with international partners.

4.4.3. Transmutation Fuels Development and Fabrication Capability

Finally, the technology choice for transmutation fuel should be addressed.

There are two candidate transmutation fuel forms and associated separations schemes for the fast reactor: metal fuel with pyroprocessing, and oxide fuel with aqueous or pyroprocessing. While both fuel types have reached a sufficient degree of development for uranium and plutonium bearing fuels, their capability to contain minor actinides in large quantities is still being researched, and a down selection at this time would be premature. Significant work is being planned by the United States and its partners in the coming years, including irradiations of TRU-bearing fuels in U.S., French, and Japanese reactors. Development work on both fuel types will continue due to the inherent technical difficulty and risk associated with this research.

Two facilities would be critical for completing that research. One is the ABTR, where transmutation fuel would be irradiated to assess performance in a prototypic environment. The other is the third facility in the GNEP-TDP, the AFCF, where transmutation fuel fabrication capabilities would be developed and irradiated fuel would be examined and separated to create material for fresh fuel fabrication. The choice of a separations scheme will follow that of the transmutation fuel, with pyroprocessing being well-adapted to metal fuels, and aqueous schemes being well-adapted to oxide fuels. Research on both approaches would also be carried out, with the AFCF playing a critical role. The AFCF would also be essential for developing and demonstrating advanced safeguards for spent nuclear fuel recycling plants and in providing the test assemblies to complete the transmutation fuel qualification.

5.0 GNEP-TDP FACILITIES AND PROGRAM ACTIVITIES

5.1. Project Management

The central feature of the GNEP-TDP is scale-up demonstration of major processes and facilities in order to evaluate potential deployment of a recycling system in approximately 20 years. All of the demonstration program facilities would be major procurement actions. Decisions on the technologies selected for demonstration and the siting of facilities will be conducted in full compliance with National Environmental Policy Act requirements, as discussed in Section 2.2.

Each facility would be managed as a separate project within the GNEP-TDP. These projects would follow the requirements of DOE Order 413.3, "Program and Project Management for the Acquisition of Capital Assets", and DOE Manual 413.3-1, including project review and approval in accordance with the DOE's Critical Decision process. Safety considerations would be factored into the design of the demonstration facilities early in the project life cycle starting with a Preliminary Hazard Analysis to be developed as part of the CD-1. Sound project cost and schedule baselines will be a high priority. The projects will also use an earned value system compliant with ANSI Standard 748 to monitor cost and schedule performance. Project management for support infrastructure needs would be provided separately.

A formal systems engineering program will be established early in the project planning efforts for all spent nuclear fuel separations and transmutation fuel fabrication facilities to ensure that mission operational requirements are properly translated into the appropriate system architectures, performance parameters, and facility operational designs. Interface control documents would be established to identify and manage the interdependencies among the various separations development and testing facilities, transmutation fuel fabrication facilities, reactor facilities, and waste disposal facilities. SNF separations technology development and demonstration plans would be updated routinely to be responsive to changes in end-user requirements for transmutation fuel fabrication and irradiation.

5.2. ESD

The first facility in the GNEP-TDP would be an ESD of the aqueous processing of commercial LWR spent fuel using a UREX+ separations process.

The proposed ESD would need to include storage of LWR SNF and operate at a scale sufficient to provide the design basis for a future industrial-scale commercial SNF processing plant. Storage of SNF would be required because the SNF is needed feed into the separations process. The demonstration would be configured to ensure the achievement of the process design targets. Advanced safeguards instrumentation would be introduced into the demonstration as the new technologies become available, and the results would be incorporated into future large plant designs.

The ESD requires a focused effort on design and supporting technology development in two broad areas: waste forms and LWR SNF separations. Technology development of alternative equipment and processes is also included for mitigating technical risk and developing the next generation SNF recycling technology.

5.3. ABTR

The second facility in the GNEP-TDP would be an ABTR for a fast spectrum actinide transmutation capability to support demonstration of an advanced, closed nuclear fuel cycle. The ABTR serves as a test reactor for conducting fuels and materials and safety testing to support transmutation fuels development and design certification of an Advanced Burner Reactor (ABR). The role of the ABR in the closed fuel cycle is to produce power while transmuting long lived TRU elements (plutonium, americium, curium, and neptunium) into shorter lived fission products through nuclear fission. By destroying TRU materials recovered from existing LWR SNF as well as from its own SNF, an ABR will significantly reduce the plutonium inventory and long-term heat and dose produced by SNF.

The ABR program conducted under GNEP currently consists of two parallel efforts:

- The ABTR Project, a relatively small-sized test reactor and supporting testing infrastructure to demonstrate the transmutation process using fast spectrum fission systems while generating power. The current target date range for reactor startup is between 2014 and 2019. Development and review of detailed integrated schedules during the conceptual design phase will provide the basis for a refined project schedule range prior to preliminary design.
- An ABR Design Certification and Technology Development Program directed at obtaining design certification from the Nuclear Regulatory Commission (NRC) for a standard ABR plant. A full-scale prototype reactor module for a standard ABR plant could potentially be built and operated in the future based on this certified design to demonstrate the suitability of ABRs for commercial application and establish confidence on the part of utilities in ABR performance and economics. Although such an activity is not part of the current GNEP-TDP, a full-scale prototype could be started up about 10 years after the ABTR startup date, or between about 2025 and 2030.

5.4. AFCF

The third facility in the GNEP-TDP would be the AFCF, which would be required to fabricate TRU-bearing transmutation fuels for the ABTR. The fuel fabrication process development would be tightly coupled with the separations processes development for both LWR SNF and fast reactor SNF. The long-term function is to provide a flexible technology development platform to demonstrate process improvements and to facilitate the development and demonstration of advanced recycling methods for transmutation fuel types that can support a number of fuel cycle strategies.

AFCF would also be used for proof-testing of safeguards instrumentation and methodology, the safeguards by design methodology (which embeds the safeguards requirements into the design) and the monitoring and control system establishing the safeguards envelope strategy. In this way AFCF would demonstrate a possible new world standard of advanced safeguards for SNF recycling plants and in providing the test assemblies to complete the transmutation fuel qualification.

5.5. Advanced Fuel Cycle R&D and Cross-Cutting Activities

5.5.1. Systems Analysis

Systems Analysis provides the overall approach to implementation of a closed fuel cycle by coordinating and analyzing the fuel cycle from a high-level systems perspective. Systems analyses are performed on systems or subsystems in order to understand their integrated behavior and performance and the resulting impacts on objectives, including overall GNEP objectives, under various scenarios. This includes applying models, tools, and analyses to evaluate potential configurations of the fuel cycle components, as well as implementing key system demonstrations, to validate the analyses. Results are targeted to aid decision-makers in selecting the best fuel cycle and reactor technologies and configurations. Figure 5 is a simplified systems view of the envisioned facilities and associated material flows.

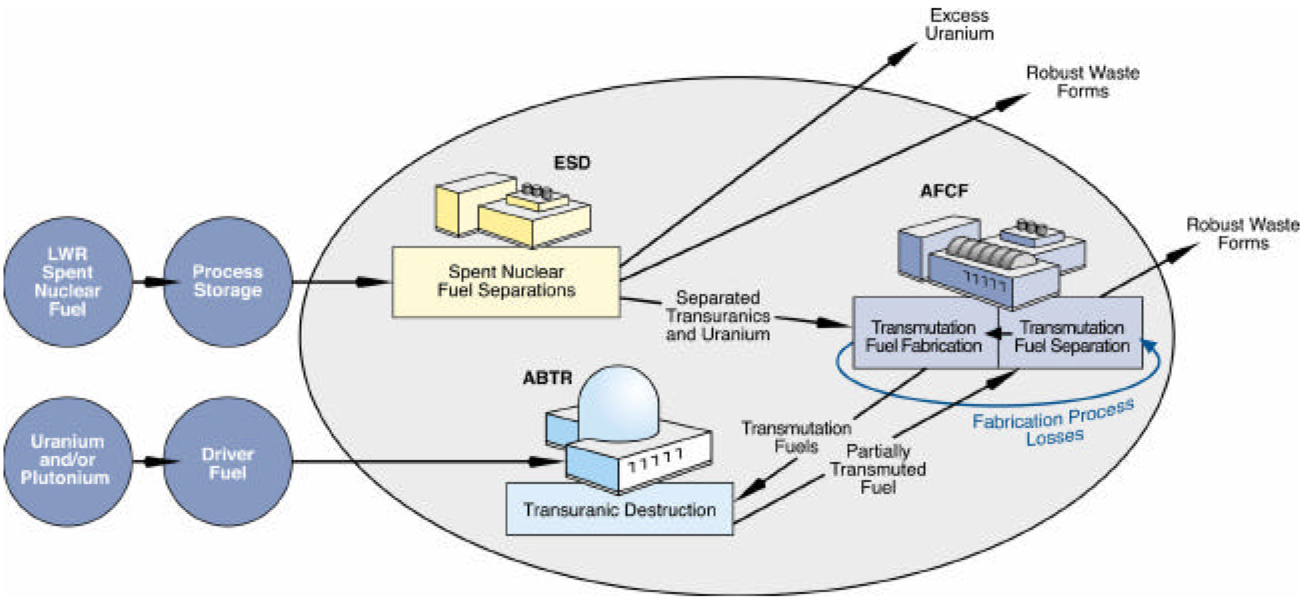

Figure 4 – GNEP-TDP Facilities and Materials Flow[r]

5.5.2. Modeling and Simulation

A major element of the GNEP-TDP would be a substantial Nuclear Energy Systems Simulation program designed to take advantage of the advances in computers and simulation in order to accelerate the development schedules and achieve appreciable cost reductions for the demonstration of recycling technologies. Most analytic tools used in the nuclear industry were developed 20 years ago. Since then, computing and networking power have grown exponentially, and significant advances have been made in the development of solution methods. Other high-tech fields are extensively using the new capabilities (e.g., aircraft design) and "virtual" problem solving networks are becoming standard practice in other industries.

5.5.3. Safeguards, Security, and Nonproliferation

The advanced safeguards technology program would be integral to GNEP and continue throughout the GNEP-TDP. The advanced safeguards program would research, develop and demonstrate advanced safeguards to ensure that the United States helps define world technical standards for the new fuel cycle. It

[r] The anticipated range of years for commencing operations at the ESD is 2011-2015; for the ABTR, 2014-2019; and for the AFCF, 2016-2019.

would include development of extrinsic and intrinsic technical measures, including real-time instrumentation to account for nuclear materials. It would seek maximum effectiveness and transparency at the minimum cost.

5.5.4. University Programs

In FY 2006, the participation of universities in the Advanced Fuel Cycle Initiative was primarily through the Nuclear Energy Research Initiative (NERI) grant program. The R&D conducted under this activity supported AFCI, as well as the Generation IV Nuclear Energy Systems Initiative and the Nuclear Hydrogen Initiative. In FY 2007, funds will be used primarily to continue support of projects awarded in the previous two years (projects typically span three years) including a focus on GNEP. Concurrent with those plans, a new structure for maximizing university participation will be investigated.

5.5.5. Safety

Safety and reliability are critical to all nuclear facilities. All civilian commercial nuclear facilities deployed in the United States will be licensed by the NRC and must meet rigorous safety requirements. By learning from past experience and technology demonstration, any future fuel cycle facilities resulting from GNEP-TDP would be at least as safe as current technology.

One of the responsibilities of GNEP-TDP safety analysis is to ensure consideration of the entire system. Current state-of-the art safety awareness is that accidents can arise from unanticipated interactions within a complex system, hence the need for integrated safety analysis that considers the entire fuel cycle and how components of the system interact.

5.5.6 Backup R&D

Additional R&D will need to be conducted in the event that any of the technologies to be demonstrated in the GNEP-TDP fail to live up to their expectations. Examples of this work include research on thermal recycle, a broad range of fuels development and alternative separations processes.

5.5.7 Leveraging Knowledge and Experience

In all of the cross-cutting activities, the GNEP-TDP will leverage the knowledge of other offices within DOE (in particular, the National Nuclear Security Administration and the Offices of Science, Civilian Radioactive Waste Management and Environmental Management), other U.S. Government organizations and National Laboratories, and the work done by international partners and such international organizations as the Nuclear Energy Agency and the International Atomic Energy Agency. The program anticipates that industry partners will be significant resources in this effort. In additional to technology development, candidate areas for such leveraging include advanced computations, safeguards, transportation and waste management.

Leveraging lessons learned will help minimize technical, cost and schedule risk.

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Appendix A

Energy and Water Appropriations Congressional Language

Nuclear Waste Disposal Account Excerpt

109TH CONGRESS 1st Session } HOUSE OF REPRESENTATIVES { REPORT 109–275

MAKING APPROPRIATIONS FOR ENERGY AND WATER DEVELOPMENT FOR THE FISCAL YEAR ENDING SEPTEMBER 30, 2006, AND FOR OTHER PURPOSES

NOVEMBER 7, 2005.—Ordered to be printed

Mr. HOBSON, from the committee of conference, submitted the following

CONFERENCE REPORT

[To accompany H.R. 2419]

The committee of conference on the disagreeing votes of the two Houses on the amendment of the Senate to the bill (H.R. 2419) "making appropriations for energy and water development for the fiscal year ending September 30, 2006, and for other purposes", having met, after full and free conference, have agreed to recommend and do recommend to their respective Houses as follows:

That the House recede from its disagreement to the amendment of the Senate, and agree to the same with an amendment, as follows:

In lieu of the matter stricken and inserted by said amendment, insert:

That the following sums are appropriated, out of any money in the Treasury not otherwise appropriated, for the fiscal year ending September 30, 2006, for energy and water development and for other purposes, namely:

TITLE I

CORPS OF ENGINEERS—CIVIL

DEPARTMENT OF THE ARMY

CORPS OF ENGINEERS—CIVIL

The following appropriations shall be expended under the direction of the Secretary of the Army and the supervision of the Chief of Engineers for authorized civil functions of the Department of the Army pertaining to rivers and harbors, flood control, shore protec-

24–421

Integrated spent fuel recycling.—Given the uncertainties surrounding the Yucca Mountain license application process, the conferees provide $50,000,000, not derived from the Nuclear Waste Fund, for the Department to develop a spent nuclear fuel recycling plan. Under the Nuclear Energy account, the conferees provide additional research funds to select one or more advanced recycling technologies and to complete conceptual design and initiate pre-engineering design of an Engineering Scale Demonstration of advanced recycling technology. Coupled with this technology research and development effort, funds are provided under the Nuclear Waste Disposal account to prepare the overall program plan and to initiate a competition to select one or more sites suitable for development of integrated recycling facilities (i.e., separation of spent fuel, fabrication of mixed oxide fuel, vitrification of waste products, and process storage) and initiate work on an Environmental Impact Statement. The site competition should not be limited to DOE sites, but should be open to a wide range of other possible federal and non-federal sites on a strictly voluntary basis. The conferees remind the Department that the Nuclear Waste Policy Act prohibits interim storage of nuclear waste in the State of Nevada. To support the development of detailed site proposals for this competition, the conferees make a total of $20,000,000 available to the site offerors,

with a maximum of $5,000,000 available per site. To be eligible to receive these funds, each applicant site must be able to identify all state, regulatory, and environmental permits required for permitting this facility, including identifying any legislative or regulatory prohibitions that might prevent siting such a facility. The conferees direct the Secretary to submit a detailed program plan to the House and Senate Committees on Appropriations not later than March 31, 2006, and to initiate the site selection competition not later than June 30, 2006. The target for site selection is fiscal year 2007, and the target for initiation of construction of one or more integrated spent fuel recycling facilities is fiscal year 2010. Any funds deemed to be in excess of the needs for the integrated recycling program plan may only be diverted to other activities after submittal and approval of a formal reprogramming to Congress.

Nuclear Energy Account Excerpt

Nuclear Energy Research and Development.—The conference agreement provides $226,000,000 for nuclear energy research and development. The conference agreement provides $66,000,000 for Nuclear Power 2010.

For Generation IV Nuclear Energy Systems, the conferees provide $55,000,000, of which $40,000,000 is provided for the Next Generation Nuclear Power Plant program. Within available funds, $4,000,000 is provided for the development of multiple high temperature fuel fabrication techniques in support of the Generation IV Nuclear Energy Systems.

The conferees provide $25,000,000 for the Nuclear Hydrogen Initiative. The conferees provide an additional $5,000,000 over the request to accelerate essential materials research and development and component design, test and evaluation for implementing the high temperature sulfuriodine water splitting process for hydrogen production necessary to the advanced reactor hydrogen co-generation project at Idaho National Laboratory.

The conferees provide $80,000,000 for the Advanced Fuel Cycle Initiative (AFCI), $10,000,000 over the request. The additional funds are to be used to accelerate the design activities associated with a proposed Engineering Scale Demonstration (ESD). This funding will allow completion of the conceptual design in fiscal year 2006 and enable pre-engineering design to commence in fiscal year 2007. The conferees direct the Department to accelerate the development of a separations technology that can address the current inventories of commercial spent nuclear fuel and select the preferred technology no later than the end of fiscal year 2007. The conferees direct the Department to submit the spent nuclear fuel recycling

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technology plan to the House and Senate Committees on Appropriations by March 1, 2006.