

United States – Japan Joint Nuclear Energy Action Plan

1. Introduction

1.1 Background and Objective

President Bush of the United States and Prime Minister Koizumi of Japan have both stated their strong support for the contribution of nuclear power to energy security and the global environment. Japan was the first nation to endorse President Bush's Global Nuclear Energy Partnership.

During the June 29, 2006 meeting between President Bush and Prime Minister Koizumi,

"We discussed research and development that will help speed up fast breeder reactors and new types of reprocessing so that we can help deal with the cost of globalization when it comes to energy; make ourselves more secure, economically, as well as make us less dependent on hydrocarbons" (1)

"U.S.-Japan partnership stands as one of the most accomplished bilateral relationships in history. They reviewed with great satisfaction the broadened and enhanced cooperation achieved in the alliance under their joint stewardship, and together heralded a new U.S.-Japan Alliance of Global Cooperation for the 21st Century." (2)

On January 9, 2007, Samuel W. Bodman, Secretary of Energy of the United States, and Akira Amari, Minister of Economy, Trade and Industry of Japan, met in Washington, D.C. to review their current and prospective cooperative activities in the energy field. The Secretary and the Minister agreed that both sides are committed to collaboration on the various aspects of the civilian nuclear fuel cycle. They agreed that the United States and Japan would jointly develop a civil nuclear energy action plan that would support such collaboration. The plan would focus on: (a) research and development activities under the Global Nuclear Energy Partnership initiative that will build upon the significant civilian nuclear energy technical cooperation already underway; (b) collaboration on policies and programs that support the construction of new nuclear power plants; and (c) regulatory and nonproliferation-related exchanges. They agreed that the plan would be completed by April 2007. This civil nuclear energy action plan, (hereafter referred to as the "Joint Action Plan"), builds upon the cooperative research and development discussions that have taken place between the U.S. and Japan over the past year and expands the effort to include collaboration on policies and programs that support the construction and regulation of new nuclear power plants, and strengthen the nonproliferation regime.

This Joint Action Plan is comprised of four main areas: 1) Nuclear Energy Cooperative Research and Development under GNEP, 2) Collaboration on Policies and Programs that Support the Construction of New Nuclear Power Plants, 3) Establishing Nuclear Fuel Supply Assurance Mechanisms, and 4) Joint Collaboration to Support the Safe and

Secure Expansion of Nuclear Energy in Interested Countries While Promoting Non-proliferation. As appropriate, regulatory issues associated with these areas will be discussed. This Joint Action Plan involves actions foreseen by provisions of The Agreement for Cooperation Between the Government of the United States and the Government of Japan Concerning Peaceful Uses of Nuclear Energy (hereafter referred to as the "Agreement.") It complements but does not replace other consultations and collaboration under existing agreements. In addition, the U.S and Japan will address the issue of nuclear liability since appropriate treatment of this issue is essential to expanded international cooperation in nuclear projects.

1.2 Organizations and Participants

Execution of this Joint Action Plan will be the responsibility of a Nuclear Energy Steering Committee (hereafter referred to as the "Steering Committee"). The Department of Energy (DOE) and Ministry of Economy, Trade and Industry (METI) will serve as contact points for coordinating the actions of the Steering Committee.

The Steering Committee will be co-chaired by U.S. and Japan. Assistant Secretary of Energy Dennis Spurgeon or his designee will be the co-chair from the U.S., and Director-General of the Agency for Natural Resources and Energy (ANRE), METI, Director-General of Research and Development Bureau, the Ministry of Education, Culture, Sports, Science and Technology (MEXT), Director General of Disarmament, Non-Proliferation and Science, Ministry of Foreign Affairs (MOFA) or their designee will be the co-chair from Japan depending upon the main subject matters to be discussed. The U.S. membership on the Steering Committee will include representatives of the Department of Energy, Office of Nuclear Energy (DOE/NE), the National Nuclear Security Administration, Office of Defense Nuclear Nonproliferation (NNSA/NA-20), the U.S. Department of State (DOS), and the U.S. Nuclear Regulatory Commission (NRC). Japan's membership on the Steering Committee will include METI (including Nuclear and Industrial Safety Agency), MEXT and MOFA. The Department of Energy's Office of Fuel Cycle Management and Japan Atomic Energy Agency (JAEA) will serve as the main contact points for technical cooperative GNEP R&D between U.S. and Japan.

The Steering Committee's efforts and implementation of the Joint Action Plan will be supported by working groups consisting of teams of experts designated by members of the Steering Committee. The working groups will make use of existing cooperative mechanisms as much as practical. The Steering Committee will coordinate and prioritize working group activities.

Execution of this Joint Action Plan will result in substantive near-term engagement with positive impacts for the nuclear energy visions of each country, while at the same time laying the groundwork for long-term cooperation.

1.3 Legal Framework

United States and Japan propose to carry out activities under this Joint Action Plan in accordance with the Agreement and respecting each other's legal and regulatory

requirements, nuclear energy policies and activities involving the peaceful use of nuclear energy. Nothing in this Joint Action Plan (in particular with reference to GNEP) will adversely affect the implementation of the existing agreements between the United States and Japan, and in particular, the programmatic consents for reprocessing.

Execution of the activities of the Joint Action Plan is based on the Agreement, the DOE-JAEA Safeguards Agreement¹, the DOE-JAEA Nuclear Science and Energy R&D Agreement², the April 21, 2004, U.S.-Japan agreement on innovative nuclear energy technologies and implementing arrangements (I-NERI) between DOE and MEXT and DOE and ANRE, and the February 28, 2005, Generation IV International Forum (GIF) Framework Agreement and subordinate System Arrangements and Project Arrangements. While the two sides believe that sufficient authority exists to conduct the activities of this Joint Action Plan, new agreements might be needed to provide additional authority to undertake future work resulting from this Joint Action Plan. This Joint Action Plan represents a programmatic commitment and does not constitute a legally binding agreement.

2. Nuclear Energy Cooperative Research and Development under GNEP

The United States and Japan propose to carry out activities under this Joint Action Plan that are consistent with the GNEP principles.

The United States and Japan will communicate closely and consult with one another concerning specific modalities of cooperation among GNEP partners. Japan and the United States will support commercial-based technical cooperation under the GNEP initiative among appropriate partners that have civil fuel cycle technology.

This Joint Action Plan is based on shared U.S. and Japan objectives for establishing a global framework to expand nuclear energy use and manage proliferation risks while enabling all to benefit from the peaceful uses of nuclear energy. The Joint Action Plan incorporates the specific areas of joint cooperation agreed upon at bilateral meetings (See Appendix 1). It identifies implementation actions for 2007 and beyond (see Appendices 2 and 3).

In order to execute this Joint Action Plan, the parties will establish the following six Working Groups (WG) (Note: 1 – 6). The WG are composed of appropriate representatives from the DOE and its national laboratories, Japanese organizations engaged in the implementation of nuclear energy research and development, and, as appropriate, U.S. and Japanese regulatory and other agencies.

¹ Agreement Between the Department of Energy of the United States of America and the Japan Atomic Energy Agency for Cooperation in Research and Development Concerning Nuclear Material Control and Accounting Measures for Safeguards and Nonproliferation, July 21, 2006.

² Agreement Between the Department of Energy of the United States of America and the Japan Atomic Energy Agency for Cooperation in Research and Development in Nuclear Science and Energy, April 4, 2007.

1) **Fast Reactor Technology WG**: Safe, secure, cost competitive, and sustainable nuclear energy is an achievable goal; however, technical challenges for improvements still remain. This working group will consider fast reactor research, development and design collaboration, to include evaluation of safety approaches, systems design concepts, fuel development, and international concepts for an advanced recycle reactor.

2) **Fuel Cycle Technology WG**: Both countries have substantial experimental and computational capabilities in the area of reprocessing and fuel fabrication technologies with proliferation resistance. As a part of this Joint Action Plan, both parties have agreed to use our respective assets collaboratively to accelerate progress towards advancing our joint objectives.

3) **Simulation and Modeling WG**: Both countries have a strong interest in advancing the state-of-the-art in simulation and modeling (e.g. fast reactor technology, nuclear fuel-cycle technology, design, waste management, fuel and material performance, and seismic analysis, etc.), using advanced technology in computer and information science.

4) **Small and Medium Reactors WG**: Both countries have a strong interest in developing small and medium reactors for countries that do not have nuclear power today or have limited electric grid capacity. Such reactors might also have design advantages in ease of use, safety, security, multi-purpose applications, and proliferation resistance.

5) **Safeguards & Physical Protection WG**: Developing technologies for safeguards, physical protection, and proliferation resistance is a necessary and integral part of our joint cooperation and is of particular importance in the area of future nuclear fuel cycle facilities and reactor designs. Both parties acknowledge the mutual benefit of joint collaboration in this area, making use of existing cooperative mechanisms as much as practical.

6) **Waste Management WG**: Both parties have expressed a strong interest in the development of advanced waste forms and generic repository concepts.

Nuclear energy cooperative research and development under GNEP is proposed to be executed in three phases. This Joint Action Plan will focus on Phase I activities. Phase II will be revisited upon the conclusion of Phase I as set forth in the report to be delivered in April 2008.

Phase I – Near Term (2007-June 2008; Report due in April 2008): The goal of Phase I is to rapidly initiate near-term cooperative work having immediate impact on relevant nuclear energy challenges. This will be achieved by using existing skill sets, working relationships, and infrastructure to address known high-priority problems. Phase I will have a limited scope and will employ working groups. Early demonstration of real value and impact will facilitate productive discussions and programmatic work across broader technical areas. Initial areas for cooperation that fulfill these goals are listed below. Details on the cooperative areas will be developed at the first working group meeting, and submitted to the Steering Committee after the first meeting. Details on the following areas of joint technical cooperation are described in Appendix 3.

- Fast reactor research and development, design, and evaluation of system design concepts
- Evaluations of and experiments on separation technologies and fuel fabrication technologies with proliferation resistance
- Computer simulation and modeling of advanced nuclear fuels, materials, reactor design, and validation with appropriate data
- Evaluation of near term feasibility, including safety, regulation, licensing, cost and schedule issues, for various small and medium reactor concepts
- Advanced safeguards and physical protection approaches for future nuclear fuel cycles and associated facilities
- Development of advanced waste forms and generic geologic repository concepts

Phase II – Mid-Term (July 2008-June 2011): Based on progress made during Phase I, Phase II is proposed to expand the scope of the Joint Action Plan and address the more complex challenges associated with advanced technologies such as fast reactors and associated separations and other fuel cycle technologies. It will include joint program planning efforts to identify priority areas for broadening experimental work, cooperation, and impact.

Phase III- Longer Term (July 2011 and forward): This phase of the work is proposed to entail the planning for, and integration of, system demonstrations that address difficult nuclear fuel cycle challenges. Demonstrations selected for Phase III should be developed with the goals of demonstrating progress towards an end-state which is a model for the future.

Proposed Joint Action Plan Schedule and Milestones

- June 2007 –Working Group meeting in U.S. to finalize Phase I work tasks, deliverables, schedule, and arrangements (e.g., I-NERI agreements)
- November 2007 - Working Group meeting to review progress to date - Tokyo, Japan
- March 2008 - Technical Review meeting on joint cooperation, all working groups, U.S.
- April 2008 Phase I Report of U.S. - Japan R&D Accomplishment to Co-Chairs of the Steering Committee.
- July 2008 - Phase II Program Planning meeting – location TBD

3. Collaboration on Policies and Programs that Support the Construction of New Nuclear Power Plants

The United States and Japan recognize the growing interest in both countries to expand the generation of electricity from nuclear energy. In the United States, DOE has established the Nuclear Power 2010 program (NP 2010), whose mission is to facilitate the deployment and construction of new nuclear power plants through cooperative arrangements between the U.S. Government and the private sector.

The NP 2010 investment coupled with financing incentives in the Energy Policy Act of 2005 (EPAAct) will encourage new orders and construction of advanced light water reactors in the United States. Domestic power companies have announced intentions to submit at least 21 license applications, representing up to 33 new units, for review by the Nuclear Regulatory Commission (NRC) starting later this year. The first new combined Construction and Operating License (COLs) could be issued before 2012.

DOE and METI propose to exchange information and views on their respective policies and directions in relation to the construction of new nuclear power plants. Therefore, both parties agree to establish a joint working group under the Nuclear Energy Steering Committee discussed in section 1.2 of this document, in order to collaborate on parties' policies and programs that support the construction of new nuclear power plants through exchange of information and views. The working group will be co-chaired by one U.S. representative and one Japan representative. The agenda for the working group meeting will include the following areas:

- Status of U.S. NRC-certified reactor designs
- Government support for technical cooperation within the business sector
- Loan guarantees, and other measures that support expansion of nuclear energy
- In accordance with the above-mentioned U.S. measures, possible future Japanese Government-supported financial facilities such as trade insurance to mitigate nuclear construction risk
- Exchange of views on how to address the issue of nuclear liability on the national and international levels in a manner that promotes expanded international cooperation in nuclear projects.

4. Establishing Nuclear Fuel Supply Assurance Mechanism

In order to promote globally the peaceful use of nuclear power while simultaneously reducing the risk of nuclear proliferation, the parties will provide technical analysis in support of, and where appropriate participate actively in, discussions mainly at IAEA concerning Reliable Nuclear Fuel supply assurance mechanism. The parties will continue to exchange information at the working level of their relevant agencies concerning nuclear fuel supply assurance, taking into consideration the six-nation proposal (Concept for a Multilateral Mechanism for Reliable Access to Nuclear Fuel) submitted by the United States and other countries and Japan's proposal (IAEA Standby Arrangements System for the Assurance of Nuclear Fuel Supply) for complementing the six-nation proposal.

5. Joint Collaboration to Support the Safe and Secure Expansion of Nuclear Energy in Interested Countries While Promoting Non-proliferation

A number of countries are planning to introduce or expand the use of nuclear power with a view to addressing energy security and global warming. Ensuring non-proliferation, nuclear safety and nuclear security in these countries is an important priority not only for the countries deploying new nuclear power plants but also for countries providing assistance and cooperation, neighboring countries, and in fact, for the international community as a whole. Under these circumstances, it is extremely meaningful for the U.S. and the Japanese governments to consult on their policies as the increasingly allied U.S. and Japanese nuclear power industries work with countries interested in nuclear power.

To this end, the U.S. and the Japanese governments will consult on their policies with regard to ensuring infrastructure for nuclear non-proliferation, nuclear safety, and nuclear security as the United States and Japan cooperate for the peaceful use of nuclear energy in countries deploying new nuclear power plants. The U.S. and the Japanese governments will also consult as necessary with respect to policies relating to the introduction or expansion of nuclear power and the nuclear energy industries in interested countries in which U.S. and Japanese nuclear industries are involved, including policies on human resources development and institutional development, export controls, and related topics.

6. Summary

6.1 Nuclear Energy Cooperative Research and Development under GNEP

This Joint Action Plan will be rapidly initiated through near-term engagement. Focus of joint cooperative research and development will include:

- *Fast Reactor Technology*
- *Fuel Cycle Technology (separations and fuel fabrication technologies with proliferation resistance)*
- *Simulation and Modeling*
- *Small and Medium Reactors*
- *Safeguards and Physical Protection*
- *Waste Management*

Appendix 2 outlines the Actions and Milestones for 2007-2008, and Appendix 3 outlines the proposed near-term activities for consideration by the Steering Committee Co-Chairs.

These actions provide demonstrable steps towards developing the key technical underpinnings of future nuclear energy systems, and this Joint Action Plan for bilateral cooperation forms the framework for the technical cooperation component of our Global Nuclear Energy Partnership.

6.2 Collaboration on Policies and Programs that Support the Construction of New Nuclear Power Plants

DOE and METI propose to exchange information and views on their respective policies and direction in relation to the construction of new nuclear power plants, and agree to establish a joint working group, under the Steering Committee, in order to collaborate on the parties' policies and programs that support the construction of new nuclear power plants.

6.3 Establishing Nuclear Fuel Supply Assurance Mechanism

The U.S. and Japan propose to expand the peaceful use of nuclear power while simultaneously reducing the risk of nuclear proliferation. To accomplish this vision, the parties will work to provide technical analysis in support of, and where appropriate participate actively in, discussions mainly at IAEA concerning Reliable Nuclear Fuel supply assurance mechanism.

6.4 Joint Collaboration to Support the Safe and Secure Expansion of Nuclear Energy in Interested Countries While Promoting Non-proliferation

The U.S. and the Japanese governments will consult on their policies with regard to ensuring infrastructure for nuclear nonproliferation, nuclear safety, and nuclear security as the United States and Japan cooperate for the peaceful use of nuclear energy in countries deploying new nuclear power plants. The U.S. and the Japanese governments will also consult as necessary with respect to policies relating to the introduction or expansion of nuclear power and the nuclear energy industries in interested countries in which U.S. and Japanese nuclear industries are involved, including policies on human resources development and institutional development, export controls, and related topics.

6.5 Concluding Statement

The Steering Committee Co-Chairs will implement this Joint Action Plan, demonstrating their ongoing commitment to achieving significant progress in advancing the frontiers of nuclear energy and that the expansion of nuclear energy can be achieved in a safe, sustainable, and secure manner, while reducing proliferation risk.

References

1. **Joint Statement by President Bush and Prime Minister Koizumi, Washington, D.C., June 29, 2006.**
2. **Joint Statement: The Japan-U.S. Alliance of the New Century, Washington, D.C., June 29, 2006.**

For the Department of Energy

For the Ministry of Economy, Trade and Industry



甘利 明 (印)

Samuel W. Bodman
Secretary, The Department of Energy

Akira Amari
Minister, The Ministry of Economy,
Trade and Industry

Date: 4/13/07

Date: 4/16/07

For the Ministry of Education, Culture,
Sports, Science and Technology

平野 文男

Bunmei Ibuki
Minister, The Ministry of Education,
Culture, Sports, Science and Technology

Date: 4/17/07

For the Ministry of Foreign Affairs

麻生 太郎

Taro Aso
Minister, The Ministry of Foreign Affairs

Date: 4月十九日
平成十九年

Appendix 1

List of Bilateral Meetings on U.S. – Japan Nuclear Energy

Cooperative Research and Development - 2006

1. GNEP Government to Government Meeting between Japan and the U.S., February 27-28, 2006, Tokyo, Japan
2. DOE and JAEA Meeting on Joint GNEP Cooperation, April 10, 2006, Washington, D.C.
3. Meeting between Samuel Bodman, U.S. Secretary of Energy, and Iwao Matsuda, Japanese Minister of State for Science and Technology Policy, May 4, 2006, Washington, D.C.
4. Meeting between Samuel Bodman, U.S. Secretary of Energy, and Kenji Kosaka, Japanese Minister of Education, Culture, Sports, Science and Technology, May 5, 2006, Washington D.C.
5. U.S. and Japan Bilateral Meeting on Joint Nuclear Energy Cooperation, May 25-26, 2006, Tokyo, Japan.
6. Argonne National Laboratory/DOE and JAEA Working Group Meeting on “Potential Joint Separation Research and Development Activities”, June 29-30, 2006, Chicago, IL
7. GNEP Government to Government Meeting between Japan and the U.S., August 21, 2006, Tokyo, Japan

Appendix 2

Proposed Actions and Milestones for 2007-2008 For Research and Development Activities

Proposed Delivery Date	Proposed Actions
June 2007	<ol style="list-style-type: none"> 1. Identify and establish Steering Committee. 2. Identify U.S./Japan Co-Chairs for each of the following agreed upon Working Groups: <ol style="list-style-type: none"> A. Fast Reactor Technology B. Fuel Cycle Technology C. Simulation and Modeling D. Small and Medium Reactors E. Safeguards and Physical Protection F. Waste Management 3. U.S. Hosts First Set of Working Group Meetings – all Working Groups (A-D and F; E may meet at a later date)
July 2007	<ol style="list-style-type: none"> 1. Joint Report by Co-Chairs of each Working Group – (“Joint U.S./Japan Nuclear Energy Cooperative R&D Plan”) which outlines agreed upon work-scope, schedule, and milestones for each side –submit to Steering Committee Co-Chairs. 2. Initiate Joint U.S./Japan Nuclear Energy Cooperative R&D
November 2007 to January 2008	<ol style="list-style-type: none"> 1. Japan hosts Working Groups (A-F). 2. Joint Report by Working Group Co-Chairs on “2007 R&D Accomplishments”- submit to Steering Committee Co-Chairs
March 2008	<ol style="list-style-type: none"> 1. U.S. hosts Working Groups Phase I Technical Review Meeting
April 2008	<ol style="list-style-type: none"> 1. “Joint U.S./Japan Nuclear Energy Cooperative R&D Report” by Working Group Co-Chairs – Submit to Steering Committee Co-Chairs 2. Plan Phase II Activities
May 2008	<ol style="list-style-type: none"> 1. Working Group Co-Chairs develop and submit “Joint U.S./Japan Nuclear Energy R&D Cooperative Plans for 2008” to Steering Committee Co-Chairs

	<p>2. Steering Committee Co-Chairs Review/Approve/or Disapprove “Joint U.S./Japan Nuclear Energy R&D Cooperative Plan for 2008”</p>
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Appendix 3

Phase I

Proposed Research and Development Activities for Consideration by the Nuclear Energy Steering Committee Co-Chairs

- (1) Fast Reactor Technology:** Fast reactor research and development, design, and evaluation of system design concepts.

In the Phase I, Japan will propose a design concept based on the results of its own development program. Exchange of personnel will be a high priority for both parties and is strongly recommended for consideration by the Co-Chairs.

Japan and the United States will work toward defining basic advanced recycle reactor specifications and associated research and development by around March 2008, with the expectation of drawing up a R&D implementation plan for development of the advanced recycle reactor (research topics, roadmap, project structure, etc.). R&D topics expected in the roadmap of Phase II are suggested to include TRU fuel safety experiments (possibly in TREAT), TRU fuel irradiation in Monju, evaluation of high burn-up oxide fuel irradiated at FFTF (post-irradiation tests), etc.

- (2) Fuel Cycle Technology:** Evaluations of and experiments on separation technologies and fuel fabrication technologies with proliferation resistance.

The U.S. and Japan propose to cooperate in the technical evaluation of the proposed U.S. Consolidation Fuel Treatment Center (subject to approval by the Steering Committee), with the consideration to include countries that have commercial scale reprocessing plants.

With regard to future research and development related to U.S. Advanced Fuel Cycle Facility (AFCF), Japan and the United States propose to conduct joint research and development for technologies of concern to both countries, and they are encouraged to reach agreement on a plan for such research by March 2008.

- 1) By September 2007, the Fuel Cycle Technology Working Group will review the results of Japanese and U.S. research. Based on the findings of the review, it will develop an R&D implementation plan (R&D topics, roadmap, program structure, etc.) for a joint R&D program and reach agreement by the end of March 2008.
- 2) The Fuel Cycle Technology Working Group will propose to conduct a joint design review of the U.S. side's conceptual design for an AFCF (September 2007 and January 2008).

Personnel may be exchanged for the purpose of carrying out these tasks.

- (3) Simulation and Modeling:** Computer simulation and modeling of advanced nuclear fuels, materials, reactor design, and validation with appropriate experimental research data. A system to confirm simulation and modeling through the collection of data from actual experiments will be considered to support the development, verification and validation of models.

During 2007, survey and study simulation and modeling technology together with elemental technology useful for data linkage, looking ahead to formulation of a preliminary conceptual design for a fast recycle reactor and an advanced fuel-cycle facility.

- (4) Small and Medium Reactors:** Evaluation of near term feasibility, cost and schedule for various small and medium reactor concepts.

The working group is encouraged to focus on the tasks listed below, with a view to completing them by December of 2007.

- 1) Conduct a study on the needs of developing countries and the specifications (electric power, safety, economic efficiency, etc.) of nuclear reactors that developing countries can easily introduce and formulate the basic requirements for small and medium reactors.
- 2) Review the designs of small and medium reactors that have been studied in Japan and the United States and draw up a concept for small and medium reactors that meet the basic requirements.
- 3) Consider the development of a R&D plan for small and medium reactors, based on mutual agreement between the respective goals of both the U.S. and Japan.

- (5) Safeguards and Physical Protection:** Advanced safeguards and physical protection approaches for future nuclear fuel cycles and associated facilities

The Safeguards and Physical Protection Working Group will use existing mechanisms, including the DOE-JAEA Safeguards Cooperation Agreement, to conduct a review of safeguards approaches for advanced nuclear facilities to identify opportunities for new or expanded collaboration, including in relation to the other working groups established under this Joint Action Plan, and possibly, in consultation with the IAEA, where practical. In addition, it will draw up a joint research, development and implementation plan for advanced safeguards and physical protection approaches by March 2008.

The Safeguards and Physical Protection Working Group may hold its first meeting after the proposed May 2007 working group meeting.

- (6) Waste Management: Concepts and Evaluations**

In the area of radioactive waste management, advanced waste forms and generic disposal concept(s) will be developed in the cooperation between Japan and the United States to support sustainable use of nuclear energy in the future, taking into account various aspects such as long-term safety, social acceptability, nuclear fuel cycle options, etc. For this objective, a generic approach and

methodology for optimization of waste management systems is to be developed, with applications to a range of future advanced fuel cycles and broad geologic settings and geochemical environments, through the following two interrelated tasks.

In the near term, the work will focus on the consolidation of the existing technical basis, to provide a future plan.

- 1) Analysis of credible scenarios for future nuclear energy use and resulting waste inventories (Task 1)**
- 2) Waste management system optimization based on the range of radioactive waste streams, advanced waste forms, and generic repository concepts (Task 2)**