# CSCAP's NEEG:
# Exploring Nuclear Energy Transparency as a Regional Confidence and Security Building Measure

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**A Review of the Work of the
Council for Security Cooperation in the Asia Pacific's
Nuclear Energy Experts Group**

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## Pacific Forum CSIS

Based in Honolulu, Pacific Forum CSIS operates as the autonomous Asia-Pacific arm of the Center for Strategic and International Studies in Washington, D.C. The Forum's programs encompass current and emerging political, security, economic/business, and oceans policy issues through analysis and dialogue undertaken with the region's leaders in the academic, government, and corporate areas. Founded in 1975, it collaborates with a broad network of research institutes from around the Pacific Rim, drawing on Asian perspectives and disseminating project findings and recommendations to opinion leaders, governments, and members of the public throughout the region.

## Council for Security Cooperation in the Asia Pacific (CSCAP)

The Pacific Forum joined with nine other institutes in July 1993 in Kuala Lumpur to establish CSCAP as a forum for non-governmental "track-two" multilateral security dialogue. A decade later, it now has 21 member countries. CSCAP members seek to enhance regional security and stability through dialogue, consultation, and cooperation on concrete policy issues and problems of mutual concern. The Council's research and analyses support and complement the efforts of regional governments and official multilateral dialogue mechanisms such as the ASEAN Regional Forum (ARF). The Pacific Forum manages the U.S. committee (USCSCAP).

## Nuclear Energy Experts Group

CSCAP Confidence and Security Building Measures (CSBM) International Working Group sponsors a Nuclear Energy Experts' Group (NEEG) which conducts indepth analysis on nuclear energy-related issues. The NEEG was formed in 1998 with the cooperation of the Cooperative Monitoring Center (CMC) of Sandia National Laboratories in Albuquerque, New Mexico. It has usually met twice annually. The NEEG has developed a generic nuclear energy monitoring scheme to promote greater transparency in nuclear energy production and research operations. It uses currently available technologies and is presented to nuclear energy producers in the region for consideration, on a voluntary basis, as a trans-national confidence building measure. It feeds into an Asia Pacific Nuclear Energy Transparency Web Site which has been developed by the NEEG in cooperation with the CMC.

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# Executive Summary

Driven by the prospect of rapid economic growth and the perceived need for energy security, the Asia-Pacific region will significantly expand nuclear energy use over the coming decades. China, India, South Korea, and Japan are projected to add a combined 45 gigawatts of nuclear power generating capacity between 2001 and 2025. An increase in the peaceful use of nuclear energy, however, brings with it rising concerns over safety, security, proliferation, and nuclear spent fuel accumulation. Particularly worrisome are projections that the amount of spent fuel in the region is projected to triple from 27.78 metric tons today to 95.07 metric tons by 2020**.** These concerns are further amplified when political insecurity in the region, including historical animosity and unsolved territorial issues, is taken into account. Plainly, nuclear energy concerns, entwined with regional tensions, have great implications for regional stability.

In order to address these nuclear energy-related concerns, the Council for Security Cooperation in the Asia Pacific (CSCAP) International Working Group on Confidence and Security Building Measures (CSBMs), together with the Nuclear Energy Experts Group (NEEG), has been conducting a nuclear energy transparency project. Nuclear energy transparency approaches range from simple information dissemination to discussion of the establishment of a Pacific Atomic Energy Community (PACATOM). The current product of this project is an extensive website (www.cscap.nuctrans.org) designed by the NEEG in cooperation with the Cooperative Monitoring Center (CMC) of Sandia National Laboratories. Longer-term efforts focus on the integration of transparency measures into plans to deal with the problems posed by nuclear spent fuel management and on the examination of multilateral cooperation to deal with nuclear energy-related problems.

Thus far, the Nuclear Transparency website has grown exponentially, validating the hopes of its planners. It contains data on nuclear energy producers and programs from Australia, China, Japan, the Republic of Korea, Russia, Taiwan and the United States, in each case provided by the representative government nuclear authority. In addition, the website provides real-time radiation monitoring from six partner institutions in Japan, Korea, Taiwan, Russia and the U.S. It also includes virtual tours of several nuclear facilities in the U.S. and Japan. As of June 2003, the website provides information on Asia-Pacific nuclear industries with more than 4,100 hyperlinks and serves about 18,000 file requests per month.

In addition to the website, the NEEG itself continues to meet on a regular basis, promoting dialogue and attempting to move the transparency process forward. As part of that mandate, the NEEG has visited nuclear facilities throughout the region, and those activities have contributed to trust and confidence in the Asia Pacific technical community.

The NEEG has also developed a template for an Asia Pacific Nuclear Energy Data Book. This project would provide a volume that explains a country's nuclear energy policy in all its dimensions. It includes the country's overall energy policy, its nuclear energy administration and regulatory framework, its nuclear power generation and research facilities, reprocessing, safety monitoring, public information and acceptance programs,

and cooperation with international regimes. The NEEG is currently preparing the first model data book.

The NEEG project is premised on the belief that nuclear energy transparency efforts, first, could build confidence in the peaceful, safe use of nuclear energy in the region, while addressing proliferation concerns. Second, the spread of the transparency norm could establish a cooperative tradition to deal with unsolved problems associated with nuclear spent fuel management. Third, evolving cooperation and enhanced confidence in nuclear energy management have the potential to create a political network that could help reduce uncertainties related to regional security issues. Importantly, nuclear transparency efforts could serve as confidence and security building measures (CSBMs) that could evolve to establish mutual trust among states that the region has long been missing.

The success of the NEEG project relies in large part on political features rather than technical issues. Main challenges to the project reside in how to promote nuclear authorities' willingness to participate in transparency efforts. By reviewing the process and development of the NEEG project, this report identifies several points that are critical for the project's future. These points include: 1) a political rationale based on an expanded cost-benefit analysis; 2) networking power; 3) flexibility; 4) fundability and sustainability; 5) ensuring relative gains; and 6) safeguards for security concerns.

The ongoing nuclear crisis on the Korean Peninsula poses a fundamental question for the nuclear energy transparency project: Can this project, as a CSBM, help foster a suitable security environment in the Asia-Pacific region? The answer is yet unclear; however, evolving cooperation in nuclear energy transparency suggests this is possible. Finally, in introducing the proposal for a verification mechanism for the nuclear crisis on the Peninsula, this report demonstrates the potential role that nuclear energy transparency efforts as CSBMs could play in crisis management.

One of the most important lessons of the NEEG process has been the need for patience. In the words of one participant, transparency "should go slow in order to go fast." Thus, emphasis has been placed on voluntary participation, even if that slowed the development of the project. Instilling a sense of ownership among participants has been deemed more important than acquiring all the relevant information quickly.

# Chapter I:
# Overview: Nuclear Energy Transparency

## Introduction

A vigorous increase in energy demands in the Asia-Pacific region, combined with the perceived need for energy security or self-sufficiency, has driven many Asian countries to develop or consider the use of nuclear energy. However, the increasing use of nuclear energy brings with it rising safety, security, and proliferation concerns. The expansion of nuclear energy programs has also magnified concerns over the accumulation of nuclear spent fuel and unsolved questions regarding the treatment and disposal of radioactive residues produced by nuclear energy production.

These concerns are multifaceted. Safety concerns include operational safety and environmental concerns, such as fear of environmental hazards caused by leaks or nuclear meltdown. Terrorism has also highlighted security concerns over the physical protection of nuclear facilities and transportation of plutonium. A country's possession of plutonium, one of the components in the manufacture of nuclear weapons, adds proliferation concerns, creating suspicions about the country's use of the material. These suspicions are amplified when reprocessing or plutonium stockpiling is concerned, leading to accusations that the country is pursuing a nuclear weapon programs. Behind processing programs and plutonium stockpiling, there are concerns over the accumulation of nuclear spent fuel and the fact that the world has not developed permanent solutions for nuclear residues.

Political insecurity compounds these concerns. The four most important issues in the region are: 1) the Korean Peninsula, 2) the Taiwan-China relationship, 3) unresolved territorial issues (including the Spratly Islands, Kurile Islands, Tokdo/Takeshima Island, and Diaoyu/Senkaku Islands), and 4) the coexistence of great powers, namely, the U.S., China, Russia, and Japan. With the exception of Japan, they are also nuclear weapon states as defined by the nuclear Non-Proliferation Treaty (NPT), and thus, weapons of mass destruction (WMD) are a salient issue for the great powers in the Asia-Pacific region. Therefore, nuclear energy concerns, entwined with those regional tensions, have great implications for regional stability.

In order to address nuclear energy-related concerns, the Council for Security Cooperation in the Asia Pacific (CSCAP) – a nongovernmental organization linking together research institutes and specialists from throughout the region – has been investigating the feasibility of multilateral approaches toward ensuring the peaceful, safe use of nuclear energy. For the purpose of this examination, the CSCAP International Working Group (IWG) on Confidence and Security Building Measures (CSBMs) has been evaluating ways to increase nuclear safety and transparency and promote confidence in the Asia-Pacific.

## Motivations and Assumptions

CSCAP missions are based on the belief that multilateral confidence building measures aimed at increasing transparency and enhancing safeguards and awareness of nuclear energy programs could help ensure that regional use of nuclear energy does not contribute to misunderstandings about the nuclear intentions of individual nuclear authorities, while also promoting nuclear safety and non-proliferation goals. It is further driven by the recognition that, even if no new nuclear reactors were ever built in the region, safety, security, and proliferation concerns associated with ongoing programs of both nuclear energy production and research need to be addressed more effectively.

Growing amount of radioactive waste in the Asia-Pacific amplifies the need to address policies and challenges of spent fuel storage and reprocessing. However, the lack of mutual trust among states in the region suggests that institutionalization of nuclear related issues is not appropriate step at this time. Instead, developing a cooperative tradition through nuclear transparency efforts should precede institutional arrangements. Increased nuclear energy transparency could not only help build confidence in safe, peaceful use of nuclear energy, but create the climate favorable for multilateral cooperation. This climate along with increased transparency could, then, form a foundation for more formal, comprehensive multilateral management. A focus on this process of confidence building is important if multilateral cooperation is to help solve contentious nuclear energy issues, such as spent fuel management. Importantly, incremental cooperation and confidence in nuclear energy management could promote mutual trust that the region has long been missing.

## The Concept of Nuclear Energy Transparency

Nuclear transparency is defined as "a cooperative process of providing information to all interested parties so that they can independently assess the safety, security, and legitimate management of nuclear materials."[1] This fundamental principle of transparency requires both technical methods and political will. Nuclear transparency technologies can provide communication methods for nuclear producers and local communities. Using these technologies, nuclear producers can assure local communities that their facilities are being operated in a safe and environmentally friendly manner, while the local communities can have necessary information whenever needed regarding safety of nuclear operations. Further, nuclear authorities' commitment to transparency encourages them to have greater responsibility for operational safety and the peaceful use of nuclear power.

Political will is also crucial. Transparency requires nuclear authorities to be willing to allow access to their operational data and decision-making processes. Their willingness to provide "access to data" and "access to process" could enhance public understanding of nuclear energy and facilitate cooperation among all interested groups. The process of promoting mutual trust, strengthening credibility of safe operations, and facilitating

[1] Charles D. Harmon, John N. Olsen, and Howard D. Passell, "NUCLEAR FACILITY TRANSPARENCY: Definitions and Concepts" (presented at the US-Japan Energy Seminar, Washington DC, Oct. 4-6, 2000) at http://www.cmc.sandia.gov/Links/about/papers/usjapanoct2000/usjapanoct2000.htm

cooperation through nuclear transparency efforts, is deemed to be especially important in dealing with problems associated with spent fuel management.

**Goals**

The CSCAP International Working Group on CSBMs established a broad scheme for a nuclear transparency project in the Asia-Pacific, the PACATOM project, in 1996 and established the Nuclear Energy Experts Group (NEEG) in 1998 to reinforce its technical credibility. Since then, the CSBM working group, together with the NEEG, has examined and implemented several nuclear transparency approaches, ranging from simple information dissemination to discussing a potential Pacific Atomic Energy Community (PACATOM). The current product of the NEEG project is an extensive website (http://www.cscap.nuctrans.org) designed by the NEEG. The website links existing transparency measures across the Asia-Pacific region and is encouraging further transparency steps. Longer-term effort focuses on integrating transparency measures into plans to deal with the problems posed by the back end of the nuclear fuel cycle.

Bearing in mind the potential role that nuclear transparency could play, the CSBM IWG identified the following goals of the NEEG project:

- to identify and articulate, and then help to address or alleviate, nuclear energy-related regional concerns;
- to identify and help institute both information collection and dissemination and a series of confidence building measures aimed at reducing current nuclear energy-related concerns while setting the stage for more formalized multilateral cooperation; and
- to assess the feasibility and define the likely parameters of an institutionalized regional regime aimed at promoting greater safety, security, and transparency in nuclear energy production and research operations.

The aim of the NEEG project is neither to promote nor to discourage or rally efforts against the use of nuclear energy. Rather, it is to ensure its safe use among those who choose the nuclear energy option, first by highlighting the regional concerns associated with its use and then by investigating whether multilateral confidence building efforts could help alleviate or reduce these concerns. At a minimum, CSCAP's efforts should contribute to a greater awareness among both the policy-making and nuclear energy communities of regional concerns related to nuclear energy research and production.

**Background**

**The Council for Security Cooperation in the Asia Pacific (CSCAP).** The Council for Security Cooperation in the Asia Pacific (CSCAP) is a nongovernmental or "track two" organization established in June 1993 "for the purpose of providing a structured process for regional confidence building and security cooperation among countries and territories in the Asia Pacific region."[2] CSCAP links regional security-oriented institutes and, through

[2] Article II of the CSCAP Charter. For a copy of the *Charter* and the June 1993 *Kuala Lumpur Statement on*

them, broad-based member committees comprised of academicians, business leaders, security specialists, and former and current foreign ministry and defense officials. Government (including uniformed military) participants take part in their private capacities, and not as official spokespersons for their governments' views.

CSCAP is comprised of 21 member committees.[3] In addition, two UN organizations enjoy Affiliate/Observer status.[4] Taiwan security specialists participate in working sessions in their private capacities. Given its broad-based membership and open participation, the CSCAP CSBM Working Group is one of the few venues (if not the only forum) in which all current and prospective nuclear energy producers can meet to discuss security-related concerns in an unofficial but highly informed setting.

As distinct from the many other valuable conferences and meetings on Asia-Pacific security issues, CSCAP serves as a consensus organization to advance dialogue on difficult issues in a consistent and productive manner. CSCAP bridges many disciplines, points of view, and national interests without imposing doctrinaire approaches. All members view it as an indispensable vehicle for building cohesion and transparency in a region resistant to overarching institutions. Importantly, it has direct links, at the highest level, into the policy-making communities of its respective member states.

CSCAP, predating the governmental, ministerial-level ASEAN Regional Forum (ARF), is now focusing its efforts on providing direct support to the ARF, while also pursuing other track-two diplomacy efforts. Several CSCAP issue-oriented international working groups are already focusing on specific topics outlined in the 1995 ARF final communique. These groups include IWGs on confidence and security building measures (CSBMs), comprehensive and cooperative security, maritime security cooperation, and transnational crime, plus a North Pacific Working Group, which focuses on the establishment of frameworks for Northeast Asia security cooperation.

**The International Working Group on Confidence and Security Building Measures (CSBMs).** CSCAP member committees of the U.S., Singapore, and Republic of Korea co-sponsor the International Working Group on Confidence and Security Building Measures (CSBMs) in the Asia Pacific. This has been the most active International Working Group, having met 20 times, most recently in August 2003 in Singapore. The first CSBM Working Group meeting was held in Washington, D.C. in October 1994 and was aimed at answering the question, "Are CSBMs appropriate for Asia and, if so, what type measures might apply?" Having answered "yes" to the basic question, the CSBM International Working Group has:

- examined basic principles for regional confidence building;
- investigated the utility and applicability of the UN Register of Conventional Arms

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*the Establishment of CSCAP,* see CSCAP Newsletter No.1, May 1994, published by the Institute for Strategic and International Studies, Kuala Lumpur, Malaysia, which serves as the CSCAP Secretariat.

[3] Australia, Brunei, Cambodia, Canada, China, India, Indonesia, Japan, Malaysia, Mongolia, New Zealand, North Korea, Papua New Guinea, Russia, Singapore, South Korea, Thailand, the European Community, the Philippines, the United States (U.S.), and Vietnam.

[4] The directors of the UN Regional Centre for Peace and Disarmament in Asia and the Pacific and the UN Department of Political Affairs' East Asia and the Pacific Division enjoy Affiliate/Observer status.

to the Asia-Pacific region, while also laying the groundwork for possible development of an Asian Arms Register;

- developed a generic outline for defense policy papers ("white papers") to aid those regional states that have decided to produce or refine current versions of this transparency tool;
- stimulated discussion and debate on the ARF's possible future preventive diplomacy role, including the development of a working definition and statement of principles of preventive diplomacy;
- performed groundbreaking work on the development of multilateral approaches to nuclear safety and nonproliferation in the region, including developing an outline for an Asia Pacific Nuclear Energy Data Book that will form the basis for future volumes outlining specific indigenous programs;
- discussed the possible formation of an Asian or Pacific Atomic Energy Community (PACATOM) cooperative mechanism.

The group also sponsors the Nuclear Energy Experts' Group, which conducts more in-depth analysis on nuclear energy-related issues.

**Nuclear Energy Experts Group (NEEG).** The Nuclear Energy Experts Group (NEEG) is part of a broader effort aimed at promoting confidence through dialogue and the development of regional transparency measures related to nuclear energy. It grew out of the CSBM Working Group's examination of regional concerns involving the various aspects of nuclear energy research and production.

The NEEG's mission is to dig more deeply into measures for promoting trust and understanding on nuclear energy issues. The primary vehicle to achieve this goal is the Nuclear Energy Transparency in the Asia-Pacific Web Site chosen by the group and designed by the Cooperative Monitoring Center (CMC) of Sandia National Laboratories.

The NEEG includes nuclear industry experts from all current Asia-Pacific nuclear energy producers – as of June 2003, Australia, Canada, India, Japan, Russia, Taiwan, the Peoples' Republic of China, the Republic of Korea, and the United States. Additional participants from Mongolia, New Zealand, Singapore, the Philippines, and Vietnam add a broad regional perspective. Beginning in two meetings at the Cooperative Monitoring Center at Sandia National Laboratories in New Mexico in October 1998 and January 1999, the group has met roughly twice a year to review progress and determine new goals.

**Nuclear Energy Use**

Regardless of whether new nuclear reactors are to be built in the Asia-Pacific region, safety, security, and proliferation concerns associated with current ongoing programs and the ever-expanding total amount of radioactive waste in the region necessitate the investigation of nuclear energy-associated confidence building measures. The need becomes magnified when one realizes that the number of nuclear power plants in Asia is destined to grow significantly in the next few decades.

This section describes the projected increase in nuclear energy consumption in the region in conjunction with economic growth, and the implications for the already serious concerns over spent fuel accumulation. Then, it examines the impetus behind decisions on nuclear energy policies in order to determine potential incentives for or obstacles to transparency efforts.

**Economic Forecasts.** While the sluggish U.S. economy reflects the current momentum of the world economy, developing Asia (defined as Asia except Japan) remains a bright spot. *The International Energy Outlook 2003 (IEO2003) reference case* by the U.S. Department of Energy presents a positive figure for the momentum of region's economic growth over the 2001 to 2025 period. It projects that the economy of developing Asia will expand by an average of 5.1 percent of GDP annually, with an annual average of 3.1 percent for the world economy over the same period.[5] Noteworthy is China's projected annual GDP growth of 6.2 percent, followed by India's 5.2 percent during the period.[6]

Energy demand correlates closely with economic growth, although the strength of their relationship varies among states and depends on their stage of economic development. Nevertheless, developing Asia, in response to the robust economic growth, is expected to see the strongest growth in energy demands. *The IEO2003 reference case* assesses that energy demands in the region will more than double from 85.0 quadrillion Btu (British thermal unit) in 2001 to 174.6 quadrillion Btu in 2025.[7] With an average annual growth rate of 3 percent, energy use in developing Asia accounts for nearly 40 percent of the total projected increment in world energy consumption and 69 percent of the increment for the developing world alone over the period.[8]

**Use of Nuclear Energy.** Currently, the use of nuclear energy as a source of electricity is decreasing in many parts of the world. *The IEO2003 reference case* predicts a drop in the nuclear share of electricity worldwide from 19 percent in 2001 to 12 percent in 2025.[9] The downward trend is especially clear in industrialized countries with the exception of Japan. The U.S. – the country with the largest number of operational nuclear power plants (104)[10] – has no orders for new nuclear plants construction as of June 2003. The Department of Energy forecasts that expansion of nuclear energy use in the country is unlikely in the next 24 years, although it projects that upgrade of existing capacity will result in a slight increase of nuclear energy generation from 98.2 gigawatts in 2001 to 99.6 gigawatts in 2025.[11]

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[5] Department of Energy, *The International Energy Outlook 2003 (IEO2003) reference case* (Washington, D.C.: Energy Information Administration (EIA), 1 May 2003), 7-11. http://www.eia.doe.gov/oiaf/ieo/pdf/consumptopn.pdf

[6] Ibid., 7-11.

[7] Ibid., 7.

[8] Ibid., 7-27

[9] Department of Energy, *The International Energy Outlook 2003 (IEO2003) reference case,* 4.

[10] International Atomic Energy Agency (IAEA), *Power Reactor Information System (PRIS)* (Vienna: WORLDATOM, 30 June 2003). http://www.iaea.org/programmes/a2/index.html

[11] Department of Energy, *The International Energy Outlook 2003 (IEO2003) reference case,* 101-103.

The trend is just opposite in Asia. A remarkable increase in nuclear capacity is expected, with China, India, South Korea, and Japan projected to add a combined 45 gigawatts between 2001 and 2025.[12] This figure is even more striking compared to the 13.4 gigawatts increase projected worldwide. As of June 2003, 20 of 35 nuclear reactors under construction worldwide are in Asia, with eight in India, four in China, three in Japan, two each in South Korea and Taiwan, and one in North Korea.[13] South Korea's nuclear capacity was 13.0 gigawatts in 2001 (its nuclear share of total electricity generation was 39 percent) and is projected to expand by 14.6 gigawatts, to 27.6 gigawatts in 2025. The two largest economies in developing Asia – China and India – both are expected to expand their nuclear power capacity significantly. With four nuclear reactors currently under construction, China is projected to see 17.6 gigawatts expansion of nuclear capacity, from 2.2 gigawatts in 2001 to 19.6 gigawatts in 2025. In India, eight nuclear reactors are currently under construction. With those completions, India is expected to increase its nuclear capacity by 4.5 gigawatts, from 2.5 gigawatts in 2001 to 7.0 gigawatts in 2025. Japan, the only industrialized country with plans to expand its nuclear power, has three nuclear reactors currently under construction. In 2001, its nuclear share of electricity generation marked 34 percent, and its nuclear capacity is projected to increase by 8.7 gigawatts, from 43.2 gigawatts in 2001 to 51.9 gigawatts in 2005.[14]

**Spent Fuel Accumulation.** Accumulation of spent fuel accompanies the generation of nuclear energy. Increasing use of nuclear energy magnifies the rise of spent fuel accumulation. The Energy Information Administration of the Department of Energy projects the amount of spent fuel worldwide will more than double from 228.3 metric tons in 2000 to 457.09 metric tons in 2020. During this period, spent fuel in Asia alone is projected to triple from 27.78 metric tons to 95.07 metric tons. Noteworthy is the increase of spent fuel in the U.S., from 42.71 metric tons to 82.71 metric tons. This constitutes the largest amount in the world both in 2000 and in 2020, although there are no orders for new nuclear reactors in the U.S. during this period.[15]

The continuing accumulation of spent fuel in the region has intensified the already serious problems in management of the back end of nuclear fuel cycle. Nevertheless, new nuclear power plants are coming into operation in Asia, and existing power plants continue to generate radioactive waste in the region. Adding to this accumulation is decommissioning of obsolete nuclear reactors and submarines in Russia. Concerns over spent fuel accumulation are amplified by the facts that existing interim spent fuel storage is approaching capacity, and that the efforts to establish new interim storage inevitably meet with political difficulties. These political difficulties, as well as the delay in final repository programs, have been implicit motivations for reprocessing policies in some countries.

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[12] Ibid., 4.
[13] International Atomic Energy Agency (IAEA), *Power Reactor Information System (PRIS).*
[14] Department of Energy, *The International Energy Outlook 2003 (IEO2003) reference case*, 106.
[15] Department of Energy, *World Cumulative Spent Fuel Projections by Region and Country* (Washington, D.C.: Energy Information Administration (EIA), May 1, 2001), http://www.eia.doe.gov/oiaf/ieo/pdf/consumptopn.pdf

**Decisions over Nuclear Power.** Understanding the considerations behind nuclear energy policies is crucial to promote the nuclear energy transparency, since these considerations have great implications on nuclear authorities' attitude toward transparency efforts.

Decisions over the use of nuclear power are determined by a multitude of factors. Economic, political, and environmental considerations clearly influence decisions on its use as an energy source. Equally influential is energy security, especially in countries with scarce indigenous natural fuels. These factors are not totally independent; rather, they are correlated or entwined with others.

**Economic Considerations.** The prospects of economic growth and the rapid increase in energy demand are certainly behind decisions to expand the use of nuclear power in the Asia-Pacific region. Economic calculations, however, result in mixed assessments of nuclear energy economics. In general, nuclear energy is a relatively expensive option for meeting energy demand compared to natural gas or coal, particularly for states with inexpensive natural resources. The economics of nuclear energy, however, may be more favorable in some countries, such as South Korea and Japan, in which technological achievement allows relatively low-cost nuclear power projects, and where other energy resources are scarce and relatively expensive compared to other countries. The energy import dependency ratio of South Korea and Japan was 86.6 percent and 81.0 percent, respectively, in 2000.[16] Their heavy reliance on external fuel supply adds another dimension to the nuclear energy economics, especially when faced with increasing demand for energy. Incremental energy needs, together with uncertainty of oil supply, has resulted in an impetus for the pursuit of nuclear power programs in the two countries.

**Environmental Considerations.** Environmental considerations also provide contradictory impulses to national nuclear energy policies. On one hand, nuclear energy looms large as a potential environmental risk. Hazardous radioactive materials generated by the nuclear power cycle pose a major threat to the environment in the following four processes/cases of nuclear energy programs: 1) leakage in case of accidents, 2) interim storage, 3) transport, and 4) permanent repository. The Asia-Pacific region has experienced numerous environmental tensions associated with radioactive hazards, including the nuclear accident at Tokaimura, Japan in September 1999, and the dumping of nuclear waste in the Sea of Japan by Russia.[17] Contributing to national decisions to refrain from using nuclear power are concerns over unsolved problems associated with highly radioactive nuclear residues. Obviously, radioactive materials produced along with nuclear power generation heighten transboundary environmental tensions that may contribute to regional destabilization.

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[16] The International Energy Agency, *Key World Energy Statistics: Selected Energy Statistics for 2000* (Paris, 2002). http://www/iea.org/statist/keyworld2002/key2002/keystates.html

[17] Nautilus Institute and Center for Global Communications (GLOCOM), "Energy, Environment and Security in Northeast Asia: Defining a U.S.-Japan Partnership for Regional Comprehensive Security" *Energy, Security, Environment in Northeast Asia (ESENA) Project Final Report* (Berkeley, December 1999), 13. http://www.nautilus.org/papers/energy/ESENAfinalreport.html

On the other hand, concerns about global warming have infused a new rationale for nuclear energy policies. The emissions standards laid out in the Kyoto Protocol in 1997 pose difficulty for many states that do not replace fossil fuels with nuclear energy. The analysis of greenhouse gas emissions from different forms of electricity generation conducted by the Nuclear Energy Agency of the Organization for Economic Cooperation and Development (OECD) indicates that nuclear power is the least carbon intensive generation technology. It further points out, "[If] the nuclear units in operation have substituted for modern fossil-fueled power plants, nuclear energy today is reducing $CO^2$ emissions from the energy sector by more than 8 percent world-wide (for the electricity sector, the reduction is about 17 percent)."[18] The preference for nuclear energy as "the most environment-friendly of all power sources,"[19] was stipulated in Japan's announcement in March 2002 that it would rely on nuclear energy to achieve greenhouse gas emission reduction goals of the Kyoto Protocol.

**Energy Security.** Concerns about energy security, a major component of national security, have a long history. The traditional concept of energy security focused on "quantity risk" that emphasizes the importance of avoiding political or strategic energy supply disruption. Added to the traditional concept are "price risk" and "environmental risk." "Price risk" encompasses economic security derived from energy price stability and "environmental risk" pays attention to environment-friendly energy sources. As a result, a stable, cost-effective, and sustainable supply of environment-friendly energy has become a key component of energy security.

The perceived need to reduce vulnerability to energy supply disruption has driven states to diversify energy fuels and sources and develop their own energy sources. The development of indigenous energy sources and technology is deemed critical to reduce vulnerability to volatile fuel prices and external political uncertainty, thereby protecting economic security. Nuclear energy can be a crucial contributor to countries whose energy supply is vulnerable to external shocks. Two oil shocks during the 1970s, together with the Sept. 11, 2001 terrorist attacks and continuing unstable oil supplies, accentuate the importance of energy security.

Concerns over energy security are especially salient in Japan, South Korea, and China. Japan, whose energy import dependency ratio was 81.0 percent in 2000, in particular sees nuclear energy as a promising way to achieve energy security. Its experience of two oil shocks urged the country to reevaluate its energy policy, resulting in increased reliance on nuclear energy from 1 percent in 1973 to 12 percent in 2000 (34 percent in 2001), with reduced dependence on oil from 77 percent to 52 percent over the same period.[20] The need to minimize vulnerability to external energy supply is further reflected

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[18] Nuclear Energy Agency of the Organization for Economic Cooperation and Development (OECD), *Nuclear Energy and the Kyoto Protocol* (Issy-les-Moulineaux, FRANCE, 2002), 7. http://www.nea.fr/html/ndd/reports/2002/nea3808-kyoto.pdf

[19] Hiroshi Araki, the former president of Tokyo Electric Power Company (TEPCO) in Japan, "Harmonization of Energy and Environment" (Keynote speech presented at the Okinawa Energy Business Forum on Harmonization of Energy and Environment, 9-10 Oct., 1998), 6.

[20] Agency for Natural Resources and Energy, *Energy Supply in Japan Today* (Tokyo, 2001). http://www.enecho.meti.go.jp/english/energy/japan/supply.html

in its reprocessing policy. Japan, importing 100 percent of the uranium it uses, stipulates the need to improve uranium utilization by developing fast breeder reactors and by reprocessing, aiming to initiate domestic reprocessing from 2005.[21] The June 2002 Energy Policy Law sets out Japan's basic principles of energy security, giving greater authority to the government in establishing the energy infrastructure. These policy developments, despite a data falsification scandal by the nuclear industry in 2002 and the disapproval of the Monju fast breeder reactor project by a Nagoya district court in 2003, indicate an increased role of nuclear energy and reprocessing in the pursuit of energy security.

South Korea, heavily relying on external fuel sources (86.6 percent in 2000), is also committed to nuclear energy pursuer, relying on nuclear energy for 39 percent of its total energy supply in 2001.[22] Its nuclear power ambition has a long history, beginning in the 1950s with U.S. support and has been aggressive since the late 1970s. The country, along with China and India, has been aggressive in developing indigenous nuclear power plant designs, establishing a 10-year program in 1987 (which was then extended for another 10 years in 1997) of transferring nuclear technology to the domestic nuclear power industry. Its continuous national pursuit of indigenous advanced nuclear technology currently envisions the development of the advanced *Korea Next Generation Reactor (KNGR)*. The country's nuclear energy capacity will expand by 14.6 gigawatts with the completion of two additional reactors.

China's nuclear energy policies, while not aggressive, also reflect the country's concerns about energy security. China, despite its low energy import dependency (2.2 percent in 2001), sees energy security as critical for the country's economic growth over the coming decades. In late May 2003, it embarked on a large study of sustainable energy development to secure sufficient energy supplies for the next 50 years or so. Given the government's plan to quadruple GDP from the 2000 level by 2020, China will see a rapid increase in energy demand (it forecasts 3.9 percent annual growth of energy consumption from 2000 to 2010).[23] Mounting fear that domestic energy resources such as petroleum are drying up has forced the government to study the expansion of energy sources. Of particular concern is its heavy reliance on coal, which provided 64 percent of primary energy consumption in 2001.[24] Although the country will continue to utilize coal as a major energy source, coal is not an environment-friendly energy source, and is therefore, not sustainable as an energy supply. This has reinforced the need to seek more environment-friendly energy sources, such as natural gas, hydropower, and nuclear energy.

**Political Considerations.** Numerous political factors influence nuclear energy policies. Two factors in particular, public perceptions and domestic political competition, deserve special attention.

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[21] World Nuclear Association, *Nuclear Power in Japan* (June 2003). http://www.world-nuclear.org/info/inf79.htm

[22] Department of Energy, *The International Energy Outlook 2003 (IEO2003) reference case,* 101.

[23] Department of Energy, *World Energy Consumption* (Washington, D.C.: Energy Information Administration (EIA)), 19. http://www.eia.doe.gov/oiaf/ieo/pdf/consumption.pdf.

[24] Department of Energy, *Country Analysis Briefs* (Washington, D.C.: Energy Information Administration (EIA), June 2003), 7. http://www.eia.doe.gov/emeu/cabs/china.html.

Public perceptions are perhaps the most influential factors for the prevailing trend away from nuclear power in many parts of the world. These are many reasons why public sentiment is against nuclear energy; they include operational safety, radioactive waste disposal, the risk of nuclear weapons proliferation. All have created a political climate unfavorable for its use.

However, the level of influence that public opinion exerts over nuclear energy policies differs in each state, depending on their political regimes and the level of democracy. On one hand, countries in which democracy is well matured and the public exerts decisive power over political outcomes generally have more difficulty in pursuing national nuclear energy policies, particularly in dealing with unsolved problems in back-end fuel management. In those cases, governments may find nuclear transparency efforts effective to win public understanding; otherwise, they may decide to stay away from troublesome nuclear energy programs. On the other hand, countries with authoritative governments do not need to persuade the public in implementing nuclear energy policies if they deem the policies necessary for their countries' interests. These countries may find transparency efforts unnecessary and feel them burdensome or intrusive, especially if they do not care about perceptions of international community.

Political decisions are also subject to changes in regimes. Since nuclear power programs generally rely on government support, policies on nuclear power are susceptible to a regime change. This political influence is particularly clear in Taiwan where political divisions between the pro- and anti-nuclear camps are sharp. Immediately after the Democratic Progressive Party of Taiwan won presidency in March 2000, President Chen Shui-bian proclaimed a policy of eventually eliminating nuclear power, attempting to reverse the Kuomintang's 50 years of pro-nuclear policies. His pursuit of a non-nuclear Taiwan was followed by a decision to cancel construction of the Lungmen nuclear plant (fourth nuclear plant), but the decision resulted in a compromise in February 2001 to complete the project. However, nuclear issues remain at the center of a political storm between the two competing political parties. In June 2003, the Taiwan government expressed its intention to hold a plebiscite on the fate of the fourth nuclear power plant, indicating another policy shift on nuclear power. Although the prospects for Taiwan's nuclear power remain to be seen, political competition will continue to play a key role in Taiwan's nuclear future.

**Implications for Nuclear Transparency Efforts.** These various considerations regarding nuclear energy create incentives and obstacles for multilateral cooperation in nuclear energy transparency. Plainly, expectations for and trust in transparency efforts differs from state to state and case by case.

Acknowledging the potential limitations in influencing decisions of individual states' nuclear policies, the NEEG project should identify ways it can promote multilateral cooperation and ways in which it cannot in order to design a plausible scheme for nuclear transparency efforts.

# Chapter II:
# Nuclear Energy Transparency Project and Its Development

**Developments Before 1998**[25]

CSCAP's International Working Group on CSBMs' first task was to identify and articulate nuclear energy-related regional concerns. Since the factors driving nuclear energy decisions are not independent, concerns over nuclear energy correlate with others and sometimes overlap. Five broad categories of concerns were identified:

- *the safety of nuclear energy production and research operations,* including dangers to the environment, operational mishaps, safety standards and training, emergency response;
- *capabilities, and growing public apprehension* (including, among other issues, growing public perceptions/misperceptions about nuclear power safety and the ever-increasing not-in-my-backyard or NIMBY factor);
- *the potential downsides and dangers associated with reprocessing,* including added safety and environmental concerns, transportation and storage difficulties, fears about proliferation or diversion for military use, and precedents and implications for programs of neighboring states;
- *spent fuel and other nuclear waste storage and disposal challenges* – both interim and long term and involving both high- and low-level radioactive waste – which have both safety and security/proliferation aspects and which also have political, psychological, and emotional dimensions that should not be underestimated or ignored;
- *questions regarding the physical security of nuclear facilities and materials* (i.e., susceptibility to terrorism, espionage or external attack); the general adequacy of current monitoring procedures; the inadequacy of current transparency efforts; the unavailability, inaccessibility, or inadequacy of public information; and problems just over the horizon associated with eventual decommissioning of aging nuclear power production and research facilities.

The group has broadly identified six potential areas of cooperation. These are: 1) safety cooperation, 2) energy cooperation, 3) research cooperation, 4) regional safeguards, 5) managing the front end of the nuclear cycle, and 6) managing the back end of the nuclear fuel cycle.

Improved international *safety cooperation* could offer many benefits. For example, crisis prevention efforts might focus on improved reactor and facility designs and on standardizing operating procedures. In addition, emergency response efforts might focus

[25] For details, see Ralph Cossa, "Occasional Paper: PACATOM: Building Confidence and Enhancing Nuclear Transparency," *A CSCAP Working Group Special Report* (Honolulu: Pacific Forum CSIS, October 1998). http://www.csis.org/pacfor/opBuildConf.pdf

on common training programs, improved sharing of information in time of crisis, and perhaps even regional response teams.

Regional *energy cooperation* might be conducted under the auspices of a regional energy authority. One possibility would be to establish an energy distribution grid for member states that could supply, utilize, and distribute energy throughout the region. Another possibility would be to conduct joint research and development on nuclear and/or non-nuclear energy sources, as well as on energy conservation and environmental protection.

*Research cooperation* could occur via regional fund that provides technical aid for joint research on medical, agricultural, and scientific applications of nuclear technologies. Such cooperation could augment existing technical assistance offered by the International Atomic Energy Agency (IAEA).

Greater transparency in civilian nuclear activities has emerged as a concern and priority in each region where nuclear power has developed. Under the IAEA, visits and inspections are carried out at nuclear facilities that states have declared as part of a so-called safeguards system. But, *supplemental safeguards activities* could provide even greater transparency, especially since specific IAEA inspection results are not made public. In each case, the regional approach encompasses the IAEA and its inspections process as an integral partner, though each has done so differently.

An Asian cooperative program might focus on the *front end of the fuel cycle*, such as the acquisition of uranium and on the monitoring and disposal of spent fuels under high safety and environmental standards. It might also encompass means to use long-term plutonium economically, by creating common recycling facilities and enabling the accumulation, use, and reuse of plutonium stockpiles – whether nationally or by an international organization. An alternative approach would seek to work away from a plutonium economy, by burning and eliminating excess plutonium stocks by the mixed oxide fuel-option.

At a minimum, resources and research programs in the *back-end of the fuel cycle* aimed at both short-term and long-term solutions might be pooled and more productively coordinated. Cooperation on temporary and *in situ* storage, vitrification, transportation, and environmental protection could support this effort. Creation of a regional repository for spent fuel would be more ambitious and perhaps contentious, but could have a major positive impact in alleviating concerns over the safety, security, and proliferation of these materials.

Among these six potential areas of cooperation, the group recognized that cooperation in safety and in managing the back-end of the fuel cycle were two areas in which multilateral cooperation could best advance nuclear energy transparency.

Safety cooperation is the least contentious area for multilateral cooperation and an area in which much has already been accomplished. Nevertheless, concerns remain throughout the region about the safety of nuclear energy programs. The fact that safety standards and regulations vary from one nuclear institution to another also amplifies concerns and suspicions.

Spent fuel management represents the most contentious and politically sensitive issue among nuclear energy-related problems. Problems in the management of the back-end of fuel cycle including the reprocessing, handling, and storage, raise safety, security, and proliferation concerns. Although decisions on the management of nuclear spent fuel reside in each nation and nuclear institution, problems shared by all nuclear producers suggest that multilateral cooperation is worth examining. Using safety cooperation as a starting point, the NEEG project envisions cooperation in the back-end of the fuel cycle as a next phase in nuclear transparency efforts.

**Developments Since 1998**

The CSCAP International Working Group on CSBMs, working with the Cooperative Monitoring Center (CMC) of Sandia National Laboratories, convened a Nuclear Energy Experts' Group (NEEG) in 1998 to examine nuclear transparency measures for the Asia Pacific. The NEEG includes nuclear industry experts from all current Asia-Pacific nuclear energy producers – Canada, China, India, Japan, South Korea, Russia, Taiwan, and the United States. Additional participants from Australia, Mongolia, New Zealand, the Philippines, Singapore, and Vietnam add a broad regional perspective.

The group's primary goal is to develop transparency options for nuclear industries. The initial focus of the transparency package was on a "generic nuclear energy monitoring scheme" centered on airborne radiation and facility safety issues. Longer-term issues like spent fuel and waste disposition are currently being addressed as extensions of the initial concept. The underlying belief is that greater nuclear energy transparency and increased awareness of nuclear energy programs would help address safety, security, and nonproliferation concerns related both to nuclear energy production and to nuclear energy research.

Starting in October 1998, participants reviewed the various Asia-Pacific nuclear energy programs and evaluated measures taken by regional nuclear energy producers. The intent was to build upon these transparency precedents and develop options that could be adopted on a voluntary basis. Then, the participants examined a variety of nuclear energy-related technologies demonstrated by the CMC. Great interest was placed on airborne radiation monitoring. At the conclusion of the first workshop, they agreed to establish a website to communicate transparency information. The data would generally be suitable for wide distribution; however, distribution could be restricted if desired, and care would be given to data security.

Along with the development of the website, the NEEG promoted greater awareness in the concept of nuclear energy transparency and tried to increase participation in the project before it was unveiled to the public in April 2000. For that purpose, the NEEG conducted visits to selected nuclear industries and organizations throughout the Asia-Pacific region: May 1999 to the Republic of Korea, July 1999 to Japan and Taiwan, November 1999 to Seoul, February 2000 to Seoul, and March 2000 to Washington. Many power companies, laboratories, and nuclear authorities in Australia, Japan, South Korea, Taiwan, Russia and the United States have agreed to cooperate. Other organizations in Canada, China, the Philippines, and Mongolia have provided information for the website and offered links to related websites. The promotion of the transparency norm has expanded to include nuclear research and spent fuel facilities: the group has visited the Waste Isolation Pilot Plant near Carlsbad New Mexico in the U.S., the low- and high-level waste storage facilities at Rokkasho in Japan, the Underground Research Laboratory at Lac du Bonnet, Winnipeg, Canada, and the Yucca Mountain Exploratory Studies Facility (ESF) in the U.S. The website continues to develop. *The Nuclear Transparency in the Asia-Pacific* website is available at http://www.cscap.nuctrans.org.

**The CSCAP Asia-Pacific Nuclear Energy Transparency Website**

The CSCAP Asia-Pacific Nuclear Energy Transparency website is intended to provide a "one-stop shopping" location for information on regional nuclear energy programs. The website introduces a comprehensive overview of technologies that are currently available worldwide to enhance nuclear energy transparency. It also provides specific information about selected existing nuclear energy production efforts. Today, it contains information, at varying levels of specificity, about nuclear energy facilities and programs of Australia, China, Japan, the Republic of Korea, Russia, Taiwan, and the U.S., in each case provided in large part by the country's nuclear authority. The information includes radiation-monitoring data in some cases, and other data regularly collected by plants or industries, which are, in many instances, made available to the general public on a near-real time basis. In the section describing CSCAP and the CSBM working group, efforts at promoting nuclear energy transparency are introduced. Links have also been established to many related sites, such as those of the various power and research facilities, regulatory agencies, and environmental monitoring organizations region-wide. These components of a comprehensive "generic nuclear energy transparency system" are laid out, thus providing specific information to assist individuals, industries, organizations, or governments desirous of more specific information on how to enhance nuclear energy transparency. As of June 2003, the Web provides information on the Asia-Pacific nuclear industries with more than 4,100 hyperlinks and serves about 18,000 file requests per month.

To enhance transparency of nuclear energy systems in the Asia Pacific, the project makes information available concerning:

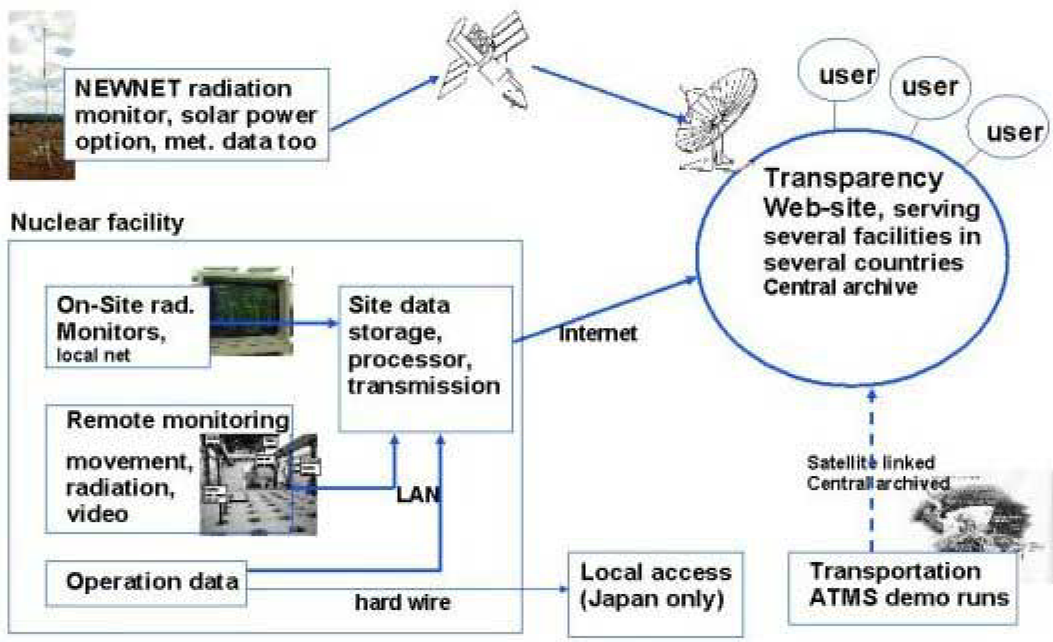
- Radiation in the air and water;
- Operational safety of nuclear facilities;
- Transportation safety;
- Safety and security of spent fuel.

The diagram below sketches how data addressing these issues at various sites are communicated through a single, internet-based information network. The data user acquires data through the central server. Authentication could be part of the system; password protection for access control is an option for sensitive data.

Nuclear facility safety combines existing on-site radiation monitors, remote monitors, and existing operational data. Confidence in safety is increased by showing that the facility is operating normally. A computer on-site gathers this data, processes it for transmission, and communicates it to the central server over the internet. Organizations in Japan, Taiwan, Russia and the U.S. are already transmitting radiation safety data in this manner. South Korean data is available through a hyperlink.

Radiation measuring systems use satellite, radio, or internet links to databases maintained by the respective data owners. Transportation safety monitoring systems use satellite links; in the future, shipments of spent fuel and nuclear waste, both domestically and internationally, may use these links to display transportation safety data.

The CSCAP website is maintained by an internet service provider and is updated from the CMC via "file transfer protocol."




**Radiation Monitoring.** The section of radiation monitoring provides near-real time, publicly available information on radiation levels to address safety and environmental concerns. Currently the website features monitoring of radiation in the air and water in cooperation with six partner institutions: The Japan Nuclear Cycle Development Institute (JNC) has provided three links to hourly data at their O-arai, Tokai, and Tsuruga facilities. Similarly, the Korea Institute of Nuclear Safety (KINS) has offered a link to their nationwide monitoring system, IERNet. The Taiwan Radiation Monitoring Center has both offered a link and sent their data directly to the CSCAP website. The Ministry for Atomic Energy of the Russian Federation (MINATOM), in collaboration with the Los Alamos National Laboratory (LANL), has provided radiation monitoring data for the Bilibino nuclear power plant in the Russian Far East. The LANL has offered a link to monitoring from several western states in the U.S. Finally, the Desert Research Institute (DRI) Community Environmental Monitoring Program (CEMP) from the Department of Energy in the U.S. joined the group to provide a link to a network of 24 monitoring stations located in communities surrounding the Nevada Test Site. In addition to the six partner institutions, the Hong Kong Meteorological Observatory has given official permission to post their annual report, and several other institutions or organizations have also offered links to their radiation monitoring data or reports available in their respective language. The website front end now provides a direct access to radiation safety data from Japan, South Korea, China, Taiwan, Russia, and the U.S.

The CMC and the Japan Nuclear Fuel Cycle Development Institute (JNC) have integrated the radiation data into a user-friendly display. This offers "one-stop shopping" access to a wide range of data and encourages other nuclear organizations to join in this trend toward broad transparency. Future development of this radiation monitoring section will be to develop a common display format to view all of these databases. Further integration of this data continues to be a high priority.

**Monitoring the Back End of the Fuel Cycle.** Operational safety together with security of nuclear materials in the back end of the nuclear fuel cycle presents growing concerns. However, the infrastructure necessary for transparent management of storage and disposal of nuclear materials is inadequate.

Promoting transparent management and safe handling of nuclear spent fuel help to address safety, environmental, and proliferation concerns. Demonstrating safe disposal of waste and the peaceful use of plutonium can help mitigate public aversion to nuclear energy and diminish apprehensions about other countries' nuclear energy programs, thereby promoting a positive political climate to deal with nuclear spent fuel problems. Importantly, a commitment to transparency encourages nuclear institutions to operate at the highest levels of safety and with greatest awareness of the responsibility incumbent on the peaceful use of nuclear energy. This procedure is seen by some as delaying repository development. However, it is a necessary step toward the ultimate goal of building a repository. Atsuyuki Suzuki, a member of Japan's nuclear Safety Commission argued that transparency should "go slow in order to go fast."[26]

By July 2000, progress in sharing airborne radiation data was sufficient to suggest progress toward monitoring an interim storage facility. The CMC conducted a workshop for the NEEG to introduce transparency concepts into the development of repository and storage engineering. Included was a visit to the Department of Energy's Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. The WIPP, the world's only certified, operating geologic repository for disposal of nuclear materials, offered many possibilities for the NEEG to develop transparency in the back end of the nuclear fuel cycle. Particular attention was given to monitoring devices installed on waste containers and digital cameras that monitor activities, all of which are accessible through the internet. In order to develop user-friendly displays and measurement methodologies, transfer of technologies to

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[26] Introduced at the NEEG workshop in July 2000.

bilateral or multilateral experiments in regional nuclear institutions is the best approach to monitoring the back end of the nuclear cycle.

Currently, the Department of Energy in the U.S. has offered a link to the WIPP Repository Transparency Demonstration, which monitors the environment and materials in underground storage.

The development of a "generic nuclear energy monitoring scheme" creates concerns about redundancy between NEEG efforts and those of the International Atomic Energy Agency (IAEA). Such concerns underscore the need for closer cooperation with the IAEA. Therefore, it is crucial to bear in mind that monitoring efforts by NEEG project would only demonstrate operational safety of nuclear facilities and nuclear materials, while IAEA safeguards have the primary role for monitoring nuclear materials.

**Virtual Tour / Video Tour.** The "virtual tour" technology is a powerful tool for gaining public acceptance. It is especially helpful to understand underground waste disposal and other nuclear waste storage sites. Through the use of a wide-angle digital camera, this virtual tour system provides a viewer 360-degree photographs of installations. Embedded "hot links" allow the viewer to change position and access supplementary information in selected areas. In effect, the viewer can build a three-dimensional brochure to demonstrate the physical layout of a particular facility. Begun by the Carlsbad Waste Isolation Pilot Plant (WIPP), the virtual tour software developed by IPIX has been used in several facilities in Japan. Currently, the Japan Nuclear Fuel Limited (JNFL) has provided virtual tours at the Rokkasho waste disposal and storage center. The Federation of Electric Power Companies of Japan has recently joined the WIPP and JNFL and is using the same software to produce virtual tours.

An equally important feature is a video tour of the Yucca Mountain Exploratory Studies Facility (ESF) that allows viewers to follow tunnel inspection and thermal tests just as the Yucca Mountain engineers do. This transparency method can help promote public acceptance and create a credible technical basis for spent fuel disposal in the geologic repository. The CMC has offered to assist other nuclear institutions in the region to start up the system.

**Current Events.** The Current Events section contains reporting on significant nuclear energy-related developments from local newspapers and journals, in separate pages covering individual domestic and regional developments, summarized with permission and with a link to the primary source. This section is designed to provide a ready source of information on newsworthy developments, both when they occur and as they are more fully examined or explained. As of June 2003, the section introduces 165 stories related to regional nuclear industries. The project envisions this section will have four categories: current news, official news releases, final reports, and sources.

**Nuclear Energy Data Book.** (Please refer to Appendix A) To further integrate the website and the nuclear energy transparency project, an effort to create a Nuclear Energy Data Book is now underway. The NEEG project envisions the voluntary production of data books regarding each participant's respective nuclear energy programs at the track-two level, rather than at an official government level. The intent is to gather publicly available information now contained in a variety of formats and compile it in a standardized manner to serve as a reference and transparency tool. The final version of the generic outline was provided at the meeting in November 2000, largely through the efforts of Dr. Kaoru Kikuyama from Japan Atomic Industrial Forum and Dr. Chu Wen-Chen from Tatung University, Taipei. All participants are encouraged to create standardized descriptions of the respective nuclear energy programs employing the generic outline as a guide.

As designed, the Asia Pacific Nuclear Energy Data Book includes the country's overall energy policy, its nuclear energy administration and regulatory framework, its nuclear power generation and research facilities, reprocessing, safety monitoring, public information and acceptance programs, and cooperation with international regimes. The NEEG is currently preparing the first model data book, which is anticipated to be 40-100 pages in length.

**Future Developments of the Website.** The site has grown considerably in size as a result of increased participation and awareness of nuclear energy transparency. However, international terrorism has raised concerns among national nuclear regulators. They are increasingly anxious about disseminating information about nuclear facilities, and some of them may have gone too far in this regard. While this trend has posed a challenge to nuclear transparency efforts, it suggests that a careful assessment of new procedures appears warranted to meet both security and transparency needs. In other words, nuclear energy producers have been put under pressure to search for risk-free ways to maintain transparency, while protecting the security of facilities. The transparency project may offer a useful alternative to public tours and visits, which have been cancelled at many sites.

Looking ahead, the NEEG's primary efforts continue to be the further development, refinement, and expansion of the website. The NEEG project envisions the addition of further information on nuclear energy research and reprocessing facilities, nuclear weapons-free zones, and plans and attitudes of current non-nuclear energy producing states. Efforts to make the website more use-friendly, such as new hyperbolic web-navigation tools developed to allow easier, faster navigation, will also continue in cooperation with the CMC.

**Cooperation in the Back End of the Fuel Cycle**

Managing the back end of nuclear fuel cycle poses a grave challenge to the future of nuclear energy programs. Concerns related to the back end include decisions to reprocess, and handling and storage of spent fuel and radioactive waste. Even if no new nuclear power reactors were ever to be built in the region, spent fuel and other radioactive materials continue to accumulate, and there are no permanent solutions to this growing problem. There is a pressing need for technical and political investment to provide permanent disposition of nuclear spent fuel; however, the issue remains politically sensitive and contentious. To date, the Waste Isolation Pilot Plant is the only operating underground repository licensed to safely and permanently dispose of low-level radioactive waste. No other technically viable and politically acceptable long-term solutions have been made in the region. Even interim solutions are much debated.

Challenges in the management of residues from nuclear energy are primarily political, rather than technical. In other words, the chief issue resides in the political will needed to make a decision on nuclear spent fuel repository. Further, the responsibility for managing the back-end of the nuclear fuel cycle rests first with individual nations and nuclear institutions. However, without safety assurances public acceptance will not be achieved; without technical support any political decisions on the management of spent fuel will be in doubt. Moreover, common experience related to political and technical difficulties among nuclear producers suggests that multilateral cooperation could offer better solutions, or at least help facilitate individual efforts toward viable policies in spent fuel management. Based on this belief, the CSCAP International Working Group on CSBMs has conducted both technical and political studies of back-end management and examined the feasibility of multilateral cooperation. The high-level goal has been to combine transparency development with geoscience and technology toward long-term solutions for the back-end of the fuel cycle.

The group first identified both problems related to spent fuel management and potential stakeholders to whom transparency efforts could serve – for example, the public, local authorities, nuclear institutions, and organizations – in order to examine potential methods of cooperation. Potential areas of cooperation in the back end of the fuel cycle are three-tiered: 1) safe and transparent management of interim storage and transportation of spent fuel, 2) addressing permanent repository of spent fuel, and 3) international or regional management of spent fuel that is free from safety, security, and proliferation concerns.

These three stages are closely connected in the sense that without safety and transparency in managing interim storage and transportation, public understanding is difficult to achieve and any political will to meet the need for permanent repository is hard to sustain. Mutual trust and confidence among states, nuclear authorities, and other stakeholders, are crucial to proceed to the ultimate goal of international and regional management of spent fuel. Such trust and confidence could not be achieved unless safe and transparent management of interim storage and transportation are achieved, and necessary information dissemination systems are well established. Continuous progress in addressing the need for a permanent repository is also essential for successful policies in interim storage by building confidence that interim storage facilities will not become permanent "dumps."[27]

**Management of interim storage and transportation of spent fuel.** Safe and transparent management of interim storage of nuclear spent fuel and its transportation are the foundation of successful back-end management and multilateral cooperation. Building confidence is essential. In this regard, providing access to data is crucial for stakeholders to understand spent fuel management and build confidence in safe operations.

[27] Matthew Bunn, Atsuyuki Suzuki, et al., "Interim Storage of Spent Nuclear Fuel: A Safe, Flexible, and Cost-Effective Near-Term Approach to Spent Fuel Management," *A Joint Report from the Harvard University Project on Managing the Atom and the University of Tokyo Project on Sociotechnics of Nuclear Energy* (June 2001), 121. http://bcsia.ksg.harvard.edu/BCSIA_content/documents/spentfuel.pdf

Both operational and airborne radiation monitoring can be applied to building confidence. Monitoring operations in interim storage facilities could demonstrate that storage facilities are operating normally. Airborne radiation monitoring around facilities and along a transportation route through the internet could show that storage facilities and routine shipments pose no hazard to the public.

Equally effective in promoting public understanding are educational methods such as virtual tours and video tours. Promoting public understanding facilitates unbiased discussion about spent fuel management. In this regard, it is important to provide data in a standardized, user-friendly manner with the non-technical public in mind. Also, care should be taken so that transparency efforts are not undermined by security concerns.

Successful interim storage management could provide the foundation for efforts to find a permanent repository. Difficulties facing interim storage management reside mostly in public perceptions, not technological factors.[28] Therefore, transparency is critical to address public concerns over interim storage. Whether the public has been informed well, and whether the public feels that its concerns have been fully addressed are critical in shaping public perceptions. Equally important is building the confidence of a host community that the interim storage will not be a permanent repository. Most communities simply do not want to live with radioactive materials. Therefore, efforts to develop a permanent spent fuel repository should be accompanied are contingent on interim storage management.

**Addressing permanent spent fuel repository.** Permanent repository poses the most pressing issue among problems in back-end management. Site selection and licensing processes to create geologic repositories are critical for a timely solution.

Several efforts, either domestic or regional, are investigating new engineering methods to address this problem area. However, methods for sharing information or findings have not been well integrated within existing projects and stakeholders.

Most of the difficulties in finding a permanent repository are in determining the necessary geoscientific characteristics of a permanent repository and in identifying potential sites.[29] Efforts and their findings should be communicated among stakeholders and existing various efforts. Information dissemination systems are needed to deal with these technical difficulties. Monitoring, virtual tours, video tours, and other technologies are also effective for this communication; however, they are not inclusive. Transparency in spent fuel disposal should become the norm and used to ensure effective information dissemination.

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[28] *Ibid*, 119.

[29] Ronald Smith, "Potential High Isolation Regions," *International Solutions to the Spent Fuel Problem by the Council for Security Cooperation in the Asia Pacific Working Group on Confidence Building and Security Measure* (February 2000), 2.
http://www.cscap.nuctrans.org/Nuc-Trans/CSCAP/cscap-links/ronsmithdoc.htm

Promote this transparency norm, particularly in back-end management, the cornerstone for the NEEG project. In this regard, visits to the four spent fuel storage facilities – the WIPP near Carlsbad in the U.S., the low- and high-level waste storage facilities at Rokkasho in Japan, the URL at Lac du Bonnet, Winnipeg, Canada, and the Yucca Mountain Exploratory Studies Facility (ESF) in the U.S. – are essential parts of the effort to create and promote this norm. It should be noted that representatives from China and several other nuclear authorities were greatly impressed by the Japanese nuclear institution's willingness to open its facilities at Rokkasho, including the enrichment plant, the low-level waste (LLW) and high-level waste (HLW) storage areas, and the construction site of the reprocessing and mixed oxide (MOX) fuel complex, and the readiness, to promptly and candidly answer many questions. This episode demonstrates how the transparency norm could help build confidence among regional nuclear authorities and encourage further cooperative schemes.

As for political dimensions of this problem, the first (and perhaps most grave) difficulty in dealing with a permanent repository lies in the site selection. Hosting radioactive materials permanently is perceived as a huge burden. Even though people appreciate nuclear energy and understand the need for a repository of radioactive residues, they simply do not want to shoulder this burden. This "not-in-my-back-yard" or NIMBY phenomenon is increasingly prevalent. Therefore, whether a site is politically acceptable depends significantly on perceptions of host communities and governments.

A joint study of the Harvard University and the University of Tokyo presents the following five factors in democracies as having great influence on host communities' perceptions. These are: 1) both procedural and substantive fairness between those who benefit from electricity generated by nuclear energy and those selected to host the repository of its residues; 2) trust, especially between those proposing a repository and potentially affected communities; 3) sovereignty, including national, regional, local, and even tribal power; 4) democratic governance, particularly whether seeking consensus or following majority rule; and 5) clashes of values and beliefs, particularly between those who basically oppose reliance on nuclear power and those who support it.[30]

Although there are no magic prescriptions for satisfying all these factors, the NEEG project recognizes that "access to processes" is an indispensable requisite for these five criteria. The experience of the WIPP, the world's only operating repository facility, highlights the importance of providing "access to processes." Transparent cooperation among the City of Carlsbad, the Department of Energy, and the WIPP operator play a key role in gaining political acceptance for the facility. Providing "access to process" in site selection and regulatory decisions could address stakeholders' concerns, and that is critical to facilitate political cooperation among them. This "access to process"and the experience of the WIPP have stimulated further study on overcoming the obstacles to siting a repository.

[30] Matthew Bunn, Atsuyuki Suzuki, et al., "Interim Storage of Spent Nuclear Fuel: A Safe, Flexible, and Cost-Effective Near-Term Approach to Spent Fuel Management," 91.

**International or regional management of spent fuel.** International or regional management would be more ambitious and could prove contentious. Although decisions for spent fuel management reside primarily in individual nuclear authorities, the fact all nuclear energy producers share the same dilemma when it comes to dealing with nuclear residues suggests that international or regional management could offer a better solution. In addition, international or regional spent fuel management has the potential to alleviate concerns over safety, security, and proliferation. At a minimum, common solutions and joint efforts could be more cost efficient. Based on this assumption, a variety of proposals for international or regional spent fuel management have been discussed by the CSBM International Working Group. These proposals include the "Internationally Monitored Retrievable Storage System (IMRSS),"[31] regional spent fuel disposal site, a regional back-end authority, and a new regional safeguards regime. Along with these discussions, the initiative by the Russian government and the Ministry for Nuclear Energy (MINATOM) to import foreign spent fuel gained legal basis in July 2001 through the passage of spent fuel import legislation[32] and has created a sense that there might in fact be an international solution to the nuclear spent fuel problem.

Among those proposals tabled, "a new regional safeguards regime" is deemed to be least likely to succeed because it would require enormous political investment. Fully funding existing institutions, rather than creating new ones, would be more successful in addressing the problems. In reality, however, existing institutions are not adequately dealing with safety, security, and proliferation concerns, or solving problems in back-end management. This dilemma has sparked consideration of other institutional options.

*Regional Spent Fuel Storage*

Increased worldwide interest in the regional storage concept over the past decade reflects a pressing need for an answer to the growing problem of accumulating stocks of spent nuclear fuel. The need is amplified by the fact that interim storages facilities are nearing capacity, and that building new domestic interim storage facilities inevitably encounters political difficulties. This need is especially serious in countries that have experienced the cancellation or postponement of reprocessing programs, and that have technical and financial difficulties in conducting studies of geologic repositories by themselves.

A regional spent fuel storage facility could strengthen nuclear materials protection and enhance transparency. In addition, from an economic point of view, regional solutions are attractive since they could reduce costs due to economies of scale. This is even more significant in light of the mounting financial burden that states have to shoulder for domestic solutions. The possibility of establishing a regional spent fuel storage facility in Russia reveals another virtue of this concept – regional solutions could help address the

[31] The concept of internationally monitored spent fuel storage was introduced by Dr. Lewis Dunn of Science Applications International Corporation *(SAIC)* at the meeting of the CSCAP CSBM Working Group in May 1998.
[32] Igor Kudrik, "Import of Spent Nuclear Fuel to Russia," *Bellona Position Paper,* (Oslo, Norway: Bellona Foundation, 6 Dec. 2002).
http://www.bellona.no/en/international/russia/nuke_industry/waste_imports/22414.html

Cold War nuclear legacy in the former Soviet Republics, which includes the need for disarmament, nonproliferation, and the cleanup of an obsolete nuclear infrastructure, which will require billions of dollars. Regional spent fuel storage on a commercial basis could generate revenues that are desperately needed to deal with this nuclear decommissioning. Despite the urgent need to proceed with this project, the lack of funds and legal guarantees has hindered British, Japanese, and other potential financiers from implementing the program and exacerbated proliferation and environmental risks.[33] Other potential benefits include: combining efforts to avoid redundancy; providing an option for countries encountering difficulties in building their own repository, and avoiding the unnecessary accumulation of separated plutonium in multiple locations.[34]

Despite these potential benefits, the idea that one country will accept other countries' nuclear waste remains highly controversial. NIMBY sentiment in general and the lack of mutual trust in particular has been a major obstacle in site selections for a regional solution. Achieving a fair and equitable balance among participating countries is the most complex issue. Figuring out how to address, in the international arena, the five democratic fundamentals previously mentioned, given a variety of political regimes and cultural backgrounds, poses a grave challenge for multilateral cooperation Strong incentives, either economic or political, are required to create the willingness to become a host state.

Equally important for site selection is the suitability of a host country. In addition to geographic and geological applicability, Suzuki, a former professor of Tokyo University, highlights the importance of political and societal factors in selecting host countries. These criteria include public perceptions of nuclear energy, government attitude to nuclear programs, an effective technical and regulatory infrastructure, strong nonproliferation credentials, political stability, and democracy. Although no state can satisfy all the criteria, some factors can change over time. He argues that utilizing these factors is important and in doing so, flexibility and transparency in the planning process are critical.[35]

Another problem with site selection is transportation risks. Transportation of radioactive spent fuel from a nuclear facility in one country to a regional storage location in another inevitably involves high risks. These risks are not necessarily technical and security problems, since specialized ships and operations are currently available, and the International Atomic Energy Agency (IAEA) and the International Maritime Organization have established strict standards. The risks, however, exist since international movements of radioactive materials unavoidably encompass a wider range of stakeholders.[36] The increased number of stakeholders, even within one country, automatically pose greater political obstacles. The cancellation of plans to transport nuclear spent fuel to the Yucca Mountain storage site in July 2003 due to the opposition of the California government

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[33] The lack of funds, estimated at $3.9 billion, and a slow pace of implementation exacerbates proliferation and environmental risks. Brad Glosserman, "Russia's New Nuclear Threat," *PacNet Newsletter*, no.42 (Honolulu: The Pacific Forum CSIS, 17 October 2002). http://www.csis.org/pacfor/pac0242.htm

[34] Matthew Bunn, Atsuyuki Suzuki, et al., op cit. 57-77.

[35] Suzuki developed these criteria and presented them at the NEEG workshop at Albuquerque in July 2000. For details, see Matthew Bunn, Atsuyuki Suzuki, et al., op cit. 57-77.

[36] Ronald Smith, "Potential High Isolation Regions," 8-9.

accentuates this difficulty. Transportation risks, in the context of regional schemes, show that regional solutions would require enormous political efforts and investments, including the need to fully establish the norm of nuclear energy transparency regionwide, while simultaneously building a nuclear infrastructure that addresses safety, security, and proliferation concerns, before the actual regional spent fuel storage begins operations.

There is another critical issue of regional storage management. Who bears the liability for the spent fuel in question? Who takes responsibility for operational safety and security of regional storage? Who ensures budgetary management? In order to address these questions, a variety of institutional arrangements have been discussed. Among those is an internationally (or regionally) monitored storage system.

*Internationally (or Regionally) Monitored Storage System*

The internationally monitored storage system concept envisions the establishment of an organization by a group of states to build and manage a site in one of the partner states. This organization would ensure that all participants' interests are taken into account, and strict safety, security, and non proliferation standards are applied.

Dr. Ronald Smith proposed an Asia Pacific institution, the *Asia Pacific Nuclear Agency (APNA),* to develop cooperative spent fuel/high level waste (HLW) storage or disposal facilities.[37] He suggests that the *APNA* be a basis for developing coherent policies that all interested parties could accept, or at least refrain from criticizing. He proposes that facilities would provide above-ground interim (around 100 years) storage, which would be internationally monitored and retrievable. This internationally monitored storage should begin on a small, limited scale, and could be expanded if it succeeds. Above-ground storage requires less demanding geological conditions, and thus, could be applied to a wider range of possible sites. The time span of around 100 years is appropriate to see and adopt technological developments in dealing with spent-fuel management. In order to ensure operational safety, security, and address proliferation concerns, the facility should be monitored and supervised by an established Asia Pacific institution, with strict safety, security, and nonproliferation standards imposed. If performance is not satisfactory, stored materials could be retrieved. An additional virtue of the system, he suggests, would be that regional management could generate revenues, which could then be used for the development of a long-term repository. Importantly, he insists, this internationally (or regionally) monitored storage system should be not only transparent but also proactive. By providing potential benefits (employment and economic development), becoming host of a regional storage facility should be seen as an opportunity by potential site candidates. The system might be more effective in gaining public understanding of nuclear energy in general, and of back-end management in particular.[38]

These discussions are necessary steps to define the transparency efforts for spent fuel management in the Asia-Pacific region. An examination of European approaches to

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[37] See Appendix B.

[38] Ronald Smith, "Potential High Isolation Regions," *International Solutions to the Spent Fuel Problem by the Council for Security Cooperation in the Asia Pacific Working Group on Confidence Building and Security Measures.*

back-end management has also been suggested. While it might be useful to draw upon European experiences, it is important to bear in mind fundamental differences in history, cultural backgrounds, and political distributions between Europe and Asia. Observers note that "realistic proposals must reflect the Asian approaches to and experience in cooperation."[39] Asia (or Asia-Pacific) needs an imaginative, original cooperative scheme for its own. John Olsen of the Cooperative Monitoring Center, has proposed the "Regional Verification of a Denuclearized Korean Peninsula"[40] which suggests the potential for Asian approaches to regional spent fuel management.

The CSCAP International Working Group on CSBMs understands that the comparative lack of multilateral cooperation in the region has been a critical obstacle in implementing regional management of nuclear spent fuel. Based on this understanding, the group believes that the process of creating a cooperative climate in the region is important. Information sharing can be implemented step-by-step. Even at a gradual pace, it is a useful and pragmatic way to address actual safety, security, and proliferation concerns at local, national, and regional levels. Progressive cooperative steps, such as in radiation monitoring and virtual or video tours, could promote the norm of transparency and facilitate future steps toward establishing a regional monitoring network and addressing permanent repository. Increased cooperative measures in nuclear energy in general and in back-end management in particular could generate a more favorable climate for regional nuclear management. Participants can select each step along a cooperation ladder that yields a recognizable, pragmatic benefit. Participation in one step could make the next step easier as cooperative experience accumulates.[41] Therefore, by identifying and justifying step-by-step, pragmatic cooperation, the norm of transparency in nuclear energy should be established to develop a foundation for broader cooperative measures.

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[39] John N. Olsen and Richard C. Lincoln, "Viewpoint: Promoting Nuclear Cooperation in East Asia: Safety, the Environment and Nonproliferation," *The Nonproliferation Review / Fall 1997:* 101-102. http://cns.miis.edu/pubs/npr/vol05/51/olsen51.pdf

[40] John N. Olsen, "Regional Verification of a Denuclearized Korean Peninsula: A Strategy for Success after the Current Impasse Is Overcome" (presented at the meeting of the Nuclear Energy Experts Group of the CSCAP Confidence and Security Building Measures International Working Group in Las Vegas, Nevada, 7-10 May 2003). The proposal expresses his personal views and does not necessarily reflect opinions or policies of the U.S. government. For details, please refer to Appendix C.

[41] Olsen and Lincoln, *op cit.* 101-102.

# Chapter III:
# Challenges and Prospects

## Evolving Cooperation

The belief underlying multilateral cooperation is that it could facilitate positive-sum gains in which voluntarily cooperating authorities (governments, states) would benefit. Based on this belief, one could expect that policies or methods originating in one area will have notable, albeit indirect, effects on interests, welfare, or situations in other areas. If that is true for the NEEG project, the following hypotheses could follow. First, since multilateral cooperation is beneficial for all participants, technical cooperation for nuclear transparency could bring benefits to those who voluntarily join the project by offering "access to data." Second, the cooperation in information sharing and "access to data" would facilitate cooperation in another dimension, "access to process." Third, incremental cooperation would create a climate for more effective transparency schemes, including institutionalization or regional management of nuclear spent fuel. Finally, cooperation might start with technical support or simply applying technical methods to transparency, and then, technical cooperation could develop to encourage political cooperation.

## Political Features

Since the NEEG project is a fully voluntary scheme, its success depends on the willingness of nuclear authorities to "go the extra mile" by providing information that is not explicitly demanded by nuclear regulators. Therefore, promoting nuclear authorities' willingness to be active in transparency is critical to the project's evolution.

As previously discussed, main obstacles to the transparency effort both in information sharing and in cooperation in back-end management have more to do with political issues than technical ones. There are numerous factors behind these obstacles. They are broadly classified into the following four categories; 1) political characteristics, namely, type of political regimes and level of democracy; 2) government/public attitude toward nuclear energy, which includes consideration behind decisions on nuclear energy policies; 3) propensity, which includes "instincts" shaped by institutional tendencies and culture; and 4) rationality, which encompasses cost effectiveness and financial burden of transparency efforts, and nuclear authorities' trust in the transparency project. Depending on the nature and strength of these factors, nuclear authorities' demands on or expectations of transparency efforts differs, as does their willingness to "go the extra mile."

Among these categories, the fourth, "rationality of nuclear transparency effort," is thought to be the most feasible for the NEEG project to address. Olsen and Lincoln note three issues that transparency efforts need to consider in providing a political rationale for nuclear transparency. These issues include:

Protection of security and proprietary information;

Concentration on technical goals;
Direct economic costs.[42]

First, securing nuclear facilities and related information from unauthorized access is crucial for the project, since these facilities represent an enormous investment. Potential benefits that transparency efforts could bring about should be compared to the risks in sharing information and implementing cooperation. The potential benefits for nuclear authorities are: achieving public understanding of nuclear energy; gaining regional acceptance for their nuclear projects; and building confidence between states in general. Second, considering the high levels of technical personnel within regional nuclear industries, policy analysis should demonstrate how the industry and states could benefit by building on technical interactions to address other nuclear issues, especially problems in back-end management. Third, the financial burden that accompanies transparency efforts, whether administrative or technical in nature, needs to be assessed in the broader context of benefits to national and regional security, public health, and economic growth. Olsen and Lincoln restate this need for a political rationale: "[w]ithout this policy rationale, technical organizations would have neither incentives nor authority to consider a wide range of cooperative opportunities."[43] Considering these three issues, the project needs to articulate a cost-benefit analysis that may accrue to safety, security, and development.

By addressing the rationality of nuclear transparency efforts, the project envisions the increase of transparency and the spread of its norm. Then, the project could gradually influence the "propensity," which includes institutional tendencies and culture and government/public attitudes toward nuclear energy. The spread of the norm of transparency could have effects even on authoritative governments in their attitude toward transparency and multilateral cooperation in nuclear energy given that they are concerned about the perceptions of and their status in the international community.

**Transparency as a Confidence and Security Building Measure**

In order to consider the prospects of the nuclear energy transparency project, one should also look into its functions as a confidence and security building measure (CSBM). A primary question is: Can a nuclear energy transparency project, as a CSBM, help foster a suitable security environment in the Asia-Pacific region? In answering this question, it is important first to understand the concept of CSBMs and their roles in security.

The concept of a confidence and security building measure is used in various ways, ranging from operational military activities to any action that builds confidence, but is most frequently referenced as a communication process between governments regarding security issues. Ralph A. Cossa, defines it as "both formal and informal measures, whether unilateral, bilateral, or multilateral, that address, prevent, or resolve uncertainties among

[42] *Ibid*, 101-102.
[43] *Ibid*., 101-102.

states, including both military and political elements."[44] CSBMs usually take one of three forms: declaratory measures, constraint measures, and transparency measures.

The Transparency efforts in the NEEG project represent multilateral cooperative efforts in nuclear energy on a strictly voluntary basis that address, prevent, or resolve uncertainties in nuclear energy-related issues among all stakeholders, including the people, nuclear authorities, and states. By providing and sharing information and examining multilateral cooperation in nuclear energy-related issues, all participants can build confidence in safety, security, and nonproliferation credibility, working to establish mutual trust.

Transparency efforts, however, have both weak and strong points. A common criticism against CSBMs in general and transparency efforts in particular is that they have no crisis management functions.

> The multilateral security frameworks in Asia such as ARF are expected to work as confidence building measures and, as a result, they can decrease the chance of growing security dilemmas. However, they are not likely to have deterrence and defense functions in the near future. In other words, they do not have "teeth" yet. That is why those multilateral frameworks cannot do much once a crisis takes place.[45]

These limitations are not fatal, however, they do require an understanding of the limits of CSBM's and realistic expectations about their effectiveness.

**North Korea**

North Korea has joined, violated, and withdrawn from the nuclear Non-Proliferation Treaty (NPT). The current crisis began in October 2002 with U.S. charges that North Korea has a clandestine uranium-enrichment program, a second path to the development of nuclear weapons. On Jan. 10, 2003, January 2003, the crisis escalated when North Korea notified the International Atomic Energy Agency (IAEA) and UN Security Council of its withdrawal from the NPT. The withdrawal followed North Korea's announcement in December 2002 that it would lift the freeze on its 5MW(e) experimental reactor and related facilities in Yongbyon, thereby effectively shutting down the IAEA's ability to directly monitor North Korea's nuclear activities. Through these developments, North Korea has denied, infringed, or invalidated three bilateral security arrangements: the Safeguards Agreement under the NPT with the IAEA,[46] the December 1991 Joint

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[44] Ralph Cossa, "Asia-Pacific Confidence Building and Security Building Measures," *Significant Issues Series,* Vol. XVII, (Washington D.C.: Center for Strategic and International Studies (CSIS), 3 November 1995), 1-18

[45] John G. Ikenberry and Jitsuo Tsuchiyama, "Between Balance of Power and Community: The Future of Multilateral Security Cooperation in the Asia Pacific," *Japanese Energy Security and Changing Global Energy Markets: An Analysis of Northeast Asian Energy Cooperation and Japan's Evolving Leadership Role in the Region*, May (2000): 1-12.
http://www.rice.edu/projects/baker/Pubs/workingpapers/jescgem/fmscap4/fmscap.html

[46] Under the Safeguards Agreement, all member states are required to allow IAEA inspections to verify not only present but past nuclear activities.

Declaration on the Denuclearization of the Korean Peninsula with South Korea,[47] and the October 1994 Agreed Framework with the U.S.[48]

Concerns over North Korea's nuclear activities currently focus on two areas: 1) a plutonium-based nuclear program located in Yongbyon and 2) a suspected highly enriched uranium (HEU) program. In particular, the 8,000 spent-fuel rods removed from the 5MW(e) experimental reactor and stored in an interim storage pond in Yongbyon pose an immediate threat, since it is estimated that North Korea could reprocess them into enough plutonium to make about five atomic bombs in approximately one month. In addition, the 5MW(e) experimental reactor, frozen under the terms of the Agreed Framework but which resumed operations in February 2003, could generate approximately 5.5 kilograms of plutonium, enough for about one bomb, annually.[49] Further, according to one report, Bush administration officials claim that North Korea's HEU program, once operational, would produce "as much as six bombs worth of HEU (about 100 kgs) per year."[50] In contrast to plutonium-production facilities, HEU production facilities are difficult to detect. Therefore, there is a wide range of estimates regarding when the North Korean HEU program began and its current stage of development. Nevertheless, North Korea's HEU program, which employes gas-centrifuge technology, is projected to become operational by "mid-decade."[51] North Korea will have the capability to make seven atomic bombs per year after 2005 on the assumption that facilities in question will be in full operation without delays, and that North Korea would immediately restart its nuclear activities. The number would be magnified if a 50MW(e) nuclear power plant in Yongbyon and a 200MW(e) plant in Taech'on[52] are taken into account. Upon the completion of their construction (possibly around 2006 or 2007), these two nuclear power plants will generate a significant amount of nuclear resources, capable of yielding 37-50 atomic bombs per year. In short, North Korea would have an incremental capacity and capability as time passed. The possibility that it could possess the capability to have some 73-90 atomic bombs by 2007[53] cannot be ruled out.

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[47] In the Joint Declaration on the Denuclearization of the Korean Peninsula, both North and South Korea promised to "ban the possession and use of nuclear weapons, including any testing, manufacturing, production, storage, or deployment of those weapons." The declaration also bound the two countries to forego the possession of nuclear reprocessing and uranium enrichment facilities.

[48] Under the Agreed Framework*,* Pyongyang agreed to freeze its gas-graphite moderated reactors and related facilities and allow the IAEA to monitor to monitor the freeze, capping North Korea's ability to produce plutonium. The agreement also called on North Korea's consistent progress in the implementation of the North-South Joint Declaration on the Denuclearization of the Korean Peninsula and remaining a member of the NPT. The U.S., in exchange, agreed to lead an international consortium, the Korean Peninsula Energy Development Organization (KEDO), to construct two light -water power reactors and provide 500,000 tons of heavy fuel oil per year until the first reactor began operations, which were supposed to start in 2003.

[49] Daniel A. Pinkston and Stephanie Lieggi, "North Korea's Nuclear Program: Key Concerns," *North Korea Special Collection / Center for Nonproliferation Studies (CNS)* (Monterey: Center for Nonproliferation Studies, 17 January 2003). http://cns.miis.edu/research/korea/keycon.htm

[50] "Beyond the Agreed Framework: The DPRK's Projected Atomic Bomb Making Capabilities, 2002-09," *An Analysis of The Nonproliferation Policy Education Center (NPEC),* 3 December 2002. http://www.npec-web.org/projects/fissile2.htm

[51] "Beyond the Agreed Framework: The DPRK's Projected Atomic Bomb Making Capabilities, 2002-09."

[52] The Agreed Framework froze their construction in 1994.

[53] Pinkston and Lieggi, *op cit*. and "Beyond the Agreed Framework."

Concerns about North Korea's nuclear activities are compounded by its missile program. The impetus of its missile development stemmed from a desire to match South Korea's military modernization efforts. Beginning with the cooperation of Chinese designers from the 1960s and 1970s and introducing Soviet missile technology in the late 1970s, North Korea's missile program acquired the capability to produce approximately 100 Scud-C missiles per year by the early 1990s.[54] Sometime in the mid-1990s, North Korea accelerated its indigenous production of the two advanced missiles, the *Nodong*-1 and the *Taepodong,* allegedly[55] with the support of foreign financing (Iran), scientists (China and former Soviet republics), and technology (China).[56]

In August 1998, North Korea shocked the world by launching a three-stage *Taepodong*-1 missile over Japan's main island of Honshu, traveling some 1,646km. This missile test proved that North Korea's intermediate-range missile could now threaten not only South Korea but also all of Japan, U.S. bases there, and even, in theory, Beijing, and the Far Eastern part of Russia. Although the third stage (solid-fuel booster) failed, the performance of the first two stages (liquid-fueled) was impressive enough for some Western experts to speculate that the missile had a potential range of some 2,000-2,500 km, and that the development of a 4,000-km *Taepodong*-2 missile was within reach.[57]

North Korea's nuclear and missile activities have grave implications for Northeast Asia. All the concerned countries in the region, South Korea, Japan, China, and Russia, feel the threat of North Korea's nuclear and missile activities. Beyond that, however, each country also has distinct concerns over the crisis on the Peninsula.

The CSBM IWG NEEG have discussed ways in which the nuclear energy transparency project could contribute to the process of integrating North Korea into the international community. The project could function as a form of preventive diplomacy. The creation of a transparency norm could influence North Korean behavior should it pursue the nuclear energy option. Moreover, the groups believe that nuclear transparency efforts could play a complementary role in bilateral security arrangements not only before but also after a crisis happens.

**Regional Verification of a Denuclearized Korean Peninsula.** Olsen has outlined one such complementary mechanism in his proposal, "Regional Verification of a Denuclearized Korean Peninsula,"[58] (please refer to Appendix C), which was presented at the NEEG meeting in May 2003, Olsen argues that the North Korean nuclear issue would end in a "grand bargain"[59] that would include the denuclearization and disarmament of the Korean Peninsula in exchange for security guarantees and economic aid for North Korea. Any such "bargain" would require a regional verification mechanism encompassing all the

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[54] Evgeniy P. Bazhanov, "Military-Strategic Aspects of the North Korean Nuclear Program," in *The North Korean Nuclear Program: Security, Strategy, and New Perspectives from Russia,* ed. James Clay Moltz and Alexandre Y. Mansourov (New York: Routledge, 2000), 101-109.
[55] None of the three governments have admitted their alleged support for North Korea's missile program.
[56] Bazhanov, *op cit.* 101-109.
[57] Ibid., 101-109.
[58] Olsen, "Regional Verification of a Denuclearized Korean Peninsula," *op cit.*
[59] *Ibid*., 1.

concerned parties: China, Japan, North Korea, Russia, South Korea, the United States, and the International Atomic Energy Agency (IAEA), to ensure the denuclearization of the Peninsula and enforce safeguards for weapon usable materials in the Peninsula. One virtue of the regional verification mechanism is that it is designed to "avoid the pitfalls of previous bilateral (US-North Korea, IAEA-North Korea, and South Korea-North Korea) agreements, all of which have failed to weather the vicissitudes of regional volatility."[60]

This verification mechanism is critical to a sustainable solution to the nuclear standoff and to the stability of Northeast Asian security, but it will be extremely difficult to establish. However, this is an area in which transparency efforts as CSBMs might fit well. The key to ensuring that this mechanism is feasible and effective is the confidence of the five concerned governments. For the mechanism to work they must: 1) share the common goals of a verifiable denuclearization and disarmament of the Korean Peninsula in exchange for security guarantees and economic aid for North Korea; 2) have confidence in others' commitment to regional security and to multilateral cooperation; and 3) have confidence in their ability to implement the mechanism. If these conditions are satisfied, these concerned parties could trust this multilateral framework as a practical and reliable tool to help solve the crisis on the Peninsula.

The proposed verification regime relies on another virtue of transparency: it promotes individual confidence in others and allows for networking. Both track one and track two efforts can provide interested parties with opportunities to exchange candid (unofficial) opinions and to hear others' views, facilitating mutual understanding. Importantly, these programs promote interaction not only among officials and non-officials but among policies as well, encouraging evolution and adaption to multilateral settings.

The PACATOM nuclear energy transparency project has been creating the networks in both technical and political arenas. On the technical side, increasing nuclear energy transparency in the region has demonstrated that the region has highly advanced technologies, such as that used for monitoring, for the verification scheme, and is full of competent technical experts who have rich experience in nuclear issues. For example, Russia has many experts in nuclear material control, protection, and accounting, and U.S.-Russia cooperation in nuclear disarmament and monitoring over the past decade underscores the role Russia can play in the verification mechanism. In addition, Japan-South Korea cooperation in nuclear materials inspections since 1996 implies a wider range of verification options in the scheme.[61] Technical networking proves that a verification mechanism for denuclearization and safeguards of weapon-usable materials on the Peninsula is credible. From the political angle, cooperation is growing and the transparency norm is spreading. The established norm, then, could facilitate confidence – and trust building. Once embedded, the verification mechanism could become more practicable and reliable, as Olsen anticipates.

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[60] *Ibid*., 1.
[61] *Ibid*., 2-4.

If the verification regime is established and successfully operated, this regime could evolve to take on other problems, particularly those related to nuclear energy. One proposal anticipates that "The regime could become the core of an institution that deals with the region's growing problem of nuclear waste."[62] Since the regime would represent regional expertise in spent fuel management and would actually have to handle North Korea's nuclear spent fuel, it could be the core institution for multilateral cooperation in regional spent fuel question. This proposal reflects the potential of nuclear transparency efforts.

**Future Prospects**

The NEEG project continues to further develop and refine the transparency scheme.

On the technical side, efforts to make information sharing more standardized and user-friendly will continue. Efforts to increase participation by other regional nuclear energy producers, such as India, are being studied. Included in the project agenda is the examination of potential transparency efforts that encompass reprocessing facilities, nuclear weapons-free zones, the prospect of enhanced cooperation between the NEEG and the IAEA, the impact of the war on terror on the nuclear energy industry, and nuclear research activities by regional states. (The NEEG is currently exploring the feasibility of visits to research reactors in the region.) The NEEG will continue to look hard at regional storage proposals, and there have been suggestions that the European experience in managing the back-end of the fuel cycle, including national means of spent fuel storage and disposal, could be helpful.

The fall of 2003 marks the fifth anniversary of the founding of the NEEG (and 10th anniversary of CSCAP). Accordingly, there are plans for an outside review of the NEEG process to provide an independent assessment of the project and see how it accords with its goals and U.S. nonproliferation objectives. Tentatively scheduled for the fall of 2003, this review is designed to be a milestone for the group, determining its future relevance and direction.

On the political side, the spread of the norm of transparency and its further strengthening continue to be a high priority. In this regard, visits to spent fuel storage facilities are an integral part of confidence and security building measures. The project also recognizes that nuclear authorities' willingness to allow access to such facilities and to promptly and directly answer questions about spent fuel management are critical to enhancing the transparency norm. This willingness also encourages further discussion on multilateral cooperation in back-end management. In addition, discussions will evolve to

[62] Brad Glosserman, "A Verification Regime for the Korean Peninsula," *PacNet Newsletter,* no.19 (Honolulu: The Pacific Forum CSIS, 15 May 2003). http://www.csis.org/pacfor/pac0319.htm Also available at Brad Glosserman, "A Verification Regime for the Korean Peninsula," *Policy Forum Online,* PFO 03-35, (Berkeley: The Nautilus Institute for Security and Sustainable Development, 18 June 2003), 3. http://www.nautilus.org/fora/security/0335_Glosserman.html

examine the continuing impact of the war on terrorism on transparency efforts, plans and attitudes of current non-nuclear energy producing states, and energy security in all its forms.

The NEEG project believes that any transparency effort should be self-enforcing and reflect Asian approaches to multilateral cooperation. With this belief, the plan to transfer website management to an Asian partner, in cooperation with the Cooperative Monitoring Center (CMC), is underway. This is designed to also enhance the region's commitment to the project by instilling a sense of "ownership" among Asian participants. The South Korean Ministry of Science and Technology (MOST) has become the most likely cooperative operator of the website. Along with the plan, the MOST is examining how to create an international foundation to pursue nuclear nonproliferation and other peace process ventures. These Asian initiatives represent a concrete steps toward more active transparency efforts and hold out hope for evolving cooperation in the Asia-Pacific region.

**Conclusion**

Examination of nuclear energy transparency efforts in the Asia-Pacific region shows remarkable progress. Participation in the nuclear energy transparency website has exceeded expectations. The discussion in the Nuclear Energy Experts Group has been frank and wide-ranging. But while greater awareness has been achieved among nuclear authorities regarding both the potential problems and the need for imaginative cooperative approaches in addressing them, much more should be done to encourage governments and nuclear authorities to "go the extra mile," individually and collectively, to deal with contentious nuclear issues.

It is necessary to satisfy the following basic conditions for multilateral cooperation to evolve. First, the project should further articulate cost-benefit analysis in a broader context – which include safety, security, and development – to provide a rationale for heightened cooperation. Second, utilizing current technical and political channels, the project should continue to deepen and strengthen the networks that have established. Third, flexibility channels should be maintained. Fourth, efforts should be fundable and sustainable. Fifth, bearing in mind that cooperation is contingent on reciprocity, the project should ensure that all relevant cooperative exchanges are self-enforcing and that participants gain benefits relative to their contribution. Sixth, the project should be designed to protect the security of all participants, including safeguards for those who would otherwise find participation unbeneficial and risky.

How the NEEG project addresses these six conditions will be critical to the success in spreading the transparency norm and facilitating multilateral cooperation. If the project successfully address these concerns, enhanced nuclear transparency could establish mutual confidence and trust among regional nuclear experts and states, and eventually, could infuse political will into the regional network. The network, then, could play a complementary role for bilateral security arrangements even in times of crisis.

Efforts to better define problems and candidly discuss concerns over and approaches to dealing with nuclear energy-related difficulties will remain at the heart of the NEEG project with the recognition that such efforts represent confidence building efforts in their own right. The belief that building confidence in the region is crucial for preventive diplomacy continues to be a moving force in this the project.

## About the Author

**Ms. Kazuko Hamada** was a Vasey Fellow at Pacific Forum CSIS from February - July 2003. She joined Pacific Forum CSIS as part of the International Professional Service Semester program at the Graduate School of International Policy Studies at the Monterey Institute of International Studies (MIIS), from which she will receive her M.A. in December 2003 and a certificate in nonproliferation studies. She received her B.A. from MIIS in December 2001. Ms. Hamada has also done extensive research on Northeast Asian economies, particularly that of China and Taiwan, and Japan's relations with its neighbors.

# Appendix A

**ASIA-PACIFIC NUCLEAR ENERGY DATA BOOK**
(Generic Outline: Draft)

**Introduction**

**I. Energy Policy**

1) Overall Policy
-Basic information about overall national energy security policy
-Outlook of each country's natural energy resources
-Regulations and laws in energy development and use

2) Environmental Policy

3) Nuclear Energy Policy
-Background to and aims by nuclear energy development
-A policy concerning nuclear energy development and use'
-Current and projected nuclear capacity
-Share of nuclear generated electricity within the total supply
-Policy measures to advance or sustain nuclear energy development

**II. Nuclear Administration and Regulatory Framework**

1) Administration and Institutes
-Gov. structure responsible for nuclear energy development and use
-Institutes for research and development, radiation protection, etc.
-Safety regulatory body
-Committees and advisory bodies

2) Regulatory Framework
-Commitment to international regulatory system
-Commitment to domestic regulatory framework for reactor licensing, safety, radioactive waste disposal and emergency response

**III. Nuclear Power Generation**

-Current nuclear power reactors
-Planning of new nuclear reactor
-Construction of new nuclear reactor
-Licensing and re-licensing of nuclear reactor
-Shut-down of nuclear reactor

**IV. Nuclear Energy Research**

**V. Fuel Cycle**

1) Front End Policy
   -Fuel acquirement and related capabilities

2) Back End Policy
   -Spent fuel management
   -High level radioactive waste disposal management
   -Intermediate and low level radioactive waste disposal

**VI. Reprocessing and Other Capabilities**

-Reprocessing
-MOX fabrication
-Uranium enrichment
-Others

**VII. Public Information and Acceptance Programme**

-Policy and practice for information disclosure and transparency in nuclear energy development and use

**VIII. Safety Monitoring**

-Environmental monitoring
-Transportation

**IX. International Cooperation**

-Bilateral cooperation
-Multilateral cooperation

**X. Commitment to Nuclear Non-Proliferation Regime**

-NPT, etc.
-IAEA full scope safeguards and new protocol
-National MPC&A and safeguards
-Export control
-Physical protection of fissile material
-Transparency

**Annex**

-Each nation provides information regarded effective as to promote transparency

# Appendix B

## International Solutions to the Spent Fuel Problem

**Council for Security Cooperation in the Asia Pacific**
**Working Group on Confidence Building and Security Measure**

**A Report by Dr. Ron Smith, February 2000**
**Director of Defense and Strategic Studies at the University of Waikato, New Zealand**

Over the last few years the CSCAP Working Group on Confidence and Security Building Measures has discussed on many occasions the possibility of cooperative solutions to the problem of disposal of spent fuel and high level waste. The purpose of this paper is to briefly review the content of the various proposals that have been made, report on their present status and make some suggestions for further policy development. Of course, the attractiveness of international solutions to the spent fuel problem arises partly from the problems that national governments are having in disposing of waste material from civilian nuclear operations. For this reason some account is given of the present state of affairs with regard to national repository proposals in the Asia Pacific region. There are other factors that make international solutions attractive. Prominent amongst these is the widely held concern about proliferation. In so far as accumulations of spent fuel provide a ready resource from which nuclear weapons may be made, a central storage location under international supervision would have the potential to reduce anxiety.[63] There is also the matter of economy. Deep geological deposition for all time is inevitably going to be very expensive.[64] Even the infrastructure to support long-term interim storage will be costly to provide. For the smaller players, cooperation could thus be enormously beneficial from a financial point of view. The time could well be right for the states of the Asia Pacific region to seriously consider establishing a cooperative institution which would have as its major focus the establishment of international facilities for the management and disposal of the backend products of civilian nuclear activity. A proposal to this effect (through the formation of an Asia Pacific Nuclear Agency) forms the major part of the concluding section to this paper.

### Part 1 – The problem

All around the world there are accumulating inventories of spent fuel and other high level waste from civilian power reactors (See Appendix 1). Much of this is in the Asia Pacific region.[65] The material will be active and dangerous for a very long time. There

63. In fact the risk here is very small. Reactor grade plutonium is quite unsuitable for weapon fabrication and no proliferator has ever gone this way. It remains, though, a theoretical possibility and it is certainly a factor in international relations.
64. Of course, this is relative. The suggested cost for a repository for Korea is over $11 billion. This is a large sum. On the other hand, the cost of ultimate disposal of spent fuel from electrical utilities has been estimated at no more than 3 percent of total generating costs. Nonetheless, there may be considerable financial benefits in cooperation, especially for the smaller players.
65. Estimates included in a 1998 report by Science Applications International Corporation (see Appendix 1) suggest a world-wide accumulation of 341,090 tonnes of spent fuel by 2010, of which 177,120 tonnes will be in the Asia Pacific Region.

are well-understood health risks from human exposure to radiation and perceived proliferation risks from the plutonium content of the spent fuel rods, and from stockpiles of plutonium arising out of earlier reprocessing. Spent fuel rods can be stored safely under water for decades. Later they can be removed from these storage pools and held in dry storage. Both wet and dry storage is often on the site of the reactor in which the fuel was burned but it may be held at a central facility or at a reprocessing plant if it is to be reprocessed. At the end, though, you have material that needs to be held securely for thousands of years. This is presumed to be long after the reactor that produced it has ceased to operate. Indeed, it may be long after nuclear exploitation in its present form (or indeed in any form) has ended. The solution has usually been seen to lie in the establishment of a final repository for this material deep in the earth where human beings who may not understand its danger are extremely unlikely to stumble upon it. On the other hand, we might presume a continued advance in technology and human understanding such that what is seen now to be without value and unalterably hazardous may become a valued resource or something which is easily transmuted into a less problematic form (isotopes of shorter half-life, for example). Either way the requirement that the material concerned be held safely and securely in the interim remains. What would be different would be the extent to which the characteristic of accessibility would cut across the requirement that human beings should not be able to stumble unwittingly upon the material or gain access for nefarious purposes.

There are two distinct aspects to such a project – the technical and the socio-political. Technically, there is the problem of determining what the desirable characteristics of such a disposal site would be and then identifying actual possibilities. This is relatively straightforward. Then there is the necessity to convince a public whose interests might be affected by such a development (and their political representatives) that the proposed development is safe and will impose negligible cost upon them. On the whole, the experience seems to be that this socio-political aspect presents major problems. Whether these are insuperable remains to be seen. For some the key here is to take your time in a process which is as transparent as it can be. The credo is 'go slowly in order to go fast'.[66] The ultimate acceptance of the now functioning Waste Isolation Pilot Project (WIPP) facility at Carlsbad in southern New Mexico may suggest that such a strategy can be successful in the end. On the other hand, the enormous difficulties that seem to be faced by the Yucca Mountain project (see below) point the other way. The crucial requirement is that the public and their representatives (official and unofficial) perceive a beneficial interest and thus have a reason to seriously consider the evidence concerning safety and advantage. This may be an interest in energy security as an underpinning of economic security (as in the case of Japan and the Republic of Korea). On the other hand, the crucial factor may be a recognition of the importance of nuclear power generation in ameliorating the potential harm of global warming caused by the combustion of fossil fuels. At the local level, the interest may be employment and infrastructure development. This seems to have been a factor in the Carlsbad case where the local authorities appear to be enthusiastic supporters

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66. Atsuyuki Suzuki, 'Strategic Views on Back-end of Nuclear Fuel Cycle - Flexibility and Transparency are the Key', a paper prepared for an invited talk at the Pacific Forum CSIS and Sandia National Laboratories "Workshop for Asia Nuclear Experts on Transparency in the Back-end of the Fuel Cycle", Albuquerque and Carlsbad 4, New Mexico, July 24-27, 2000, p.4.

of a project that they are satisfied is safe and which has brought considerable local benefit.

Countries with developed civilian nuclear industries also have plans for the ultimate disposal of the waste material from these industries but in most cases these have not yet got to the stage of actual working repositories. Partly this is a matter of quite ubiquitous antinuclear and "not in my back yard" (NIMBY) sentiment and partly the explanation is technical. Spent fuel needs to be monitored for some decades after it comes out of the reactor, whilst the intense initial radioactivity and the associated heat generating capacity decline. Whatever view is taken of its ultimate fate, it will be held above ground and probably close to the reactor that produced it for of the order of fifty years. This relative lack of pressure to move to the next stage has made it easy to do nothing in the face of pressure from antinuclear and environmental interests. Progress has thus generally been slow. Of course, for states which got into nuclear power generation more recently, the imperative to answer the final repository question has been correspondingly weaker. Part 2, below, surveys the state of play for the major players in the Asia Pacific region

**Part 2 – National policies and progress**

**Australia**

Australia has no nuclear generating industry but it does have a research reactor at Lucas Heights near Sydney that has been operating for 42 years. It is presently looking at replacing this facility with a new reactor. One of the issues surrounding this decision is the question as to what will ultimately be done with the radioactive accumulation from the previous one. This includes 'conditioned' waste from the reprocessing of spent fuel which ultimately will be returned from overseas and the decommissioning wastes from the present reactor, as well as the low level wastes from general nuclear operations (like radio-isotope production). The conditioned spent fuel from the Lucas Heights reactor is officially categorised as Long-Lived, Intermediate Level Waste (LL ILW), in recognition of the relatively low concentration of radioactive isotopes and consequent relatively low heat output.

In July 1999, Federal Industry, Science and Resources Minister, Nick Minchin, announced that a national repository for low level and short-lived intermediate level wastes would be built at a site in South Australia. A site 40km west of the township of Woomera has now been selected. This would replace the more than 50 temporary storage facilities around Australia, mainly at hospitals and universities. At the time of the announcement, the Minister also kept open the possibility that a storage capability for 'long-lived intermediate waste' could be 'co-located' with this facility. What is envisaged for the low level (and generally shorter-lived wastes) is shallow burial (around 20 metres depth) in an area 'about the size of a football pitch'. This is generally not thought to be satisfactory for higher level wastes.

The situation in Australia is probably mirrored in a number of other countries in the region that also have research reactors. It is particularly mentioned here because of its significance with regard to the *Pangea* proposal (see below for details) under which an extensive international facility would be built which could also have taken the wastes from Lucas Heights. In terms of quantities the amount of this sort of material would be trivial but the possibility that the Pangea Company might have taken responsibility for its disposal was seen in some quarters as a way of getting the much larger approval.[67]

### Canada

In 1978 the governments of Canada and Ontario directed Atomic Energy of Canada to develop a concept for the deep geological disposal of nuclear fuel wastes. By 1981 it had been decided that site selection would not begin until after a full federal public hearing, followed by approval of the concept by both governments. In 1989 the review/hearing process began but it was still on the basis of a non-specific 'concept'. There was no identified site and no suggested implementing agency, although it was generally envisaged that the wastes concerned would be spent fuel rods or solidified high level waste from reprocessing and that the material would be placed in a stable geologic structure (probably granite) some 500 to 1,000 meters below the surface.

The panel charged with this review process reported in March of 1998. It recommended a 'step by step' approach, with the first step being the setting up of a nuclear fuel waste management agency. The panel also recommended that the search for a specific site not proceed at the present time. These recommendations were based on a judgment that:

'The safety of the disposal concept may have been adequately demonstrated to the established technical community, but, in the Panel's view, this fact is not proven to be accepted by the broad Canadian public'.

It may well be that the ambiguous and fundamentally inconsistent conclusion cited above reflects deep divisions in the review panel themselves.

### China

The present intention of the Chinese authorities appears to be to reprocess spent fuel from its civilian power reactors, or, at least to hold this material ready for a decision to proceed with reprocessing. There are already plans for a civil reprocessing pilot plant in Gansu province (Lanzhou Nuclear Fuel Complex). This, together with the fact that the civilian nuclear industry is relatively young (even for northeast Asia), will mean that China will not have a spent fuel/high level waste *disposal* problem for some time to come. It thus has little incentive to participate in cooperative solutions from the standpoint of need. This is not to say that it will not do so. Certainly China has the geology, climate, land forms which would be appropriate for a deep underground permanent repository. In fact geological studies are underway in the northwest to select an underground disposal site for high level waste. In its world-wide study, Pangea Resources (see below) identified four suitable regions and one of these was in western China. Whether China will take nuclear material from *other states* for long term storage or disposal, is another matter. There are obvious sensitivities about this. Certainly, the possibility that China would take waste from abroad was very firmly dismissed by a Chinese representative at the 1998 CSCAP CSBM meeting in Washington. The common presumption that states should take care of their own waste was reflected in a memorable declaration, 'China will cook its food in its own kitchen'.

67. AAP, Feb. 22, 1999.

## Japan

Preliminary studies for a possible deep geological disposal site have been undertaken. Detailed plans exist at the conceptual level. In a report published in 1999 the Japan Nuclear Cycle Development Institute concluded that there was a 'wide distribution of geological environments where deep underground final disposal is technically possible'[68] but no site for a Japanese repository has been chosen. Indeed, a substantial antinuclear constituency and the well-recognized NIMBY sentiment mean that there is considerable nervousness about taking such a step. To some degree, Japan is able to put the problem off by its policy of reprocessing spent fuel. Presently, this is being done overseas (in Britain and France) but Japan is building a reprocessing capacity of its own. This is at Rokkasho-mura in northern Honshu. However, even when this comes on stream it will not be able to handle all Japan's spent fuel. On the other hand, some local authorities are proving difficult to persuade to allow the use of MOX fuel in reactors in their region. Unless this pattern changes, *demand* for MOX is going to be well within the capacity of the Rokkasho plant and the pressure will be rather on finding interim storage capacity for an increasing accumulation of spent fuel. There is some suggestion that this particular problem has been solved. There are well-developed plans for the construction of an interim storage facility by 2010, with a number of local authorities said to be willing to host such a facility.[69]

In any case there will be a need to deal with the high level waste produced by reprocessing. This is presently held at an interim storage facility also at Rokkasho-mura. It is anticipated that it will be stored here for 30 to 50 years, after which time a final disposal facility will be ready. Generally, there is a strong feeling in Japanese official circles that accumulated spent fuel and separated plutonium constitute a kind of strategic energy reserve, as well as being (from another perspective) a major and highly contentious disposal problem.

The newly established Japan Nuclear Cycle Institute (JNC) intends to develop a deep underground experimental laboratory to investigate HLW storage and disposal. The operational start date for an actual repository is suggested to be between 2030 and 2040.

## South Korea and Taiwan

Neither South Korea nor Taiwan presently reprocesses its spent fuel. For well-understood political reasons there is unlikely to be any change in this situation in the immediate future. Both administrations have considered the problems of building a national repository but clearly the economics of such a step would be daunting if they each proceeded alone. Non-proliferation considerations also strongly point to cooperative solutions in this sort of case.

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68. Suzuki, p 2. However Suzuki, himself, says (p. 7) that Japan (like other NE Asian states) is generally unsuitable for geological disposal sites because of tectonic problems.
69. Kaoru Kikuyama of the Japanese Atomic Industrial Forum (private correspondence)

**South Korea**

The Ministry of Commerce, Industry and Energy (MOCIE) announced in October 1998 a new plan for radioactive waste management after the failure of earlier disposal plans.[70] Under this the government is required to complete site selection for a spent fuel repository by 2016. Responsibility for the program has been transferred from the Ministry of Science and technology and KAERI, to MOCIE and the power utility KEPCO, itself, although the actual personnel responsible may have changed little. The entity responsible for technical work is still the Nuclear Environment Technology Institute (NETEC).

More recently, there has been some suggestion that Korea might be looking at the construction of an interim storage facility. Certainly, it appears that on-site spent fuel storage capacity will be full by 2006.

As far as permanent disposal is concerned, a detailed 'preliminary repository conceptual design' has been prepared in cooperation with Sandia National Laboratories.[71] This forms the basis for the further development of a 'reference repository system', which is to be followed (in 'Phase 3') by the establishment of a 'Korean Standard Repository'. No site has yet been designated, although the concept design assumes some specifics in the way of geology. The disposal site will be in granitic rock, at a place assumed to be between two large fault zones and at a depth of 500m below the surface. The design capacity for the facility is 36,000 tons and the 'Total System Life Cycle Cost for the base case repository is $11.15 billion to be spread over nearly 80 years). This figure is largely based on estimates prepared by U.S. authorities in relation to Yucca Mountain and work done by the Swedish Nuclear Fuel and Waste Management Company.

**Taiwan**

The utility, Taipower, is responsible for the management of all radioactive wastes. As far as spent fuel is concerned, increased pool storage capacity has been created at the various reactor sites by 'reracking'. It is hoped that this will accommodate fuel rods from the reactors until a series of interim dry storage facilities to be built at each site are completed around 2005/6. According to decisions taken in 1991, the Taiwanese authorities gave themselves forty years (from that date) to investigate and build a final (permanent) disposal facility. Since 1986 Taipower has had a 'nuclear backend fund' (from a levy on nuclear power production) to pay for this development. The Corporation has also been pursuing the possibility of regional cooperation 'in parallel with domestic disposal problems'.[72]

70. The Uranium Institute, Waste Reports, 1999.
71. Sorenson et al, 'Conceptual Design and Performance Assessment of a Deep Geological Repository for High-Level Nuclear Waste in Korea', Sandia National Laboratories, USA and Korea Atomic Energy Research Institute, Korea.
72. Information taken from an English language review of radioactive waste policy, 'Management of TPC's Radioactive Waste, December 2000, supplied to the author by Micheal Lin of Taipower.

**United States**

The designated site for the ultimate disposal of spent fuel from the American nuclear power industry and high level waste from the American nuclear weapons program is Yucca Mountain in the state of Nevada. The site is approximately 100 miles north-west of Las Vegas and close to the Nevada nuclear weapons' test site. Under the provisions of the 1982 Nuclear Waste Policy Act and the project timeline subsequently published by the U.S. Department of Energy, viability assessments and environmental impact reports are to be completed by 2001 when a decision whether or not to proceed should be taken. Assuming such a decision is made, emplacement of waste should begin in 2010 and be completed around 2033.

The waste material is to be held in a network of specially excavated tunnels at least 300m below ground.

There is a number of problems. The project is vehemently opposed by environmental groups and by the Nevada State authorities. Persistent opposition has also come from the U.S. Environmental Protection Agency. Legislation to reduce the influence of the EPA was vetoed in 2000. The same legislation (Nuclear Waste Policy Amendment Act, 2000) also provided for an interim storage facility near the Yucca Mountain site which might have taken waste from 2007.

The original proposal for a deep geological repository envisaged that emplacement would start in 1998. Substantial sums of money have been taken from the nuclear utilities on the basis of this undertaking. The companies are now threatening to sue the U.S. Government to recover the cost of continuing to store spent fuel. In response, the U.S. Department of Energy is proposing to 'take title' of spent fuel without moving it and pay for its continuing storage. This, too, is opposed. The Minnesota Legislature has taken steps to prohibit the building of any further on-site storage at the Prairie-Island nuclear facility.

## Part 3 – International Solutions

### PACATOM

The PACATOM proposal as it was presented in 1997 and 1998 envisaged an intergovernmental organization that would facilitate cooperation between the states of the region in respect of the peaceful uses of nuclear power. One important consequence of this cooperation would be increased mutual confidence and feelings of security produced by greater transparency in nuclear activities of the participating states. Six specific potential areas of cooperation were enumerated.[73] They included safety cooperation (facility design and emergency response), research on nuclear technologies, inspections, cooperation on the nuclear fuel cycle (common recycling facilities, or spent fuel storage/disposal facilities).

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73. 'PACATOM: Building Confidence and Enhancing Nuclear Transparency', Pacific Forum CSIS, October 1998, page 6. See also, Robert A Manning, 'PACATOM: Nuclear Cooperation in Asia', *The Washington Quarterly*, Spring 1997, pp. 217-232.

It was pointed out in CSCAP meetings held around this time that a number of these functions were already being discharged quite satisfactorily by existing organizations (such as WANO and IAEA) and that PACATOM would thus be merely duplicating this activity. Discussion was also overtaken by the Asian financial crisis so that it seemed inopportune, too, on economic grounds. It may now be appropriate to re-consider a more limited cooperative institution of this kind, which might focus specifically on the storage, or ultimate disposal of spent fuel.

The original suggestion (in the Manning paper referred to above) was for the establishment of a regional waste site (or sites) on the Asian mainland or on an uninhabited off-shore island. This would have the virtue of being economic, especially for the smaller players, like Taiwan and Korea. It would also allow for the generalization of best practice and perhaps make a contribution to non-proliferation by providing for the establishment of a 'plutonium bank', in which separated reactor-grade plutonium would be 'deposited'. It would be available for 'withdrawal' by the owners but, of course, this could not be done without the fact that it *was* being withdrawn being known. Possibilities for a new 'PACATOM' are explored in Part IV, below.

**Internationally-Monitored Retrievable Storage**

The concept of an internationally monitored storage system for nuclear materials first came to the attention of the CSCAP CSBMs' Working Group through a paper presented at the May 1998 meeting by Dr Lewis Dunn of *Science Applications International Corporation (SAIC)*. The presentation was based on a (then) recently completed report by *SAIC*, prepared for the United States Department of Energy and the Office of the Secretary of Defense. A variety of possibilities was envisaged, ranging from a system of national storage facilities subject to oversight by an international monitoring regime, to a fully developed international spent fuel organization, which would run one or more storage sites. It was also envisaged that an international storage site (or sites) might be established by a fully commercial organization. This would, of course, be subjected to expert, independent supervision.

The crucial virtue of such a scheme was seen to be the contribution it could make to reducing proliferation anxieties. Other advantages might be to generally strengthen nuclear materials protection standards and enhance transparency. The SAIC study also envisaged a possible regional version of the Internationally Monitored Retrievable Storage system, centered in East Asia.

**The Pangea Proposal**

Pangea Resources International is incorporated in Baden, Switzerland. With a wholly owned subsidiary company, Pangea Resources Australia Pty. Ltd., with an office in Perth, Australia. Pangea Resources is owned by British Nuclear Fuels Limited and Panterra Resources Limited. The company is studying the feasibility of developing and operating a deep geologic repository to take spent fuel, high level waste and long lived intermediate level waste from anywhere around the world. Consideration primarily of geological and climatic factors led the promoters to choose a potential repository host region in inland Western Australia (hence the establishment of an office in Perth). Pangea Resources has also identified (in general terms) what it considers to be suitable repository host regions in both Southern Africa and Argentina, but their interest is focussed primarily on Australia for the time being. No specific repository sites have been selected to date in any of the potential host regions.

The company envisages building a repository complex, 'several hundred metres below ground', which would be accessed by ramp and which would accommodate, in separate workings, the high level and intermediate level wastes. The complex would be some distance from the coast and the entire development would entail building a port and a dedicated rail-line. The potential market for such a project is seen to be very large. The company estimates a world-wide accumulation by 2015 of some 250,000 tons of spent fuel and high level waste. Notwithstanding that the major nuclear nations have national plans for ultimate storage of their high level waste, Pangea claims that the project could increase the GDP of Australia by 1 percent and bring a revenue over forty years of $200 billion. The Pangea repository proposal is for the disposal of about 75,000 tons of spent fuel, which they estimate to be about 30 percent of the current world inventory.

The Pangea proposal for Australia was leaked in December 1998 and received a generally hostile reception from the media and from politicians. A spokesperson for Federal Industry Science and Resources Minister, Nick Minchin, said that there was no intention to take nuclear waste from overseas.[74] Similarly, Labour Opposition Leader, Kim Beazely, said that countries using nuclear power had to find ways of dealing with waste themselves rather than dumping it in Australia. Antinuclear and environmental groups were similarly vocal, although they did not always appear to understand the issue (particularly, that the project primarily concerned residues from civilian operations). Dr Denborough, of the Nuclear Disarmament Party, said that the waste ought to be 'buried under the Pentagon, as this was the place where most nuclear weapons had been planned'.[75] By January 1999 the focus of interest had moved to Western Australia with a rumour that a toxic and radioactive waste dump was to be built in the north of the state, inland from Port Hedland. The evidence for this was that roads in the area were being upgraded. Pangea deny any link with the so-called 'road to nowhere'.

At this time, Minister Minchin reaffirmed government opposition to such a project but did concede that the Australian Government was looking for a site to dispose of the country's own nuclear waste. The Premiers of West Australia and South Australia also ruled out support for a waste repository in their respective states. However, not all politicians are against such a project. West Australian Liberal Senator Ross Lightfoot told ABC Radio that there was support for the project within the government. He conceded that ministers might be reflecting what the majority of the people of Australia want (but) 'The majority of people of Australia are probably wrong'.[76] In a later speech, Senator Lightfoot urged Australians not to dismiss the plan out of hand.

> If the plan can be proved to be safe, then it would be a hugely profitable new industry. It would be far better for a geologically and politically stable country like Australia to be managing nuclear waste rather than to take the

74. Australian Associated Press, Feb. 21, 1999.
75. AAP, Dec. 8, 1998.
76. AAP, March 25. 1999.

risk that some of our near neighbours may decide to accept the massive profits from this industry.[77]

However, the Pangea proposal for Australia still faces enormous obstacles. The Western Australia legislature has passed a 'Nuclear Waste Storage (Prohibition) Act' and the South Australian government is considering similar legislation, although the prime target here seems to be the proposal (mentioned above) to establish a storage facility for indigenous 'intermediate level' wastes. For the time being Pangea remain optimistic. They accept that there is 'substantial entrenched opposition' but insist that the company 'is taking a long term view, and is not being put off at this time by statements of Government policy opposing its proposal. It may need the appearance of some substantial new factor (such as Australia, itself, adopting nuclear energy for power generation) to alter entrenched attitudes.

**Russia (The NPT – MINATOM Project)**

This is a joint project between the Russian atomic energy agency, MINATOM, and the Non-Proliferation Trust, incorporated in Washington. The proposal is to establish, on a commercial basis, an interim storage for up to 10,000 tons of spent fuel. Favoured sites are at the Mayak nuclear processing plant or near the central Siberian city of Krasnoyarsk. As the trust's name suggests the major justification for the project is in terms of non-proliferation but other advantages are claimed for what would also be a solution to the nuclear fuel storage problem which many East Asian countries face. Amongst those mentioned specifically in this context are China, Germany, Japan, Spain, Switzerland and Taiwan.[78] No American spent fuel would go to Russia. It should also be noted that this is not a long-term solution since the proposal is for 'an initial storage period of forty years'.[79] Revenue from the project would be used to construct a geological repository that would then be the final disposal site. Claimed virtues of the NPT-MINATOM project also include money available for a nuclear cleanup in Russia and sums to be devoted to improving security for fissile material stockpiles, and to generally provide employment for technical persons. There is also talk of contributions to the care of Russian senior citizens and orphans.

The proposal is strongly opposed by a variety of organizations, including the Bellona Foundation of Norway, Greenpeace, and local environmentalists, who have reasserted that proposals of this kind would be contrary to present law in Russia, which forbids the importation of foreign nuclear waste.[80] This legal obstacle seems now to have been removed by an overwhelming vote in the Russian Duma (December 2000). The relevant legislation still needs approval from a parliamentary upper chamber and there are further procedural votes required in the Duma but no problem is anticipated in regard to either of these steps. More generally, Greenpeace also doubt whether the Russians are sincere in their commitment to use some of the revenues from such a project to clean up nuclear pollution sites. The fact that the proposal is an interim one

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77. AAP, March 30, 1999.
78. PPNN Newsbrief, Programme for Nuclear Non-Proliferation (University of Southampton), Vol. 52, 2000, p. 18.
79. http://www.NPTInternational.com/questions.htm (p. 4)
80. http://www.greenpeace.org/pressreleases

(40 years) is also seen as a major problem since these wastes need to be safely accommodated for much longer than this – say thousands of years. Furthermore, there is some indication that MINATOM envisage something more than mere storage. They want to reprocess the spent fuel. In this connection, it has been reported that a deal has been struck to import the major components of an unfinished German MOX fuel fabrication plant.[81] From the point of view of adding value to the operation, this makes sense but reprocessing itself raises further political problems. Certainly the American end of the NPT partnership is implacably against reprocessing but the fact that the Russian authorities are planning to extend their MOX fabrication capability, and perhaps take spent fuel beyond what is envisaged in the NPT-MINATOM proposal, is the cause of some scepticism in the United States.

**Transportation Issues**

The adoption of an international solution to the spent fuel problem would inevitably entail increased international movement of nuclear material and much of this would be by sea. This is not necessarily a problem. There are available specialized ships and specialized operators (most notably Pacific Nuclear Transport Limited) and notwithstanding periodic outbursts of anxiety the safety record for such shipments is extremely good. Indeed, PNTL claim that over all their years of shipments between Europe and Japan there has never been an accident that involved the release of radioactive material. The risks associated with sea transportation have been much studied[82] and there are strict standards (both for the transportation casks and for the ships) laid down by the International Atomic Energy Authority and the International Maritime Organization. Nonetheless, the establishment of an international repository, especially one away from the main nuclear power production areas, would have major implications for sea transportation and would more directly involve a wider range of stakeholders. The Pangea proposal, sketched above, to take 75,000 tons of spent fuel (over some 40 years) would require of the order of one thousand shipments[83]. All those involving spent fuel from Northeast Asia would pass through the South Pacific Ocean and Tasman Sea. A repository established in Argentina or southern Africa would have similar implications, except that the transportation distances would be

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81. PPNN Newsbrief, Programme for Nuclear Non-Proliferation (University of Southampton), Vol. 51, 2000, p. 2.
82. These have covered a variety of specific cargoes, including spent fuel, vitrified high level waste and unburnt MOX. Some of the specifics are obviously different in the different cases but the accident scenarios and the safety conclusions have a good deal in common. See, for example, KB Cady (Cornell University), 'Marine Transport of Nuclear Reactor Fuel, Plutonium and Vitrified Waste', 1997. See also Edwin S Lyman (Nuclear Control Institute), 'The Sea Transport of Vitrified High Level Radioactive Waste: Unresolved Safety Issues', 1996, and the extensive critique of this by a group from the Sandia National Laboratory, 'Comments on a Paper Titled ' The Sea Transport etc.', 1997. A series of reports published in 1999 by the Central Research Institute of Electric Power Industry (Japan), may also be relevant.
83. A typical fuel assembly weighs about 500 kilograms and a typical maritime transportation flask may contain 6-12 assemblies and weigh of the order of 100 tons. PNTL ships have four or five holds, which could carry twenty flasks, or more, in total. A shipment could thus contain as much as 200 tons of spent fuel but may be more likely to contain half of this. A repository of 75,000 tons would thus require of the order of 750 shipments to fill. (Information culled from various documents including that submitted to IMO by BNFL and partners)

even larger. Presumably, cargoes for Africa would still go through the Tasman Sea. Of course, the situation would be different if a significant proportion of the nuclear waste material came from beyond the Asia Pacific region.

The recent pattern of occasional shipments of nuclear material through the South Pacific en route from Europe to Japan has been the cause of considerable reaction particularly from New Zealand and some of the smaller island states of the region. The level of concern may have been maintained by the fact that the consignments that passed were different on different occasions (High Level Waste, MOX and, earlier, separated plutonium). A familiar pattern of spent fuel cargoes passing without incident may have a diminishing impact, particularly if it is initiated with a considerable effort in public education. On the other hand, New Zealand and the South Pacific Forum countries have taken a very strong line on nuclear shipments through the region and this has been reflected in discussions in the CSCAP Maritime Cooperation Working Group. It is also reflected in the acceptance for first reading in the New Zealand parliament, in July of 2000, of the *New Zealand Nuclear Free Zone Extension Bill*. The purpose of this legislation is to ban both cargoes of nuclear materials and nuclear propelled vessels from the New Zealand 200-mile exclusive economic zone. The bill is unlikely to proceed further than the appropriate select committee. This is because the major parties recognize that (amongst other things) it would breach New Zealand's international law obligations but the fact that a first reading was permitted (by these parties voting for the legislation) speaks volumes for the state of antinuclear sentiment in New Zealand. Even those politicians who know better cannot resist pandering to it.

By contrast the Australian government has refrained from associating itself with this kind of sentiment and has not supported South Pacific Forum initiative to push for tighter controls on nuclear shipments. Australian policy is simply to satisfy itself that all nuclear cargoes are shipped in strict accordance with internationally agreed standards. It has been much criticized by Greenpeace and others for this stance. Opposition in Australia has increased of late with a shipment of Australian nuclear waste (from Lucas Heights) leaving Sydney at the same time as fresh shipments from Europe to Japan (and scheduled to pass through the Tasman) were announced.

**The Suzuki Criteria**[84]

Discussions of possible repository sites frequently focus substantially on matters of climate and geology, to the relative neglect of wider social and political matters that may often turn out to be equally important. In a paper delivered to a workshop of Asian Nuclear Experts earlier this year, Professor Suzuki of the University of Tokyo sought to redress this imbalance by presenting the full range of criteria that might be appropriate to siting decisions. He points out (as has already been mentioned) that the size of a country's indigenous nuclear power program has crucial implications for the economics of developing geological disposal. Again, when looking for an international nuclear waste repository site, land area and population density is as important as geological environment. But it is the political and societal factors in potential host states that provide the most

84. Criteria developed by Professor Atsuyuki Suzuki of the University of Tokyo and presented in a paper to a workshop of Asian Nuclear Experts at Albuquerque in July 2000.

interesting criteria. These include the character and stability of the regime and public and official attitudes to nuclear activities within the state concerned. Equally the existence of an appropriate infrastructure would be essential if sophisticated nuclear operations are to be undertaken. Ideally, this would include a skilled workforce (especially in regard to nuclear operations) and experience of working with IAEA safeguards standards. Another specific criterion would be the degree of commitment to non-proliferation. This, in turn, might well determine the final criterion, that of U.S. agreement. The fact is, that much spent fuel around the world has come from U.S.-design reactors, or is otherwise subject to U.S. consent in regard to its disposal. United States' government approval for any cooperative scheme for interim storage or final disposal is thus essential.

Professor Suzuki rates a range of potential host countries according to these criteria. Not surprisingly, countries that score well on some criteria, score poorly on others. Australia has the geology, the open space and the political stability but (as indicated earlier) official institutions are generally antagonistic to the prospect of hosting an international repository. On the other hand, the Russian government may be keen, and the geology may be quite suitable, but their claim is weaker in respect of political stability and the state of the infrastructure. Clearly, if an international cooperative solution to the spent fuel problem is to be found it will entail substantial compromise on the matter of the Suzuki criteria. It should be noted also that many of these latter criteria are decidedly less objective than judgments about geology and land space and thus more contestable. They are also less permanent features and the fact that they have a greater capacity for causing offence may make them more difficult to use. Again, on the matter of compromise, it is clear that some criteria are more susceptible to this than others. Geology and land area are clearly unalterable features, whilst infrastructure may change only slowly. By contrast the political character of a regime may change quite rapidly and in both directions. Policy settings (such as opposition to reprocessing) can be changed over night but in practice they often exhibit a tenacious permanence.

Important though these criteria are, Suzuki argues that the way they are utilized is more important. He stresses the importance of transparency and flexibility in all aspects of the planning process. Particularly he advocates the principle, 'go slowly in order to go fast'. Of course we understand what is meant here but literally the principle is nonsense. You do not achieve speed in a cumulative process by performing each step slowly. In the case of nuclear projects that inevitably generate great opposition, to resolve to go slowly is only to play into the hands of those whose sole object is obstruction and delay. That said, it is of course true that an appearance of haste can suggest panic or that there is something to hide. Undue haste may also provoke an adverse reaction that then causes a long halt. This is the sense of 'more haste less speed'.

## Part 4 – Possible Courses of Action

### Ultimate disposal or interim storage?

Spent fuel is a potential resource as much as a waste. It contains significant amounts of fissile Plutonium 239 and this can be recovered and re-used in the form of Mixed Oxide (MOX) fuel. Indeed, this is already happening in many parts of the world and reactors are already being designed to work entirely on MOX. Presently, the economics of reprocessing are unfavorable, due to the low cost of uranium fuel but this may not always be so. There are also other factors, such as energy security, that come into the equation and fuel costs are anyway a very small proportion of total costs in the case of nuclear power. More speculatively, it might be said that the concentration of radioactive isotopes (other than Plutonium 239) in spent fuel, represents a potential resource in itself. The history of technology has many examples of materials that at one time appeared to have no use but which later (when a use was found) turned out to be valuable. Technological developments may also throw up economic processes for transforming high level waste so that it presents less of problem. Much of the present difficulty in gaining public acceptance for permanent repository proposals lies in the apparent need to secure the material against radiation leakage tens of thousands of years into the future.[85] A treatment that shortened the average half-life of the isotopes in the waste (transmutation) could transform this aspect of ultimate disposal. Again, this is very speculative. Some commentators even doubt the possibility in principle of developing such technology but it surely cannot be excluded. All of this points to the adoption of an interim storage strategy.

Should we also look to a limited proposal in the first instance? This might be a proposal to only take certain wastes, such as military wastes or high level wastes from reprocessing. Alternatively, the limitation might be to begin with an experimental or pilot-scale proposal. If the name is any guide the low-level repository for defense wastes near Carlsbad certainly started out as a pilot project. WIPP stands for Waste Isolation Pilot Project. That no longer seems to be the understanding. WIPP will be taking the full range of low-level wastes (both direct handling and remote handing, and corrosive as well as merely contaminated) from sites all across the United States. On the other hand, there may be suspicion of a program that calls itself 'interim' or 'experimental'. What happens after the end of the interim period or after the pilot project is completed, or if the 'experiment' somehow fails? Is it possible that the results are unsatisfactory but the activity cannot end because no one else will take the material? Interim or experimental solutions really need broadly the same grounds for acceptance as long term solutions do. Having regard to the likely cost of establishing this kind of facility and the concomitant cost of upgrading supporting infrastructure, experimental or interim proposals would be most feasible where the infrastructure was already substantially present or the elements of a suitable facility were already in existence. This seems to be the case with the NPT-MINATOM proposal described earlier. Otherwise, it might mean that an interim international spent fuel storage facility would be above ground – say as an extension of the existing high level waste storage at Rokkasho-mura.

**Where to go now**

On present evidence it seems likely that the Pangea proposal will fail in Australia. Despite the claims by the company of economic benefits to the country, there is little will in political circles to rationally address the proposal on its merits. The company's alternative

85. The U.S. Department of Energy 'Viability Assessment of a Repository at Yucca Mountain: Overview', December 1998, comments that 'For 10,000 years after the repository is closed, people living near Yucca Mountain are expected to receive little or no increase in radiation exposure. The maximum radiation exposure from the repository is expected to occur after about 300,000 years.' (Even then it is only double the background and applies only to people living within 20 km.)

sites (in southern Africa and Argentina) score well on geography but would be well down on most of the other Suzuki criteria. These sites also have the most extensive implications for sea transportation of nuclear materials and this (as indicated earlier) might raise other difficulties. Similarly, the NPT-MINATOM proposal faces considerable obstacles. Again, there are transportation problems, this time relating to land transport. Even if this scheme does go ahead in its present form it would take only a small fraction of the world's present accumulation of spent fuel. Together these (admittedly preliminary) judgements suggest that neither of these schemes can presently be relied upon to produce a solution to the problem of what the Asia Pacific states will do with their spent fuel and high level wastes.

**A new organization?**

The time may now be right to reconsider a cut-down version of the PACATOM proposal. The states of the region might establish an Asia Pacific institution that would have as its principle function the development of cooperative spent fuel/HLW storage or disposal facilities. So as to avoid confusion with earlier proposals and the European model from which the name PACATOM was taken, the organization might call itself the Asia Pacific Nuclear Agency (APNA). Apart from this central function APNA would also take over some of the transparency and confidence building functions developed earlier by this working group.

Bearing in mind the Suzuki principles, the organization might begin by developing a single facility that would be limited in scope and limited in duration. If it were successful it could be followed by other cooperative schemes, also run by APNA but in different locations. Essentially the facility should provide for above ground interim storage on an internationally monitored basis for (say) 100 years.[86] The fact that it was on the surface would substantially lessen dependency on geological factors and thus widen the range of possible sites. The capacity of such a repository would need to be such as to make the project economic and, clearly, the plan would need to address the question as to what happens when the 100 years have elapsed. One possibility here is to include a levy that would go towards the development of a longer-term repository. We simply do not know what possibilities technological development will bring. It is thus undesirable to attempt to commit over a long time period, if it can be avoided. Whatever may be said about the supposed evils of consigning present problems to generations to come, there are some things that simply have to be left to the future. The crucial requirement is that the material be left in a form that can be dealt with and that it is safe during the storage period. Objections to proposals for above ground storage of this kind tend to turn on social uncertainties. What happens if the structure of society breaks down and crucial knowledge is lost? This is a situation that has been envisaged in many a Hollywood film. To judge by the social conditions that are frequently depicted in such features, the existence of a few nuclear dumps would be the least of our worries. One might also ask how likely such a catastrophic loss of technology really is.

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86. This seems to be the solution that France is adopting. A July 1998 report of the National Advisory Committee (CNE) concluded:Spent nuclear fuel, which has considerable potential residual value, should be stored at surface or sub-surface level, to allow easy access and keep future options open. On the other hand, for low and intermediate level transuranic wastes and (ultimately) High Level vitrified wastes the proposal was for deep geological disposal.

An alternative cooperative project might draw a clear distinction between spent fuel and separated plutonium, on the one hand, and vitrified high level waste on the other. It is much easier to recognize potential value in the case of the former and these materials have proliferation implications that vitrified high level waste does not have. This anti-proliferation aspect would also make the project more politically attractive. On the other hand, too great an emphasis on this would be counter-productive. The biggest obstacle to setting up any repository scheme, anywhere in the world, is public apprehension about things nuclear. Any cooperative initiative would need to be careful to avoid this. A second reason for making the distinction (between spent fuel and HLW) is that future storage for spent fuel is a problem that all the nuclear states in the region have, whereas only Japan and China (on present policy) will accumulate HLW.

On this basis APNA might begin with a regional, above ground, storage facility for (say) 10,000 tonnes of spent fuel and separated plutonium to serve the needs of Japan, Korea and Taiwan, plus China, if China wished to become involved. Such a facility would be monitored for performance and the material would be retrievable if performance was not satisfactory. It would by no means take all the spent fuel in the region but it might take sufficient for it to be very worthwhile for the three or four countries involved. China and Japan might separately cooperate on a regional High Level Waste repository, which could be of the deep geologic kind. Both of these projects would be on such a modest scale (having regard to the size of the accumulated stockpile) as to be describable as ‘pilot’ projects, and thus meeting Professor Suzuki’s *desiderata*. At this stage a cooperative venture of this kind ought not to be seen as an alternative to existing national programs, although if it were successful it might supplant national schemes in some cases, particularly those of Korea and Taiwan.

A cooperative storage project of this kind would need to be not only transparent but also proactive. It should not apologize for itself. As well as being a service to the countries of the Asia Pacific, it should be seen as an *opportunity* (perhaps bringing employment and development to a less-developed region) and a positive virtue (in its contribution to combating climate change and promoting security). Like holding the next Olympics, it should be a possibility to be sought, rather than an imposition to be feared.

Such an opportunity might be of particular interest to China, notwithstanding periodic assertions that China would not take waste from outside the country. The development of a major interim storage facility in the far west of the country, perhaps followed by a deep-geological repository for permanent placement, could bring substantial development to the region and, potentially, a considerable amount of money. For China, itself, it could be an important source of foreign exchange, as well as being seen as a valuable contribution to non-proliferation. If it restricted itself to wastes from NE Asia, a site in China would also have the virtue of having the shortest lines of international (sea) communication. A facility such as this could be developed and financed by the Pacific region states through an Asia Pacific Nuclear Agency, as outlined above, or the actual development could be sub-contracted to a commercial organization that would build and operate it. This would leave to APNA a general supervisory and promotional role (in conjunction with the governments concerned).

If China were not willing to participate in this way (or at all) the problem would fall back on site acceptability. Again, the ideal would be for the facility to be seen as an opportunity rather than something that was imposed on an unwilling populace. To this end the aim should be to offer a total concept that would be so attractive that municipalities and district administrations would positively clamor to be considered as the location. The extreme case would be something like the development of a nuclear 'Disneyland'. The inspiration for this notion is the visitor centre at BNFL's Sellafield plant in Cumbria, which (it is claimed) is the second most popular tourist destination in the region (and the region is the Lake District). At the very least, the facility would be open for tours, with interactive displays and illustrated explanations of what is going on. These would include extensive tracking and monitoring displays but might also include background information about what is being done and why, and how the activities at the site fit into the wider context of nuclear power generation. The facility could include 'rides', both virtual and real, through basic nuclear processes. Even without this, an opportunity to walk through the dry storage 'hall' and inspect the casks, with their IAEA safety seals, might be of considerable interest.[87] However extensive the 'Disneyland' feature might be, it would be essential to set up a NEWNET-type network in the locality. This is an internet-accessible, radiation-monitoring system for public information and education of the sort first established in the Los Alamos district of the United States. It has been so successful in engendering public confidence and feelings of security that it has been extended to other parts of the United States and, through CSCAP, to NE Asia. Overall, a cooperative repository of this sort ought to be a test of active transparency, marketing itself as a modern, environmentally-sensitive, attraction - interesting and important, fun and safe.

A cooperative final repository of the Yucca Mountain or Pangea kind would be a different proposition altogether. It would raise acute questions about siting and about responsibility for the facility over a very long term. A repository of this sort would inevitably have to be situated in some distant and inaccessible location. It could be very economically attractive to a country willing to host it but it might have greater acceptability problems stemming from the very long time horizons envisaged. On the other hand, the well-worked out Pangea proposals for a repository in Australia and the very detailed studies undertaken for the proposed Yucca Mountain repository show that safety and environmental concerns can be satisfactorily addressed.[88] Although it is taking only low level material, the now fully operational WIPP site also shows that such repositories can pass all regulatory hurdles. Some sort of permanent disposal may be an appropriate solution for the relatively small amounts of High Level Waste but for reasons adduced above, it may not be desirable as a response to the much larger, spent-fuel problem. An experimental repository for HLW only, could be a valuable, small-scale cooperative experiment, to be conducted in parallel to the interim spent fuel project.

The countries of the Asia Pacific Region face common problems in dealing with the disposal of materials from the back end of the nuclear cycle and in gaining public

87. The October 1997 CSCAP meeting in Japan included a visit to the dry storage facility at Fukushima Daiichi Nuclear Power station. The author's impression on this occasion was of walking through a gloomy medieval cathedral amongst the tombs of long-dead crusaders.
88. In the Pangea case, of course, no specific site has been publicly identified and thus no specific approval process has taken place.

acceptance for nuclear activities generally. In these circumstances an urgent investigation of the possibilities for cooperative action could be a serious policy option.

**Appendix A-1**

**World Accumulation of Spent Fuel by 2010**

(from SAIC data)

| **Region** | **Tonnes of Spent Fuel** |
|---|---|
| **North America** | **126,510** |
| **South America** | **5,860** |
| **Europe** | **137,300** |
| **Africa** | **830** |
| China | 1,050 |
| India | 7,360 |
| Japan | 27,730 |
| Korea | 10,840 |
| Taiwan | 3,320 |
| **Asia (Total)** | **50,610** |
| **Russia** | **19,980** |
| **TOTAL** | **341,090** |

# Appendix C

## Regional Verification of a Denuclearized Korean Peninsula:
**A Strategy for Success after the Current Impasse Is Overcome**

**John Olsen**
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### The Issue

The unfrozen and unsafeguarded nuclear weapons program in the Democratic People's Republic of Korea (DPRK) is the most serious issue confronting the international community in East Asia. While U.S. government attention focuses on returning the DPRK to "frozen" status and dismantling the apparent dual-breakout strategy in plutonium production and high-enriched uranium (HEU), less attention has gone into planning for verification of a nuclear-weapons-free Korean peninsula. The current impasse may end in a broad agreement, a "grand bargain," with the DPRK that addresses nuclear weapon, missile, and conventional force issues, and offers the North security guarantees and substantial economic aid in exchange.

Under these conditions, a new approach to verification will be required for several reasons: First, verification tasks in the DPRK would include certain nuclear weapon issues that are outside the scope of the IAEA mission. Second, the new agreement would likely involve increased aid, and contributing countries will insist on assurances that the DPRK is complying with its agreements. Third, the security guarantee will probably be multilateral, suggesting a multilateral approach to verification. Finally, a new approach would be needed to avoid the pitfalls of previous bilateral (U.S.-DPRK, IAEA-DPRK, and ROK-DPRK) agreements, all of which have failed to weather the vicissitudes of regional volatility.

### Regional Verification: A Possible Approach

Assuming that the DPRK agrees to verifiably dismantle its nuclear weapons and freeze its long range missile programs, we suggest that a regionally managed verification regime, staffed and sustained by all interested parties (Russia, China, ROK, DPRK, Japan, IAEA, and the U.S.) could be an effective solution. This regime's charter could be verification of all present and future nuclear agreements for both North and South Korea: Safeguards, weapon program dismantlement and measures included in the ROK/DPRK Denuclearization Agreement of 1992. The "grand bargain" may require verification of missile and conventional force terms, as well. In order to contribute to a lasting and broadening reduction of inter-Korean tensions, a role in monitoring agreements on biological or chemical weapons could be considered for the future.

Each of these countries has strong interest in a peaceful, nuclear-weapons-free peninsula and has called on the DPRK to return to compliance with the Nonproliferation Treaty (NPT). In addition to supporting global nonproliferation regimes, these countries also have strong national interests:

- Russia's President Putin is pursuing an ambitious plan to expand economic growth in the Far East using the Trans-Siberian Railway to connect through North Korea to South Korea. Russia's Far East would be more secure without a nuclear race that might expand to include Japan, China, South Korea and Taiwan.
- China is concerned that a nuclear threat from the DPRK could overturn the Japanese commitment to foreswear nuclear weapons, swiftly threatening the Asian balance of power. As Shambaugh[89] points out, China's goal is regime reform in the North to secure a peaceful environment for economic growth. It seeks to avert inflamed relations between North and South Korea, especially those that could provoke U.S. military actions.
- Japan faces the prospect of a nuclear threat from a nuclear-weapon-armed North and remembers the Taepodong missile test of 1998 that overflew Japan. As a U.S. ally, it knows that it may be a target in a confrontation resulting from DPRK nuclear adventurism. Abandoning its Peace Constitution and facing an aggressive, nuclear-armed and missile-wielding Korean neighbor would be very unpopular.
- The Republic of Korea is most threatened, if not by the nuclear weapons themselves, then by the cover they might provide for ever more extortionate demands from the North. Already the political split on the proliferation policies in the North is having a corrosive effect on ROK society and on the U.S.-ROK Alliance.
- The U.S., as guarantor of the ROK's and Japan's security and foremost advocate of nonproliferation, faces an adversary who is determined to convert every issue into a bilateral confrontation. The U.S. needs a comprehensive solution that leverages on the shared interests of all regional parties, while effectively and verifiably reducing the threat.
- The DPRK is primarily concerned with regime survival and may exchange verifiable denuclearization for a multilaterally guaranteed security pact. If such a grand bargain can be made at the highest levels, the DPRK may accept multilateral participation in future assurances of security on the peninsula.

**Roles of the Potential Partners**

Each country plays a role and brings special assets to a regional verification regime:

*Russia*

Russia has relatively good relations with the DPRK, and a long history of engagement in the military and nuclear arenas. In addition, Russia has extensive experience in nuclear disarmament and nuclear monitoring borne of U.S.-RF cooperation over the past decade. The RF nuclear weapons program has many capable experts in nuclear material control, protection and accounting (MPC&A). For example, the Institute of Automatics (VNIIA) in Moscow possesses the necessary technical expertise.

[89] David Shambaugh, "China and the Korean Peninsula: Playing for the Long-Term," NAPSnet at http://www.nautilus.org/pub/ftp/napsnet/special_reports/shambaugh.pdf, March 24, 2003.

*China*
China, as the DPRK's largest aid supplier, would represent a sympathetic presence in a verification regime. China could influence DPRK compliance within a regional regime, mitigating the North's tendency to make every dispute a bilateral issue with either the U.S. or the IAEA. Although China is a nuclear weapon state, it has submitted civilian facilities to international safeguards, pledges to observe export controls, and has participated in IAEA safeguards training.

*Japan*
Japan could play a major role in funding a regional verification regime. Since the mid-nineties Japan has allocated substantial funds to support dismantlement of nuclear weapons and other activities in the Russian Federation. RF leadership and technical activity in a Korean Peninsula verification regime could qualify for funding within this established program. Moreover, Japanese and ROK nuclear materials inspections institutions, the NMCC and TCNC, respectively, have been engaged in very cordial cooperative exchanges since 1996. This cooperation may enable Japan to play a direct role in nuclear inspections.

*ROK*
The ROK is most affected by the nuclear crisis, yet finds itself almost as a bystander. A regional verification regime gets the ROK back into the picture and establishes a relationship with the North that is more in keeping with the ruling party's "Sunshine" policy. The ROK might take the lead in training the DPRK inspectors who would participate and could achieve the aims of the 1992 Denuclearization Agreement – a significant political success. In addition, The ROK has made significant investments in capabilities for arms control monitoring and inspections since founding the Korea Arms Verification Agency (KAVA) in the early 1990s.

*IAEA*
The IAEA is charged with monitoring DPRK obligations under the NPT, but its role is restricted to civilian nuclear facilities and material. This role could continue in cooperation with the other parties of the regime. If nuclear weapons are dismantled, the nuclear weapon states in the regime might take the lead and place the defense nuclear material under verification, which could include the IAEA. For example, in the future it is expected that IAEA will verify defense nuclear material at the Mayak facility in Russia. The IAEA also has experience in cooperating with other regional nonproliferation regimes: EURATOM carries out material safeguards in Europe and reports to the IAEA. In South America, ABACC has become a partner with the IAEA in monitoring compliance with the NPT in Argentina and Brazil. Underfunded as the IAEA is, partnership with a regional regime might be a desirable way to meet their responsibilities.

*United States*
The U.S. would retain the lead responsibility in striking the grand bargain that addresses security and comprehensive nonproliferation. The U.S. would play a

major role in setting demanding goals for the verification regime and coordinating establishment of the regional regime. Government-to-government agreements probably would be needed between the U.S. and all parties to enable appropriate institutional cooperation in the verification regime.

*DPRK*
The DPRK needs to be drawn into the regional verification process as a full partner. The DPRK may evolve gradually to a more "normal" nation as their participation in the verification regime assures them of a secure environment.

## A Regional Verification Regime: Practical Issues

A regional verification regime could have the following responsibilities:

- Monitor refreezing/dismantling the DPRK nuclear weapons facilities
- Verify Compliance with NPT
    - Resolving the past history of the Yongbyon radiochemistry plant, the IAEA retaining the lead responsibility in this
    - Administering and conducting all normal safeguards activities on the peninsula
    - Implementing Strengthened Safeguards agreements on the peninsula
- Verify North-South Denuclearization Agreement
    - Subsuming roles envisioned for the Joint Nuclear Control Commission (JNCC) under the 1992 Denuclearization Declaration for North-South mutual inspections
    - Inspecting and freezing the HEU program and safeguarding or removing any products
    - Instituting comparable verification of non-enrichment and non-reprocessing compliance in the ROK
- Verify Dismantlement and Reduction Terms
    - Receiving, dismantling and safeguarding any nuclear weapon components that DPRK possesses, weapon state members of the regional regime taking the lead in this until the materials can be placed under normal safeguards
    - Verifying freeze on the facilities for developing and producing long range missiles
    - Verification of mutual reductions or redeployment of conventional forces

The regional verification regime should be located close to, but not on the Korean peninsula. Two competing options might be considered in Vladivostok, Russia or Shenyang, China. Both locations have air connections to both Koreas and avoid problems associated with basing in one or the other of the inspected parties. If the new institution is located in Vladivostok, a RF nuclear laboratory might manage it conveniently. This would benefit from extensive U.S.-RF cooperation on nuclear security in the last decade and feature Russian technical expertise. Additionally, Russian leadership and basing might qualify for financial support from Japan.

China's Shenyang is also close at hand. A city of 8 million, it has good air connections and is about four hours by road from the North Korean border. While China is typically reluctant to take a leadership role, perhaps a multilateral format may be more attractive. This suggests joint Chinese-Russian leadership, where China leads in logistics and institutional development and Russia leads in technical verification. The other partners will have to consider whether they can accept a Chinese location, or fear development of a Chinese "dominant influence" on the peninsula.

The size of a regional institution would be relatively small. Considering the difficulties of inspecting inside the DPRK, and also the breadth of nuclear industry in the ROK, we might estimate[90] that a permanent Russian management staff of about ten would be sufficient, supported by about 20 secretarial and clerical staff. Roughly 25-30 inspectors would be needed for combined industries of North and South Korea; these could be drawn from 3-5 inspection experts each from China, ROK, RF, Japan, DPRK and the U.S. The IAEA's Tokyo center could also assign 6 inspectors. During the initial phase, while the IAEA would be taking the lead in clarifying the past history of the Yongbyon radiochemistry facility, the IAEA might assign a larger team. Additional technical support staff (20) would be needed to provide communications, database capabilities, reporting to the IAEA, calibration of instruments, and laboratory testing of samples. If in Vladivostok, most of these staff would be assigned from a RF institution, perhaps supplemented by DPRK and ROK technicians. If in Shenyang, the support staff would be assigned from Chinese institutions, supplemented by DPRK and ROK technicians. Establishing a new institution in Vladivostok or Shenyang, training regional inspectors, and transferring inspection responsibilities from IAEA-Tokyo would be the initial tasks of the organization. Once the organization was functional, it would be strong enough to undertake the Yongbyon determination. The institution would need a transition plan wherein the IAEA would play a dominant role in this first big step, since the IAEA already has this as a principal responsibility.

## Conclusion

Preventing a nuclear arms race in Northeast Asia would be a significant success for the U.S. and the international community. A regional verification regime for a non-nuclear Korean peninsula could be a new, positive aspect of future U.S. relations with China, South Korea and Japan. It would also cement ties that have developed between the U.S. and the RF over the last decade of cooperation. This might open up new roles for RF scientists and engineers (potentially with Japanese funding), address critical ROK, Japanese, Chinese and U.S. security concerns, and return the U.S.-ROK alliance to smooth cooperation. All of these are substantial gains toward U.S. policy goals.

Although the verification regime would initially focus on the nuclear issues, the charter of the overarching agreement should include missiles and conventional forces. As we have

[90] Roughly based on precedents: (a) ABACC with 9 people including secretaries for 2 countries, 4 reactors and 3 enrichment plants or (b) Japan with 60 inspectors for 52 power reactors, reprocessing, enrichment and fuel fab plants, or (c) Japan's Rokkasho projected to need 20 inspectors. We scale these to the situation of the ROK and DPRK, which would have 19 power reactors and frozen reprocessing and enrichment facilities.

learned from the KEDO/Agreed Framework experience, a narrow charter is efficient in carrying out a well-defined goal, but brittle when subjected to stresses from a new direction. Therefore, verification of cessation of long-range missile programs and defensive deployment of conventional forces should be linked to the nuclear issue in a comprehensive package. Moreover, multilateral security guarantees and economic assistance may be more robust and credible when offered within the multilateral framework.

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