Appendix 1

New Nuclear Policy-Planning Council
13th Meeting
Reference Paper 1

Interim Report Concerning the Nuclear Fuel Cycle Policy

12 November 2004
Japan Atomic Energy Commission
New Nuclear Policy-Planning Council

1. Proceedings to Date

The Japan Atomic Energy Commission's (AEC) New Nuclear Policy-Planning Council (Planning Council) was established on 15 June 2004 with the aim of bringing together by mid 2005 Japan's 'new long-term program for the research, development and utilization of nuclear energy'. The first meeting was held on June 21. The Planning Council decided to commence by intensively studying the topic of most interest to its members, namely the nuclear fuel cycle policy. Including the first meeting, 12 meetings were held over a total of 30 hours. (If the deliberations of the Technical Investigation Subcommittee are counted, 18 meetings were held over a total of 45 hours.)

In regard to the future direction of the nuclear fuel cycle policy, deliberations on how to deal with spent nuclear fuel considered the following 4 basic scenarios:

Scenario 1: Reprocess spent fuel after storing it for an appropriate period of time [CNIC's note: i.e. reprocess all spent fuel];

Scenario 2: Reprocess spent fuel, but directly dispose of that quantity which exceeds reprocessing capacity [CNIC's note: i.e. reprocess to the capacity of the Rokkasho Reprocessing Plant, which is currently undergoing uranium tests, and dispose of the rest by deep burial without reprocessing];

Scenario 3: Directly dispose of spent fuel [CNIC's note: i.e. all spent fuel];

Scenario 4: Store spent fuel for the time being and at some time in the future choose whether to reprocess it or directly dispose of it.

A comprehensive evaluation of these scenarios was carried out against the following criteria: (1) safety assurance, (2) energy security, (3) environmental compatibility, (4) economic considerations, (5) nuclear non-proliferation, (6) technical viability, (7) social acceptability, (8) assurance of choice, (9) issues associated with policy change, (10) overseas trends.

The evaluation was based on the reference case in the Advisory Committee for Natural Resources and Energy's 2030 Energy Supply and Demand Forecast. Under this case the total electricity generated by nuclear power between 2000 and 2060 is assumed to be around 25 billion kWh. (Generation capacity from nuclear power is expected to increase before stabilizing at 58 GW from 2030.)

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AEC established a Technical Investigation Subcommittee within the Planning Council to carry out technical investigations, in order to make an assessment of the economics of the scenarios. So far this subcommittee has met 6 times for a total of 15 hours to consider expert technical issues. It calculated the costs associated with the direct disposal of spent fuel, the costs of the nuclear fuel cycles associated with the above 4 scenarios, and other matters necessary for the evaluation.

2. Assessment of the Basic Scenarios

The results of the evaluation of the 4 scenarios, considered against the various criteria, are shown in the appendix. [CNIC has added its comments to this appendix.] The evaluation criteria can be broken down into the following 4 categories: (1) prior conditions which are essential to the viability of the scenarios, such as safety assurance and technical viability; (2) factors which can be used to compare the policy significance of the scenarios, such as energy security, environmental compatibility, economic considerations, nuclear non-proliferation, and overseas trends; (3) practical restrictions such as social acceptability (problems finding a site) and issues associated with a change of policy; and (4) assurance of choice, that is adaptability in the light of future uncertainty associated with the scenarios. An outline of the evaluation of each basic scenario is presented below in terms of these 4 categories.

(1) Evaluation of prior conditions which are essential to the viability of the scenarios
* In regard to 'safety assurance', by preparing appropriate response measures, taking into account the evaluation of assumed accidents based on the safety evaluation guidelines, it is possible to assure safety to the required standards. However, at this stage, Japan lacks technical knowledge in regard to direct disposal that takes into account Japan's natural conditions. It is necessary to accumulate this knowledge. The point has been made that scenarios 1 and 2, which involve reprocessing, require more facilities to handle spent fuel than the other scenarios, and therefore could entail a higher release of radioactivity into the environment. However, the exposure doses resulting from these releases will be low and well within the regulatory limits. They will also be much lower than exposure from natural radiation. Therefore, it cannot be said that these releases represent a significant difference between the scenarios.

* In regard to 'technical viability', reprocessing technology is being scaled-up, reflecting past experience with the technology; the system for glass canister (high level waste left after reprocessing) disposal has been prepared and the implementing organization made clear, and technical knowledge is being continually improved. By contrast, there is a lack of accumulated technical knowledge on which to judge the suitability of direct disposal in the Japanese disposal environment. Therefore, scenario 1 presents fewest technological problems. In regard to scenario 4, due to the fact that technological choices will be postponed for a long period of time, there will be problems associated with the need to continue to make investments to maintain a technology base and human skills that may never be used.

(2) Evaluation of factors which can be used to compare the policy significance of the scenarios
* At current uranium prices and with the current level of technological knowledge, scenario 1 is the least 'economic' of the scenarios. However, (1) from the point of view of 'energy security (stability of supply, resource conservation)', it has the effect of reducing the amount of uranium required by

between 10% and 20%; (2) from the point of view of 'environmental compatibility', by not directly disposing of the spent fuel with the uranium and plutonium contained therein, by reprocessing the spent fuel and extracting that uranium and plutonium, and by dealing with this uranium and plutonium by [re]using it, the inherent radioactive harm from the high level waste (glass canisters) after 1,000 years has elapsed will be one eighth of that if the spent fuel had been disposed of directly. The volume of high level waste would be reduced to between 30% and 40% and the space required to bury it would be reduced to between a half and two thirds of that if the spent fuel had been disposed of directly. Therefore, this scenario is superior. It is highly compatible with the closed-loop economy objectives of using resources as effectively as possible, and reducing waste to the greatest extent possible. Furthermore, if the fast breeder cycle is implemented, the superiority of this scenario is even more marked. Moreover, if the costs associated with a change of policy are considered, it is not unlikely that it will also cease to be less economic.

Against this argument was the view that, at a stage when the fast breeder has not been implemented, in pursuing a method of achieving the effect of uranium conservation, a comprehensive assessment should consider, in addition to reprocessing, reducing the concentration of the tailings (the uranium left after the process of enriching natural uranium). It has been pointed out that this would have the same uranium conservation effect as reprocessing, but at a reduced cost. In response to this view it was pointed out that the superiority of scenario 1 becomes much more pronounced if the fast breeder is established, so the path towards implementation of the fast breeder should be made clearer.

* At current uranium prices and with the current level of technological knowledge, the nuclear fuel cycle cost of scenario 3 was calculated to be 0.5-0.7 yen per kWh cheaper, so from that angle scenario 1 is superior. However, because usable plutonium will be buried instead of being placed under human control, this scenario is inferior to scenario 1 from the point of view 'energy security' and 'environmental compatibility'. Moreover, if the costs associated with a change of policy are considered, it is not unlikely that it will also cease to be more economic. The point was made that considering the fact that, with a view to realizing a closed-loop economy, large costs are incurred in order to recycle industrial goods[1], it will be possible to gain the public's understanding for the extra 0.5-0.7 yen per kWh required for the nuclear fuel cycle of scenario 1, given that this scenario is superior from the point of view of 'environmental compatibility'.
[Note 1: The cost of recycling industrial goods per item is 13,000 yen for automobiles, 4,830 yen for refrigerators, and 3,675 yen for air conditioners, whereas the difference in the nuclear fuel cycle costs would be 600-840 yen per year per household, which represents 1% of annual electricity costs (72,000 yen). For the average office building the difference would be 70,000-90,000 yen per year, being 1% of annual electricity costs (6,500,000 yen).]

* In regard to 'non-proliferation', when conducting reprocessing, in order to avoid giving rise to international concerns about nuclear proliferation and nuclear terror, it is necessary to create strict, internationally agreed safeguards and measures for the protection of nuclear materials. In the case of scenario 1, so that pure plutonium oxide doesn't exist at the reprocessing plant, uranium nitrate and plutonium nitrate solutions are combined to make MOX powder (mixed oxide powder). This is to implement Japan's promise to the international community and is done in accordance with technical procedures agreed with the US. In the case of scenario 3, the temptation for diversion of this material will increase in the period between hundreds and tens of thousands of years after disposal, so it will be necessary to develop and implement an efficient and effective internationally agreed

monitoring and physical protection system. When these things are taken into account, there is no significant difference between the scenarios on the issue of non-proliferation.

* In regard to 'international trends', each country is making a choice between reprocessing and direct disposal in response to geological factors, resource factors, scale of nuclear power generation, and cost competitiveness. The overall trend shows that countries with small scale nuclear power generation, or which have made a policy decision to exit from nuclear power generation, such as Finland, Sweden, Germany and Belgium, and countries with abundant energy resources within their own borders, such as the US and Canada, are choosing direct disposal, while countries with large scale nuclear power generation, such as France, Russia, China, and countries with a basic policy of continuing with nuclear power, or with poor energy resources within their own borders are choosing reprocessing. However even the US, which has chosen direct disposal, in order to continue to use nuclear power in future, because it judges that it is important keep to a minimum the increase in number and size of disposal sites for the high level waste that accompanies nuclear power, has begun research into advanced reprocessing technology to assist with this problem.

* Scenarios 2 and 4 have strengths and weaknesses similar to scenario 1 in regard to the reprocessing component and similar to scenario 3 in regard to the direct disposal component.

(3) Evaluation of practical restrictions

* Scenario 1 is no different from the current policy, however scenario 3 involves a policy change. For this reason, (i) at this stage Japan lacks accumulated technical knowledge in regard to direct disposal that takes into account Japan's natural conditions and finding a locality which will accept the final disposal of spent fuel, which contains plutonium, would be expected to be much more difficult than finding a site for the final disposal of glass canisters; (ii) it will be necessary to rebuild the trust of regions with proposed sites, which until now have assumed reprocessing would proceed. This will take time. During that time, the removal of spent fuel from nuclear power plants and the creation of interim storage facilities will stagnate. There is a strong possibility that, one by one, currently operating nuclear power plants will be forced to cease operating. These are issues connected to 'problems finding a site' and 'issues associated with a change of policy'.

* In the case of scenario 4, (i) there is the problem of maintaining over a long time period the technology and human resources, as well as the international understanding, in regard to Japan's reprocessing program; (ii) many interim storage facilities will become necessary (9~12 sites by 2050), but because no policy decision has been made about disposal after storage, it will be difficult for local people to remain confident regarding the 'interim' status of the facilities, so there is a strong possibility that attempts to find a site will stall and, one by one, currently operating nuclear power plants will be forced to cease operating; (iii) there is a strong possibility that the search for a final high level waste disposal site, which has already begun, will be affected by the policy change and become stalled for a long period of time. These are issues connected to 'problems finding a site' and 'issues associated with a change of policy'.

(4) Evaluation from the perspective of assurance of choice ('adaptability to future uncertainty')

There is uncertainty in regard to the direction of future socioeconomic developments, such as the direction of technological development and the international situation, so, while Japan is strong, it is desirable to advance projects and investment that will assure 'adaptability to future uncertainty'.

From this perspective scenario 1 is superior to the other scenarios in regard to 'adaptability to future uncertainty', because it maintains infrastructure for technical innovation which can respond to changes of circumstances in regard to reprocessing (human resources, technology, knowledge, etc.), while maintaining international understanding of Japan's reprocessing program. However, it was pointed out that, since it is difficult to change direction with scenarios that involve facilities which require large investments, such as reprocessing facilities, due to the time required to recover the investment, these scenarios are more rigid than the other scenarios, and therefore, if projects are promoted in accordance with these scenarios, research should also proceed into technologies required for options other than reprocessing. On the other hand, scenario 4, because it maintains adaptability and postpones to the future the decision about the direction that should be taken, logically should be adaptable to future uncertainty. In practice, however, by not undertaking any projects for a long period of time, it will face problems maintaining infrastructure and international understanding.

3. Basic thinking regarding Japan's future nuclear fuel cycle policy

The basic thinking regarding nuclear fuel cycles which would make each of these basic scenarios possible can be condensed into a path based on reprocessing and a path based on direct disposal. The Planning Council considered which of these two options, taking into account the evaluation already carried out of the 4 basic scenarios (discussed in section 2 above), is suitable to become Japan's future nuclear fuel cycle policy.

The result of our deliberations to date - the basic stance regarding Japan's future nuclear fuel cycle policy, the basic policy direction for the time being, and the way forward for the future - are discussed below.

(1) Basic stance
In order to promote Japan's nuclear power generation, it is necessary to make a comprehensive assessment: to assure not only the most economic outcome, but also to assure energy security and adaptability in the face of future uncertainty and to pursue a closed-loop economy. From this perspective, striving as far as is reasonable to use nuclear fuel resources effectively, assuring 'safety', 'non-proliferation' and 'environmental compatibility', while also taking into account 'economic considerations, our basic stance is to adopt the effective use of plutonium, uranium, etc. recovered by reprocessing spent fuel.

The main reasons for selecting this basic policy stance are as follows.
At the current price of uranium and level of technical knowledge, if the cost of a change of policy is not taken into account, the reprocessing option is less 'economic' than the direct disposal option. However, it is superior from the perspective of 'energy security', 'environmental compatibility' and 'adaptability to future uncertainty', etc.. When the policy significance is compared, bearing in mind that there might be supply and demand pressures on uranium in future, and considering that nuclear power will be a core ingredient of Japan's electric power generation for the long term, taking a comprehensive view the reprocessing option is recognized as superior.

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Both government and private companies have undertaken activities and accumulated social capital (technology, trust of local communities, international agreement on numerous issues related to reprocessing) over a long period of time with the aim of bringing to fruition the nuclear fuel cycle. Japan has established nuclear power as a core ingredient of its electric power generation. In order to continue to use nuclear energy over the long term and enjoy the superior 'energy security', 'environmental compatibility' and 'adaptability to future uncertainty' that it offers, introducing technological advances as appropriate, this social capital has great value and should be maintained.

In order to further nuclear power and the nuclear fuel cycle, it is essential to obtain the understanding and support of the public. If a change of policy were made from the reprocessing option to the direct disposal option, due to the fact that it is essential to maintain the trust of the regions where facilities are located, the government and private companies would have to make every effort to rebuild that trust. That would be expected to take time. During that time removal of spent fuel from nuclear power plants would become problematic. A situation can be imagined where, one by one, power plants have to cease operating and progress in the search for sites for intermediate storage facilities and for final disposal might cease.

During deliberations about the basic thinking, the view was expressed that the direct disposal option should be chosen on the grounds that it is superior to the reprocessing option, not just from the point of view of 'economic considerations', but also from the point of view of 'safety' and 'non-proliferation'. In the assessment of the basic scenarios, it was judged that there is no significant difference between the two options from the point of view of 'safety' and 'non-proliferation' if the design, construction and operation of the facilities is carried out in accordance with the safety standards established by the government and if strict, internationally agreed safeguards and measures for the protection of nuclear materials are in place. However, bearing in mind that the above view was expressed, both the government and companies, when implementing the project, must ensure transparency within Japan and internationally. As well as ensuring the implementation of safety and safeguards measures etc., they should periodically reassess the appropriateness of these regulations and the technical standards related to their application.

A view was presented that a policy allowing private companies to choose either reprocessing or direct disposal should be adopted. However, even if the government decided to change its policy to one of leaving it up to the company to choose, despite the fact that any benefits would not materialize for some time, the government's administrative expenses, including for technological development activities, would increase, and concerns about interim storage facilities would emerge, causing problems finding a site. The problems would be similar to scenario 4, so this was judged not to be an option for consideration.

(2) Basic policy direction for the time being

For the time being, to the extent of the reprocessing capacity that will become available, spent fuel will be reprocessed, and the spent fuel generated in excess of this capacity will be placed in interim storage. Consideration of what to do with the spent fuel placed in interim storage will commence around 2010, and be based on the track record of the Rokkasho Reprocessing Plant, progress in research and development relating to the fast breeder reactor and reprocessing, international developments in relation to nuclear non-proliferation, and so on. Consideration of this matter will be based on the basic stance and will pay regard to flexibility. A decision will be made in plenty of

time to construct and commence operations at the necessary facilities before the Rokkasho Reprocessing Plant ceases operation.

The government should, in accordance with the basic policy, put in place the necessary research and development system, make economic arrangements to cover expenses, take sincere steps to ensure safety and non-proliferation, and, in order to develop mutual understanding with the public and the regions where facilities are located, proceed steadily with public hearings and provision of information. In particular, still greater efforts are required to advance the pluthermal program and to find sites for interim storage facilities.

It is hoped that private companies will, in accordance with the basic stance, take responsibility for advancing the nuclear fuel cycle, based on the steps taken by the government, bearing in mind the need to ensure safety and trust and to improve the economics of the project. In particular, in regard to the Rokkasho Reprocessing Plant, it is hoped that they will ensure the smooth operation of the plant by thoroughly securing safe and stable operations, by undertaking thorough risk management for the project, including preparing measures to deal with problems that arise, and by thorough accountability to the local community through risk communication.

In order to promote thorough transparency in regard to the use of plutonium, companies should publish their plans for the use of plutonium before it is separated. It is appropriate that they clarify the purpose of use, by providing estimates of the quantity to be used, the place where it is to be used, when use will commence and for how long the use will continue. It is hoped that companies will carry this out sincerely, by providing more and more detailed information as the project proceeds.

Due to the fact that, over the long-term, there are many uncertainties in regard to technological development, the international situation, etc., both government and private companies, separately and cooperatively, should conduct research as necessary in order to be able to respond to future uncertainties.

(3) Way forward for the future

From now on, via reviews of the progress of the existing long term plan, this Planning Council will consider the future direction of policies which, based on this basic policy, are necessary in order to advance the nuclear fuel cycle policy: the fast breeder reactor; improvement of light water reactors; technological development of fuel cycle technology etc.; the system for ensuring transparency of the peaceful use of plutonium; the system of public hearings and provision of information to the public; the advancement of the management and disposal of radioactive waste (how to deal with waste returned from overseas and transuranic waste, etc.); the system for the research which is needed in order to be able to respond to future uncertainties; etc..

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Appendix 2

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Open Letter
to

Shunsuke **KONDO**
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Paris, 12 March 04

Sir,

Thank you very much again for the invitation to give evidence to the Japan Atomic Energy Commission in the framework of its reappraisal of the Atomic Energy Long-Term Plan.

Please, however, allow me to express my deep concern over the following issue.

In a recent paper, the Atomic Energy Commission stressed the significance of "democratic management" in the pursuance of peaceful nuclear research and use: "We, the Atomic Energy Commission, fulfil our responsibility incessantly recalling this principle (…)". The document also states that "the Commission itself shall continually conduct policy evaluations and reappraisals, taking into consideration the most recent information and state of affairs so that the possibility of attaining overall objectives stipulated in the Atomic Energy Basic Law is not impaired."[1]

It is in this context that the Commission is organising public hearings, including evidence given by independent experts like myself. However, I have learned that at least part of the Atomic Energy Commission's Secretariat is carried out by officials who are receiving a salary by the Commission while are also on the payroll of the private nuclear industry. Asked whether this situation would not constitute a case of Conflict of Interest, one of the members of the Commission's secretariat answered: "May be."

I consider it a very serious case of Conflict of Interest, if members of the Atomic Energy Commission's Secretariat are simultaneously receiving salaries by the Commission and by the nuclear industry. Such a situation would certainly severely damage the Commission's credibility as independent State body acting in an exemplary democratic manner in collective public interest.

I would be grateful if you could share with me your thoughts on this serious matter.

Thank you very much for your attention.

Sincerely,

Mycle Schneider

[1] Atomic Energy Commission of Japan, *New Year Policy Statement*, January 6, 2004

Appendix 3

19 March 04

Dear Mr. Schneider,

I appreciate your presentation at our 5th Public Hearing on March 2, 2004.

Par your letter on the conflict of interest dated March 4, I would like to make the following points clear to you.

(1) The mission of the Atomic Energy Commission is to act as a guardian of principles and objectives set in the Atomic Energy Basic Low, deliberate the long term program of research, development and utilization of atomic energy, review the relevant actions taken by various stakeholders along the program, and make advice them, if necessary. Commissioners are the government officer appointed by the Prime Minister with the approval of the Diet and endeavor to accomplish the mission impartially.

(2) The Commission makes any decision collectively though the Commission and the Commissioners receive various secretariat services from the Commission's Secretariat which is under the supervision of the Chairman. The Secretariat is composed of national government employees, who act under the obligation of the National Public Service Law.

As you indicated that your letter is an open letter to us, I would like to ask the Secretariat to put your letter with this response on the Opinion Corner of our Web page. If you have any serious problem on this treatment, please let me know it at your earliest convenience.

Thank you again for your kind service to us.

Sincerely

Shunsuke Kondo
Chairman