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Summary Report of Peer Review

(Provisional Translation)

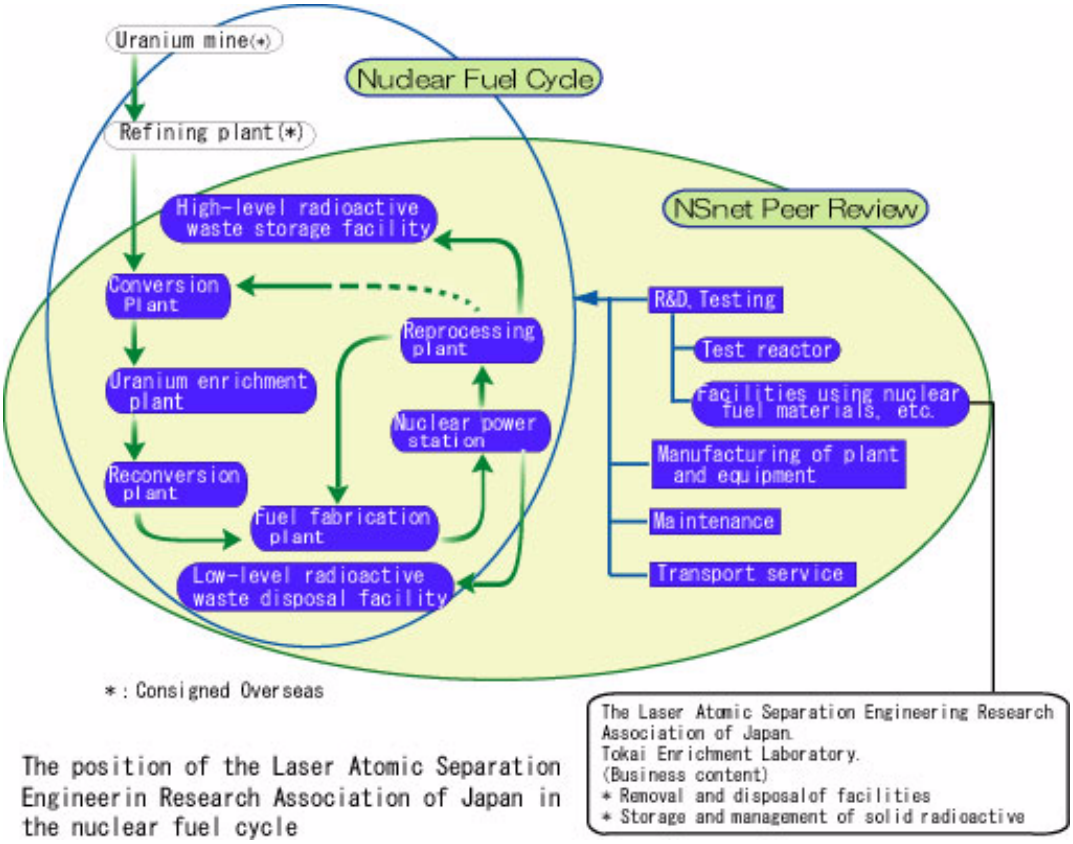
Place of Review:	Tokai Enrichment Test Facility, The Laser Atomic Separation Engineering Research Association of Japan (Tokai-mura, Naka-gun, Ibaraki Prefecture)
Date of Review:	May 28-30, 2002
Publisher:	Nuclear Safety Network

Contents

1. Objectives

The purpose of the NSnet peer review (hereafter referred to as “review”) is to achieve an improvement in the “safety culture” of the entire nuclear power industry by sending review teams of member specialists to member facilities, where they conduct reciprocal evaluations on common nuclear safety subjects among members and share mutual knowledge about the horizontal progress of good practices as well as subjects to be improved would be achieved.

2. Summary of Facility Operations



The position of the Laser Atomic Separation Engineerin Research Association of Japan in the nuclear fuel cycle

The Laser Atomic Separation Engineering Research Association of Japan was established by nine electric power companies in Japan, as well as by the Japan Atomic Power Company, the Japan Nuclear Fuel Limited, and the Central Research Institute of Electric Power Industry, with the aim of carrying out experimental research involving atomic vapor laser isotope separation (AVLIS) for uranium technology, which is one of the next generation uranium enrichment methods gaining attention. Its establishment as a foundation was approved on April 1987, with the Science and Technology Agency (present

Ministry of Education, Culture, Sports, Science and Technology) and the Ministry of International Trade and Industry (present Ministry of Economy, Trade and Industry) as the competent government offices, based on the Mining and Manufacturing Technology Law[1].

At the Tokai Enrichment Test Facility of the Laser Atomic Separation Engineering Research Association of Japan (hereinafter referred to as "the facility"), during the six-year period from fiscal 1987 to fiscal 1992, development of equipment on the scale of an annual one-ton SWU/year[2] took place with the aim of confirming the technical feasibility of AVLIS, as the first phase of research and development. Experiments were conducted on the operating characteristics of each kind of equipment and machinery and to verify uranium enrichment. Through this series of trials, engineering data were collected and technical development issues associated with increased scale extracted. Based on results garnered until that time, the second phase of research and development took place from fiscal 1993 to fiscal 1999, proceeding with development of fundamental equipment and machinery aiming at their commercial application, and carrying out performance testing (vaporization) using commercial-scale separating equipment, confirming a desired performance level with the laser equipment. Moreover, an enrichment test combining the separating equipment and laser equipment, which comprise the fundamental devices in such systems, was conducted in March of this year, based on which confirmation and evaluations of the performance of the system in its entirety are now being carried out.

Along with the conclusion of the research, in the future we plan to mainly carry out such work as decontaminating and dismantling of the facilities and the storage and management of the generated radioactive waste.

At present, the scheduled quantity of annual use of fuel materials which the facility has received approval is 1,600 kg of natural uranium, about 50 kg of depleted uranium, and about 2 kg of enriched uranium, with the facility legally categorized as one engaged in the use of nuclear fuel materials. However, it is considered a facility[3] that, even if the aforementioned material quantities are collected in one place, cannot reach criticality and at which there is no need to assume the possibility of a criticality accident. In addition, because of the approved quantity, the facility does not fall under Item 2, Article 16 of the "Law for the regulations of nuclear source material, nuclear fuel material and reactors."[4] This means that there is no need for "safety regulations" or "facility inspections," and that "the Nuclear Disaster Special Measures Law" is not applied to the facility.

3. Points of Review

In this review of the facility this time emphasized the main points of how to safely manage the facilities and waste after enrichment experiments have concluded and what policies to adopt to guarantee safety.

The review was divided into six sections: (1) Organization/Management, (2) Emergency measures, (3) Education/Training, (4) Operations/Maintenance, (5) Radiation protection, and (6) Serious accident prevention. It was carried out as focusing on the best practices in the nuclear industry.

The review points developed in detail for each section are organized in the following manner:

(1) Organization and administration
- ・Management and passing on of technical know-how following conclusion of research
- ・Safety leadership (establishment of policies and targets)
- ・Mechanisms and status of efforts to infuse a safety culture and improve morale among staff
- ・Consideration of human factors

(2) Emergency measures
- ・Emergency measures based on the gist of "the Special Measures Law for Nuclear Disasters"[i]
- ・Set-up of system and notification of staff at times of emergency （including partnerships in the「Nuclear Establishment Safety Cooperation Agreement(Tokai NOAH Agreement[5])

(3) Education and training
- ・Conducting of safety education
- ・Education plans for staff of cooperating companies

(4) Operations and maintenance
- ・Formulation and checking of documents and procedure manuals, approval, methods of revision
- ・Conformity with approval items (contents of approval)
- ・Carrying out of safe operations (status of following documents and procedure manuals)
- ・Safety management of facilities and maintenance management of laser equipment
- ・Future dismantling work plans
- ・Appropriate management of radioactive waste

[i] The laboratory is a facility that falls outside the scope of the "Nuclear Accident Special Countermeasure Law," but focuses on operations based on the purport of the enactment of the law, and on partnerships with other operators.

(5) Radiation protection

・Appropriate dose management for staff

(6) Serious accident prevention

・Prevention measures against fires and explosions

a. Handling of flammable material such as uranium tailings

b. Set-up of work operations manual and notification of staff, in consideration of preventing accidents

4. Period and Outline of Review

(1) Date

May 28 (Tue.) to May 30 (Thu.), 2002

(2) Formation of Review Teams

A group: Hokuriku Electric Power Co., Inc., Nippon Nuclear Fuel Development Co., Ltd., Mitsui Engineering & Shipbuilding Co., Ltd.

B group: Hokkaido Electric Power Co., Inc, Hitachi, Ltd.

Coordinators: NSnet Office

(3) Fields of Responsibility

A group: Organization/Administration, Emergency measures, Education/Training

B group: Operation/Maintenance, Radiation protection, Serious accident prevention

(4) Target facilities of the review

The scope of this review comprised the Tokai Enrichment Test Facility.

5. Schedule of Review

The review was carried out for 3 days according to the schedule shown below.

<table>
<tr><th colspan="2"></th><th colspan="2">A Group</th><th colspan="2">B Group</th></tr>
<tr><td rowspan="7">5/28
(Tue.)</td><td rowspan="2">AM</td><td colspan="4">Opening (Greetings, Members Introduction etc.)</td></tr>
<tr><td>1. Organization/ Administration</td><td>-Effective organization management
- Cultivating safety culture
[Document Examination]</td><td>4. Operation/ Maintenance</td><td>- Ensuring safe work
- Work equipment and machinery
[Document Examination]</td></tr>
<tr><td rowspan="5">PM</td><td rowspan="2">1. Organization/ Administration</td><td>＜Tokai Enrichment Laboratory director＞
[Interviews]</td><td rowspan="2">4. Operation/ Maintenance</td><td rowspan="2">- Engineering of nuclear fuel cycle research facilities
[Document Examination]</td></tr>
<tr><td>＜Management class＞
[Interviews]</td></tr>
<tr><td>2.Emergency measures</td><td rowspan="2">- Emergency plans
- Emergency training
[Document Examination]</td><td>4. Operation/ Maintenance</td><td>＜Chief class＞
[Interviews]</td></tr>
<tr><td rowspan="2">6. Serious accident prevention</td><td rowspan="2">-Accidents caused by fires/explosions
[Document Examination]</td></tr>
<tr><td>2.Emergency measures</td><td>-Emergency equipment/ resources
[Field Observation]</td></tr>
<tr><td rowspan="6">5/29
(Wed.)</td><td rowspan="5">AM</td><td>1. Organization/ Administration</td><td>・ Consideration of human factors
[Document Examination]</td><td rowspan="2">5. Radiation protection</td><td rowspan="2">- Confinement of radioactive substances and monitoring
- Dose control
[Interviews]</td></tr>
<tr><td>1. Organization/ Administration</td><td>-The human factor
[Field Observation]</td></tr>
<tr><td>3.Education/ Training</td><td>- Implementation of trainings
[Document Examination]</td><td rowspan="3">4. Operation/ Maintenance
5. Radiation protection
6. Serious accident prevention</td><td rowspan="3">Test bldgs.
（main control room、laser generation room、uranium treatment room、nuclear fuel storage area, etc.）
Waste storage building
[Field Observation]</td></tr>
<tr><td>2.Emergency measures
3.Education/ Training</td><td>＜2 chief class individuals＞
Carried out jointly
[Interviews]</td></tr>
<tr><td>PM</td><td colspan="2">Verification of Facts</td><td colspan="2">Verification of Facts</td></tr>
<tr><td rowspan="2">5/30
(Thu.)</td><td rowspan="2">AM</td><td colspan="4">Verification of Facts</td></tr>
<tr><td colspan="4">Closing</td></tr>
</table>

6. Methods and Items of Review

6.1 Methods of Review

The review investigated the various activities carried out by the facility to improve safety, and pointed out some good practices and suggestions for improvement, through observing the plants where the activities take place, examining and studying the documents presented by the facility, and interviewing employees, as shown below.

6.1.1 Execution of Review

(1) Field observations

For the field observations, direct observations of how actual activities are implemented for the items confirmed in the interviews and documents, were conducted with investigations based on the experiences and knowledge of the reviewers.

(2) Document examinations

For the document examination, the review was conducted through requesting necessary relevant documents based on explanations regarding related documents for each review item. Following the plant and operation observation, documents related to the observation were required, and more detailed investigations were done.

(3) Interviews

Interviews based on the following objectives were conducted with the director of Tokai Enrichment Test Facility (hereinafter referred to as “the director”), managers and responsible persons.

(a) Examining the level of the effort and awareness toward the safety culture development, including nuclear safety measure

(b) Gathering additional information not confirmed in the documentation

(c) Questions and answers including ones arising from document examination

(d) Evaluating the level of understanding about the determined items and the responsibility imposed on each member

(e) Evaluating whether the determined rules are being implemented or whether they are merely carried out in name only.

6.1.2 Standing point to select Good Practices and Suggestions for Improvement

(1) Good Practices

"Information on good practices incorporating appropriate, effective, and unique methods into activities to ensure safety should be widely distributed to the members of the NSnet and the nuclear industry"

(2) Suggestions for Improvement

"After comparing the facility practices with the best in the nuclear industry, suggestions to improve and enhance safety activities should be implemented so as to achieve the highest level of nuclear safety."

Even if current activities are equal to or higher than general standards in the nuclear industry, there is still room for improvement.

6.2 Items of Review

The plant observations and confirmations, document examinations, and interviews were carried out based on the review items shown below. The results were evaluated and organized in the Itemized Results, and those were summarized as the Main Conclusions.

<u>Section 1: Organization/administration</u>

This area was investigated from the perspectives of, related to the securing of safety in the nuclear industry, whether necessary staff members were secured, whether a safety culture that always places top priority on safety was sufficiently fostered, and whether sufficient deliberations were conducted regarding examples of problems and human factors.

(Review items)

(1) Effective organizational control
   a. Transparency and appropriateness of organization and systems
   b. Organizational targets and management leadership

(2) Activities related to fostering safety culture and improving morale
   a. Formation of a workplace culture in which each person in the organization emphasizes safety
   b. Transmission of information to local areas and regions

(3) Incorporation of examples of problems and the human factor
   a. Further consideration of human factors

Section 2: Emergency Measures

The Special Measures Law for Nuclear Disasters is not applicable to the facility. An emergency here means a disaster is likely to occur or has occurred at the facility due to an earthquake or a fire or an abnormal leakage of nuclear fuel materials has occurred or workers engaging in radiation work have been exposed beyond a certain dose limit.

The review was conducted to clarify the plan for cooperating with other operators and whether training has been implemented without fail, in view of the purpose of enacting the Special Measures Law for Nuclear Disasters.

(Review Items)

(1) Emergency Plans

a. Adoption of emergency plans

b. Information dissemination to employees

(2) Emergency Training

a. Execution of accident trainings

Section 3: Education/Training

Based on the idea that improvements in the level of safety awareness and skills of employees increased accident prevention, the review examined whether effective education and training systems had been maintained, whether systems of qualification etc, had been introduced, and whether those systems were actually being carried out.

(Review Items)

(1) Implementation of Trainings

a. Systems of education and trainings (including Technology (know-how) transfer)

Section 4: Operation/Maintenance

In this review, “Safe operations” corresponded to the area of “safety work related to operations at the time of Test,” while “Safe maintenance” corresponded to “inspections of equipment and machinery and related safety work.” These were collectively reviewed as “Safe work.”

The review was conducted to examine whether a high-level of safety is ensured with each work item. Namely, the review focused on, with respect to people, whether documents such as work procedures and manuals have been developed and observed without fail, and with respect to equipment, whether safety functions are clearly classified and are under favorable control. As a consolidated effort, whether nuclear fuel materials are appropriately controlled was also examined.

(Review Items)

(1) Ensuring safe work

a. Development of documents and manuals

b. Methods for developing, checking, approving, and revising documents and manuals
c. Consistency with approved items (contents)
d. Ensuring safe work

(2) Facilities and equipment
a. Equipment and machinery inspections

(3) Engineering of nuclear fuel cycle research facilities
a. Nuclear fuel material control
b. Chemical substances control
c. Radioactive waste control

Section 5: Radiation Protection

This section evaluates the strategies and conditions of implementation from the perspective of the confinement of radioactive substances, prevention of leakage into the environment, and employee dose control.

(Review Items)

(1) Confinement of Radioactive Substances and Monitoring
a. Appropriate control of negative pressure[6]
b. Radiation Monitoring

(2) Dose Control
a. Dosage management for staff

Section 6: Serious Accident Prevention

In view of the above-mentioned points of review, the review was conducted with regard to accidents involving fires and explosions to clarify whether systems that may cause accidents have been identified, whether multiple measures have been taken to prevent accidents that may cause serious impacts on the facility and its peripheral area, or whether the system ensures quick detection of accidents when they occur.

(Review Items)

(1) Accidents Caused by Fires/Explosions
a. Procedures, equipment, and instruments that can cause fires/explosions
b. Administrative methods for the prevention of fires/explosions
c. Detection of fires/explosions at the time of an accident and methods of alleviating the problem

7. Main Conclusions

In summing up this review of the Tokai Enrichment Test Facility of the Laser Atomic Separation Engineering Research Association of Japan, we have not found any item that would lead to a serious accident unless immediate remedies were taken in the nuclear safety field.

Since the facility's establishment in April 1987, there have been no accidents or disasters in that 15-year period, and it was confirmed that the Tokai facility director continues to take the lead in safety efforts in order to ensure a continuation of no accidents or disasters.

The facility, always making efforts regarding new issues with the aim of "without safety there is no development" and "attainment of enrichment service cost projections equivalent to international standards," has promoted development with a top priority on safety, boasting of its engagement in AVLIS, which is a collection of advanced, cutting-edge technologies.

In addition, utilizing the merits of an office with a small number of staff, a situation that promotes ready communication, active debate has taken place, from the director to the chief class, in accordance with 「和而不同（和して同ぜず）[7]」which is a cherished motto of the director. It was confirmed that the aim is to have this permeate throughout the entire staff, including the staff of cooperating companies.

Upon conclusion of enrichment testing in March of this year, the facility's main work in the future will comprise the removal of facilities and the storage management of waste. When carrying out such work, however, it would be desirable for safety to be a constant concern, just as it has always been, with continued safety activities aiming at the fostering of an even more developed safety culture and a continuing situation in which there are no accidents or disasters.

In this review, we have found some good practices that should be introduced not only to other NSnet members, but also widely to the nuclear industry. The good practices are described below.

・<u>Attaining a total of 15 years with no accidents or disasters</u>

Since construction on the actual-scale separating equipment, efforts toward new issues have always taken place based on the passwords "without safety there is no development" and "attainment of enrichment service cost projections equivalent to international standards," the director's mottos. Through such efforts, the concept of safety has been conveyed from the director, to the management class, and from the management class all the way to the general staff and staff of cooperating companies,

boasting of engagement in development of a collection of advanced, cutting-edge technologies, leading to a total of 15 years without any accidents or disasters.

・Active adoption of measures to prevent human error in enrichment trials

The following measures to counter human error have been adopted in the enrichment trials, contributing to the attainment of no accidents or disasters:

(1) Representative examples of measures to prevent mistaken operations in hard facets

① Automation of operations, adoption of centralized operation methods

② Attachment of acrylic covers to the main buttons of the control panel in the central control office

③ Adoption of dual-action operation of the switches in the general power source room

④ Laser opto-isolator interlock

(2) Representative examples of measures to prevent mistaken operations in soft facets

① Creation of a manual of work procedures in the form of a checklist, and reading through of the procedures before starting work

② Undergoing of practical training to the extent possible before actual operation

③ For each actual operation, having one person read out the procedures and one person carry out the operations

・Uranium waste storage and disposal designs

In the storage and disposal of uranium waste in the waste storage buildings, a metal container holding such uranium waste as uranium pieces is further enclosed in a stainless steel box, and the lid of this stainless steel box is sealed on their own judgment, given the special circumstances related to storage and management that may turn into a relatively long period of time.

Due to the sealing process, confirmation of whether the waste material has been stored and disposed of in sound condition is certain and easy.

・Multiple measures for uranium tailings to prevent fires

Uranium powders and flakes are ultimately turned into a stable material utilizing secondary oxidation, thereby preventing fires. In addition, multiple fire-prevention measures have been adopted, such as the infusion of inert gas into metal containers during the period of temporary storage, and prior to this step, a surefire method of fire prevention that involves monitoring of the materials even during nighttimes and holidays.

The following represent proposals toward the further improvement of the laboratory safety activities.

・Timely release of information to local region and general public

To introduce the facilities, experiments and research activities widely to the local region and the general public, a homepage on the Internet has been established, leading to the release of such information. Nevertheless, as the information on the homepage has not been revised to reflect the present situation, it is hoped that the data is updated to the most current information.

・Foundation of system with development parallel to Hiyari-Hatto and examples of troubles at other facilities

The response to a Hiyari-Hatto occurrence at the laboratory mainly comprises knowledge coming out of morning meetings and weekly process councils, which has created a situation in which there is no accumulation of data. At the time of removal and disposal of the facilities in the future, it is thought that the example of Hiyari-Hatto will prove useful in securing safety, and thus it would be advisable to create a system for conveying to following generations the Hiyari-Hatto example, and to survey and analyze information related to troubles at other facilities and human error in work, with an eye to all nuclear power industry facilities. Moreover, as the source of this information, one plan might be to utilize the NSnet homepage databases.

・Addition of ethical and other training curriculum, based on lessons from JCO accident

Although the laboratory has made thorough the idea of promoting work based on the letter of laws, ordinances, regulations, and permits, there is no curriculum of ethical education, which points to a need for ethical training that leads to further improvement in ethical considerations.

In addition, although the facility uses a small enough amount of uranium that criticality accidents are not possible, with many individuals that have necessary knowledge for a parent organization with external assignments, it is hoped that it will also incorporate general criticality safety information in its training curriculum for essential staff, in order to achieve a further improved safety culture, from the perspective of reconfirmation of the JCO accident.

[1] Mining and Manufacturing Technology Law:
To achieve improvement in production technologies in mining and industry, this is a law that stipulates necessary organizations for conducting related testing and research cooperatively. If the government approves joint research carried out by technical research organizations approved on the basis of this law, any participating companies receive special tax benefits.

[2] SWU:
Abbreviation for Separative Work Unit. A unit of separative work. This is an important concept used as a measurement to indicate the size of the added value through the process of enriching uranium. The actual units are kg or t, but these are the same as units of uranium quantity, leading to confusion. For this reason, SWU is written as a unit measurement, such as in the example tSWU. Moreover, the amount of fuel necessary for one year of operations at a 1.0 million kW-class nuclear power plant is the equivalent of about 120 tSWU. (Source: Nuclear Power Dictionary: Nikkan Kogyo Shimbun)

[3] Reason for not hypothesizing a criticality accident:
Figures for the minimum critical mass under the harshest conditions are presented in the "Nuclear Safety Guide TID-7016, Revision 2" (NUREG/CR-0095, ORNL/NUREG/CSD-6), based on empirical measurements of critical mass and logical extrapolation from them. The value for a solution of 100-percent enriched 235U is 0.63 kilograms. In addition, a relaxation coefficient in the event of a lower degree of enrichment is derived and applied to obtain minimum critical mass values at any degree of enrichment. In TID-7016, Revision 2, the corresponding values are 25 kilograms-U for an enrichment of less than 5 degrees and 4 kilograms-U for one of 5 - less than 20 percent. The amount of enriched uranium approved for use by the laboratory is roughly one-tenth the minimum required for criticality, an amount not considered to lead to criticality.

[4] Article 16-2 of the Law for the Regulations of Nuclear Source Material, Nuclear Fuel Material and Reactors:
A provision of the ordinance that defines nuclear fuel materials pursuant to Sub-clause 1 of Article 55-1 (Facility Inspections) and Sub-clause 1 of Article 56-3 (Safety Regulations) of the Law for the Regulations of Nuclear Source Material, Nuclear Fuel Material and Reactors. Based on the criteria whether the volume of enriched uranium and so on that are handled at the facility requires the consideration of criticality, the criteria is set forth in this provision whether the facility requires the preparation of safety regulations, prior approval, and facility inspections in accordance with the above-mentioned law. Regarding the handling of enriched uranium, the volume of ^{235}U is prescribed: 1.2 kg for enrichment levels below 5% and 0.7 kg for enrichment levels equal to or over 5% and below 20%. If uranium with different enrichment levels is stored, the Regulations are applicable when the sum of the ratio of each enrichment level to respective criterion is equal to or larger than 1. Safe masses of enriched uranium are 24 kgU for enrichment levels below 5% and 3.5 kgU for enrichment levels equal to or over 5% and below 20%.
The volume of storage permitted at the laboratory is below these criteria, which does not require the preparation of safety regulations, prior approval, and facility inspections in accordance with the above-mentioned law. This also indicates that if the whole volume of enriched uranium in the facility is put together, it will not cause criticality.

[5] Nuclear Establishment Safety Cooperation Agreement (Tokai NOAH Agreement):
"NOAH" is an acronym standing for the cities and towns in which 21 nuclear operators that entered into the Nuclear Establishment Safety Cooperation Agreement are located, including the village of Tokai-mura, and starting with the towns of Naka-cho, Oarai-cho, Asahi-machi and Hitachinaka city. This agreement is also called the "Tokai NOAH Agreement."

[6] Control by negative pressure; A means of containing radioactive material by controlling the flow of air through reduction of the internal air pressure to a level below the external air pressure.

[7] 和而不同（和して同せず）:
A passage from the Analects of Confucius.「君子和而不同、小人同而不和。」（which means a wise person seeks peace not compromise, but a smaller man seeks compromise not peace）"Peace" in this case means cooperating with other while maintaining one's own beliefs, and "compromise" means being immediately swayed by others' opinions because one lacks one's own core beliefs.