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Summary Report of Peer Review

(Provisional Translation)

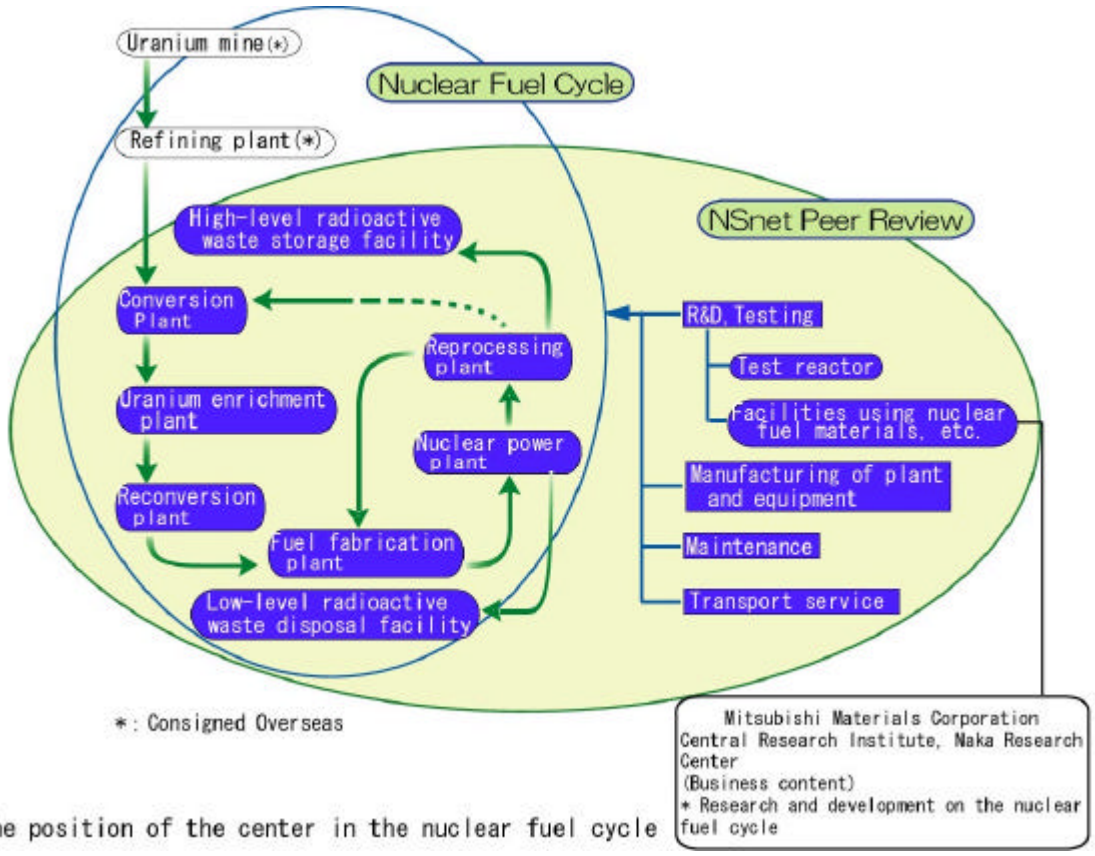
Place of Review:	Central Research Institute, Naka Research Center, Mitsubishi Materials Corporation (Naka-machi, Naka-gun, Ibaraki Prefecture)
Date of Review:	June 19-21, 2001
Publisher:	Nuclear Safety Network

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 that have been singled out.

2. Summary of Facility Operations



The position of the center in the nuclear fuel cycle

The review was conducted at the Naka Research Center of the Central Research Institute of Mitsubishi Materials Corporation located at Naka-machi, Naka-gun, Ibaraki Prefecture (hereafter referred to as the "Center".). Mitsubishi Materials Corporation started nuclear research in 1954. Since then it has been engaging in research, development, and engineering for commercialization. In this process, to conduct research, development, design, and engineering covering the entire

scope of the "nuclear fuel cycle" from a comprehensive standpoint, the nuclear department became independent from the then-central research institute. This led to the establishment of Naka Nuclear Energy Development Center in July 1984. Later, it committed to enhance and integrate its research area (fields of energy and environment), aiming to take the role of a company-wide research department. It was then reorganized as Energy & Ecosystem Laboratories Central Research Institute. Moreover, in June 2001, it integrated research in the fields of Microelectronics and Advanced materials.

The Center conducts extensive research and development, including developing fundamental technology and establishing practical and commercial processes, regarding the entire nuclear fuel cycle; i.e. refining and conversion, fuel processing, reprocessing, waste treatment and disposal. The Center had approximately 90 employees (as of the June 15, 2001). Approximately 45 of them are directly engaging in research for nuclear fuel related tasks, while 10 are engaging in facility and safety control on a full-time basis.

The Center has R & D Buildings (1st through 5th Building) and laboratories (A through D) as nuclear fuel cycle-related research facilities, together with Waste Storage, office building, and so on as other facilities (see Reference Figure 3). These facilities can be divided into facilities with controlled areas, where "nuclear fuel materials and radioisotopes (hereafter referred to as RI[1])" (Both of them hereafter referred to as "radioactive materials") and radioactive waste are handled, and the others. Facilities with controlled areas include "R&D 1st and 2nd Building," in which nuclear fuel materials are handled, "R&D 4th Building," in which nuclear fuel materials and RI, and "Waste Storage," in which radioactive waste is stored. In these facilities, the following research, development, testing, or control are being exercised.

- R&D 1st Building: Comprehensive research into the nuclear fuel cycle (research into fuel production, enrichment, reprocessing, and so on.)
- R&D 2nd Building: Depleted uranium[2] (UF_6)[3] reconversion tests and so on were conducted in the past. Currently, depleted uranium is stored. In the future, research into melting treatment of radioactive waste is planned (construction work on the interiors was being carried out as of June 2001).
- R&D 4th Building: Research into radioactive waste disposal
- Waste Storage: Radioactive waste generated in R&D Buildings 1st, 2nd, and 4th is

stored (except for RI waste).

The volume of nuclear fuel materials that can be handled at the Center is below the minimum critical mass[4]. Therefore, neither is the assumption of criticality accidents[5] required nor does it come under Article 16-2 of the Ordinance for the Enforcement of the Law for the Regulations of Nuclear Source Material, Nuclear Fuel Material and Reactors[6]. Namely, even if the entire volume of nuclear fuel materials that are permitted to be used in the Center is put together, it does not lead to criticality. Thus, the Center is a facility that does not require Safety Regulations and facility inspections prescribed in the Law for the Regulations of Nuclear Source Material, Nuclear Fuel Material and Reactors. Since it does not require safety regulations, neither is it a facility to which the Law on Extraordinary Measures against Nuclear Disasters is applicable.

3. Points of Review

The Center conducts a variety of research, development, and testing as mentioned above at each development testing building capable of handling nuclear fuel materials, such as uranium, rather than routinely manufacturing certain products. However, since the volume of such materials that are permitted to be handled is below the minimum critical mass, criticality accidents do not have to be assumed.

This review refers to the safety measures for operations and modification of the equipment, concerning with the theme of R&D which characterizes the Center. It also stressed measures implemented to prevent serious accidents such as fires at the test facilities for nuclear fuel materials.

The review was divided into six sections: 1) Organization/administration, 2) Emergency measures, 3) Education/training, 4) Operation/maintenance, 5) Radiation protection, and 6) Serious accident prevention. It was carried out as focusing on the best practices in the nuclear fuel cycle industry.

In the section of serious accident prevention, criticality accidents were excluded from the scope of review because of the above-mentioned reason and the prevention of fires and explosions was reviewed. As a facility that uses nuclear fuel materials, however, efforts in criticality safety control[7] education was examined in the section of education and training.

In addition, in the section of emergency measures, although the Law on

Extraordinary Measures Nuclear Disaster is not applicable to the Center, the review was conducted focusing on measures in view of the purpose of the Law and cooperation among other operators.

In the other fields, as considering the factors behind the criticality accident at the JCO uranium processing plant in September 1999 (hereafter referred to as "the JCO accident"), the review focused on the safety measures on changing equipment or introducing novel procedures. The review also focused on efforts to cultivate and improve the "nuclear safety culture" which include the policies and activities of the organization, the organization's system and clarification of responsibility, worker education and training, worker knowledge and skills, the observation of written operation procedures, and the transfer of technologies. For the operating equipment and facilities, particularly adequate safety awareness and the ethics of employees' actions, as well as the company's self-checking activities that affect the safe operation of equipment and facilities, were considered as essential.

4. Period and Outline of Review

(1) Date

June 19 (Tue.) to June 21 (Thu.), 2001

(2) Formation of Review Teams

1st group: Tohoku Electric Power Company, Incorporated; Mitsui Engineering & Shipbuilding Co., Ltd.

2nd group: The Chugoku Electric Power Company, Inc.; Central Research Institute of Electric Power Industry; Kyushu Electric Power Company, Inc.

Coordinators: NSnet Office

(3) Fields of Responsibility

1st group: Organization/administration, emergency measures, education/training

2nd group: Operation/maintenance, radiation protection, serious accident prevention

(4) Target Sites

The review was conducted mainly at R&D 1st, 2nd and 4th Building and Waste Storage in which control areas are established.

5. Schedule of Review

The review was carried out over a three-day period for each field according to the schedule shown below.

<table>
<tr><td colspan="2"></td><td colspan="2">1st Group</td><td colspan="2">2nd Group</td></tr>
<tr><td rowspan="6">6/19
(Tue.)</td><td rowspan="2">AM</td><td colspan="4">Opening (Greetings, Members Introduction, Outline of R&D/facilities etc.)</td></tr>
<tr><td>Document Examination
1. Organization/ administration</td><td>- Effective organization management
- Cultivating safety culture</td><td>Document Examination
4. Operation/ maintenance</td><td>- Ensuring safe work</td></tr>
<tr><td rowspan="4">PM</td><td>Interview</td><td>- General Manager
- Employees</td><td rowspan="2">Document Examination
4. Operation/ maintenance</td><td>- Facilities and equipment
- Engineering of nuclear fuel cycle research facilities</td></tr>
<tr><td rowspan="3">Document Examination
1. Organization/ administration
2. Emergency measures</td><td rowspan="3">- Reflecting problematic events and the human factor
- Emergency plans
- Emergency training</td><td>Interview</td><td>- Employees</td></tr>
<tr><td>Document Examination
5. Radiation protection</td><td>- Dose control</td></tr>
<tr><td>Plant Observation</td><td>- Development testing Buildings I
- Office building (Control Alarms Board)</td></tr>
<tr><td rowspan="4">6/20
(Wed.)</td><td rowspan="3">AM</td><td>Document Examination
3. Education/training</td><td>- Implementation of trainings</td><td>Document Examination
6. Serious accident prevention</td><td>- Accidents caused by fires/explosions</td></tr>
<tr><td>Plant Observation</td><td>- Office building (Emergency equipment/ resources)</td><td>Document Examination
5. Radiation protection</td><td>- Confinement of radioactive substances and monitoring
- radiation monitoring</td></tr>
<tr><td>Interview</td><td>- Employees</td><td>Plant Observation</td><td>- R&D 4th building
- Waste Storage</td></tr>
<tr><td>PM</td><td colspan="2">Verification of Fact</td><td colspan="2">Verification of Fact</td></tr>
<tr><td rowspan="2">6/21
(Thu.)</td><td rowspan="2">AM</td><td colspan="4">Verification of Fact</td></tr>
<tr><td colspan="4">Closing (Reporting, Greetings, etc.)</td></tr>
</table>

6. Methods and Items of Review

6.1 Methods of Review

Targeting the various activities carried out to improve the safety promoted by the Center, this review pointed out some good practices and items-to-improve, through

observing the plants where the activities take place, examining and studying the documents presented by the Center, and interviewing employees, as shown below.

In the process of review, the review team in a timely manner introduced useful instances (e.g. fires and the temporary cancellation of controlled areas in some work similar to the installation of melting furnaces) to promote nuclear safety cultural exchange.

6.1.1 Execution of Review

(1) Plant observations

For the plant 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 General Manager, and employees(researchers) in charge of research and testing.

(a) Gathering additional information not confirmed in the documentation
(b) Questions and answers including ones arising from document examination
(c) Evaluating the level of understanding about the determined items and the responsibility imposed on each member
(d) Evaluating whether the determined rules are being implemented or whether they are merely carried out in name only.
(e) Examining the level of the effort and awareness about nuclear safety measures

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 station's 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, 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.

Section 1: Organization/administration

In this section, the review focused on the issue of ensuring nuclear safety, and examined whether the manpower required for safe operations was secured, whether "safety culture" that always prioritizes safety, was fully recognized, and whether adequate studies were given to problematic events and human-factors.

(Review Items)

(1) Effective Organization Management
   a. Clarifying the line-organization and system of responsibility
   b. Justifying the operation system
   c. Setting up new goals of the organization
   d. The leadership of middle to upper managers

(2) Cultivating Safety Culture
   a. Creating a work environment where every person in the organization gives priority to safety

(3) Problematic Events and Human Factor

a. Reflecting past problematic events
b. Further consideration of the human factor

Section 2: Emergency Measures

The Law on Extraordinary Measures against Nuclear Disasters is not applicable to the Center. An emergency here means an extreme situation (e.g. a disaster is likely to occur or has occurred at the facility due to an earthquake or a fire) or an abnormal situation (e.g. the abnormal leakage of nuclear fuel materials has occurred or workers engaging in radiation work have been exposed beyond a certain dose limit). Measures to cope with these situations were reviewed as emergency measures.

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 Law on Extraordinary Measures against 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.

And how the transfer of technical know-how is incorporated in the education and training system was also included in the review items.

(Review Items)

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

Section 4: Operation/maintenance

At facilities that mainly conduct testing and research like the Center, "safe operation" means "safe work" in testing and research, while "safe maintenance" means "safe work" in facility maintenance. 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. Facilities and equipment interlocks
    b. Facilities and equipment inspections

(3) Engineering of nuclear fuel cycle research facilities
    a. Nuclear fuel material control
    b. Radioisotope control
    c. Chemical substances control
    d. 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 administration of negative pressure

b. Radiation Monitoring

(2) Dose Control

a. Employee dose control

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

Summarizing the results from the review of the Naka Research Center of the Central Research Institute of Mitsubishi Materials Corporation, no problematic items were identified, the nature of which may cause a severe accident unless nuclear safety improvement measures were taken immediately. In addition, it was confirmed that all employees, including the General Manager, are seriously endeavoring to continue enhancing nuclear safety.

This is represented by the following practices:

- Based on the recognition that "stable corporate operation cannot be achieved without safety" and the traditional corporate philosophy of Mitsubishi Materials Corporation, "giving the highest priority to safety and trying to achieve co-existence and co-prosperity with local communities," leadership of the top management pursues organizational management focusing on safety with the aim of no disasters occurring on the site, taking advantage of experience at mining work where strict safety activities are promoted on the principle of concentrating on work sites.

-The sense of safety that observing procedures and checking step are indispensable

penetrates among researchers.

These practices have blended together to establish a workplace culture that gives safety the highest priority.

It is expected that the Center will aim to further promote its safety culture by continuing voluntary efforts to ensure safety such as the actual status of the current activities to ensure safety in a concrete format, taking the opportunity of reorganization to meet the needs of the company.

Based on these, some good practices were identified during the review, which should be introduced extensively to other members of the NSnet and the nuclear industry. The major good practices are as follows:

- System to ensure nuclear safety including cooperating companies centering on The Committee for Nuclear Safety Measures

Mitsubishi Materials Corporation has established an independent system to ensure nuclear safety by internally setting up The Committee for Nuclear Safety Measures, chaired by the President, in December 1999, with the aim of further ensuring safety and crisis management regarding nuclear-related research following the JCO accident. Specifically, Chief Advisor for Nuclear Safety are assigned in the secretariat of the committee to conduct nuclear safety inspections twice a year with regard to nuclear facilities, including RI handling facilities and those of cooperating companies, to promote safety culture and quality assurance. They are also actively engaging in other activities, such as periodically reporting to the committee.

- Auto-calling system connected to the alarm board to alert the personnel

The Center has a system interconnected with alarms for fires (emergencies) and abnormal negative pressure in the buildings in the control area, which can automatically send the personnel concerned information about where and what kind of events have occurred. This helps summon the personnel quickly and certainly at night and on holidays.

- Strict safety and facility control by voluntarily developed safety rules

Even though Article 16-2 of the Ordinance for the Enforcement of the Law for the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors is not applicable to the Center, it has drawn up its own Safety Rules Concerning the Use of Nuclear Fuel Materials voluntary, which is comparable to safety regulations. Based on these safety rules, the Radiation Work Procedures and the Safety Control Manual against Criticality have been developed to ensure safety control. In addition, although the Center is not a facility covered by the Guideline for the Safety Examination of Uranium Processing Facilities, facility designs have been carried out in conformity with the Guideline to ensure voluntary control.

On the other hand, several suggestions were made to improve the current activities to ensure safety at the Center as well as to continue favorable performance. Major proposals are as follows:

- Stipulating the Center's experience and know-how regarding safety activities in in-house documents

The Center has developed a workplace culture prioritizing safety and recorded favorable safety performance for 17 years since its establishment. Taking the opportunity of reorganizing into a new organization as the Naka Research Center, it is desirable to consider the following items to continue further improvement of the present favorable status, utilizing its experience in safety activities and accumulated know-how:
① Drawing up the managerial policy (including safety policy) of the Center that has been developed in accordance with the company's action guidelines.
② Stipulating basic subjects concerning the Center's safety activities (management of relevant meetings, task sharing, safety patrols, safety education, etc.) in in-house documents

- Utilizing other companies' human factor case studies

Meeting of the Accident Case Study held at the Center, it is desirable to further promote awareness of human error prevention by extracting cases that can be horizontally incorporated into the Center. This includes, for example, centering on cases at nuclear power stations, referring to human factor case studies compiled by the Central Research Institute of Electric Power Industry (CRIEPI).

- Improving the on-site display of points to cope with emergencies and important safety matters

To further improve on-site emergency response and safety awareness, it is desirable to display points of emergency equipment operating procedures and important safety matters on the site.

Other details concerning this report may be found on the Japanese homepage.

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[1] RI: Radioisotope or Radioactive Isotopes

[2] Depleted uranium: Uranium that has the same composition of isotopes as naturally produced uranium (containing approximately 0.711 weight percent of ^{235}U) is called natural uranium. If the composition of ^{235}U exceeds that of natural uranium, it is called enriched uranium. If it is below that of natural uranium, it is called depleted uranium (excerpted from "Nuclear Dictionary: The Nikkan Kogyo Shimbun Ltd.")

[3] Uranium hexafluoride (UF_6): Solid clear crystal at a normal temperature. Since it sublimes and turns into gas at 56.6 degrees Celsius, it is used to separate uranium isotopes. Its triple point is 64.01 degrees Celsius. At 64.05 degrees Celsius or higher, liquid phases occur, which eventually turn into two phases (gas and liquid) and can be handled as liquid (excerpted from "Nuclear Dictionary: The Nikkan Kogyo Shimbun Ltd.")

[4] Minimum critical mass: A certain level of mass of nuclear fissile substances below which criticality cannot be attained. The value of this level varies depending on the type and form of nuclear fissile substances as well as the conditions in which they are kept (neutron deceleration and reflex conditions) (excerpted from "Nuclear Dictionary: The Nikkan Kogyo Shimbun Ltd.")

[5] Reasons why criticality accidents need not be assumed: In an industrial scale, the minimum critical mass under the most severe conditions is mentioned in the Nuclear Safety Guide (USAEC Report TID-7016) with theoretical extrapolation using experimental measurements of critical masses. For 100% enriched ^{235}U, the value is 0.82 kg in the form of solution. If the level of enrichment is lowered, a relaxation coefficient is evaluated, based on which the minimum critical mass for each level of enrichment is determined. TID-7016 Rev.2 shows that 12.5 kgU for enrichment levels below 5% and 2.0 kgU for enrichment levels equal to or over 5% and below 20%. The volume of storage permitted at the Center is below this minimum critical mass, which cannot cause criticality.

[6] Article 16-2 of the Ordinance for the Enforcement 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 Center 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.

[7] Criticality safety: To safely control facilities, such as nuclear fuel processing plants and spent fuel reprocessing plants which handle fissile substances in a way so that such fissile substances do not reach a criticality state, causing criticality accidents (excerpted from “Nuclear Dictionary: The Nikkan Kogyo Shimbun Ltd.”)