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## **Summary Report of Peer Review**

(Provisional Translation)

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Place of Review: Tokai Plant, JCO Co., Ltd.  
(Tokai-mura, Naka-gun, Ibaraki Prefecture)

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Date of Review: April 16-19, 2002

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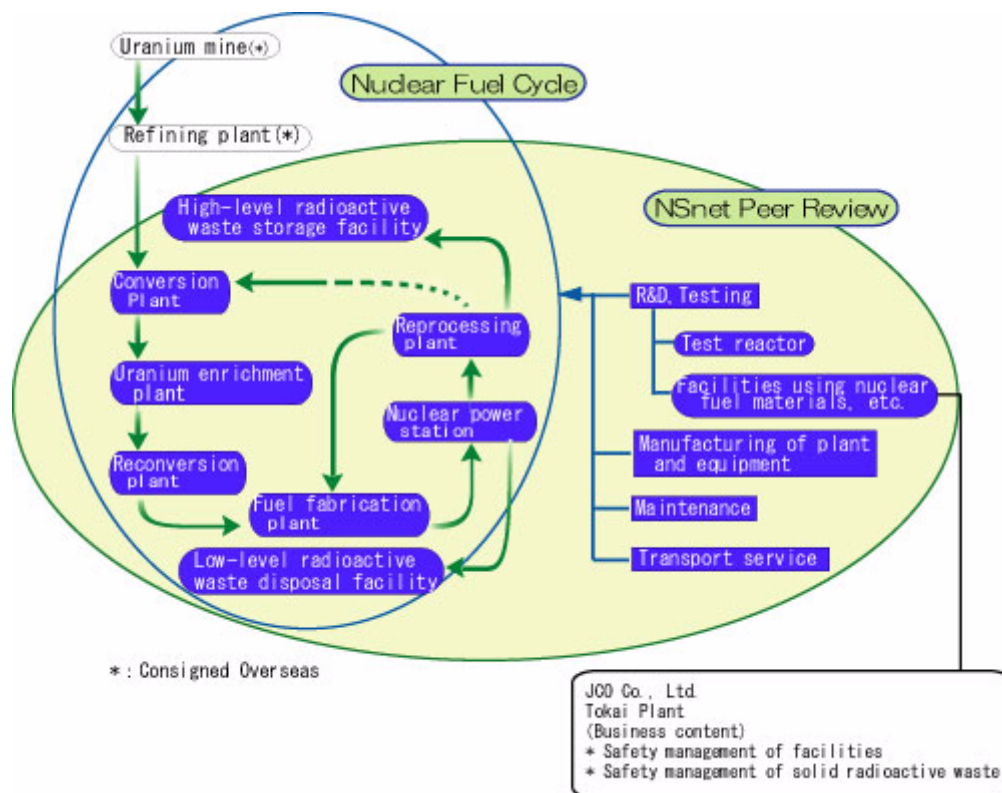
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## 1. Objectives

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 JCO in the nuclear fuel cycle

JCO Co., Ltd. (hereafter referred to as “JCO”) took over operations from the Nuclear Fuel Division of Sumitomo Metal Mining Co., Ltd., the parent company, in 1979. It was established as the Japan Nuclear Fuel Conversion Co., Ltd., and its name was changed to JCO in 1998. Based on solvent-extraction technology carried out with pulse columns developed by Sumitomo Metal Mining Co., Ltd., the company possesses a reconversion process for reforming  $UO_2$  from  $UF_6$  and a process of

refining and recycling processed scrap such as grinding scraps from UO<sub>2</sub> pellets generated at fuel fabrication plants.

On September 30, 1999, JCO suffered a criticality accident<sup>i</sup>, Japan's first, which occurred in what at that time was the experiment conversion facility. As a result, the authorized business license for the company's processing operations was revoked. Based on a changed license for nuclear fuel material use, on March 15, 2000, about 260 tons of uranium stored in the facilities was shipped out. Owing to completion of this transport project, on September 29 of the same year, JCO notified the government about this and changed the license for use, including the change of use objectives. It was authorized on November 22, 2000.

As a result, JCO is currently engaged mainly in the following activities:

- Safety management of facilities (including storage and management of non-operating machinery and equipment)
- Safety management of solid radioactive waste

Presently, the maximum quantity of nuclear fuel material approved for the JCO Tokai Plant (hereinafter, Tokai Plant), is 13kg of uranium and 150g of thorium. In legal terms, the facility is classified for nuclear fuel material use, but is considered a facility in which there is no possibility of criticality being reached even if the nuclear fuel material approved for such use is all gathered in one place and for which there is no need to assume an accident due to criticality<sup>ii</sup>. In addition, because of the approved quantity, Article 16-2 of the "Law for the Regulations of Nuclear Source Material, Nuclear Fuel Material and Reactors<sup>iii</sup>" is not applicable to JCO. This means that there is no obligation for "Safety Regulation" or "Site Inspection," by law and that "the Special Measures Law for Nuclear Disasters" is not applied to the facility.

### **3. Points of Review**

In this review of JCO, we emphasized the activities carried out for the purpose of securing safety of current operations of the company indicated in the previous items, after the criticality accident.

The review was divided into six sections: (1) Organization/administration, (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 category are organized in the

following manner:

(1) Organization/administration

- Proper management resources (appropriate number of workforce)
- Safety leadership (establishment of policies and targets)
- Activities for fostering a safety culture and improving morale
- Consideration of human factors

(2) Emergency measures

- Emergency measures based on the gist of “the Special Measures Law for Nuclear Disasters”
- Tie-ups with other operators

(3) Education/training

- Conducting of safety education (including education regarding criticality safety<sup>iv</sup>)

(4) Operations/maintenance

- Formulation and checking of documents and procedure manuals, approval, methods of revision
- Conformity with approval items (contents of license)
- Carrying out safe operations (status of following documents and procedure manuals)
- Safety management of facilities
- Appropriate accountancy system of nuclear fuel material
- Appropriate management of solid waste (in drum containers)

(5) Radiation protection

- Appropriate radiation protection for workers

(6) Serious accident prevention

- Prevention measures against fires and explosions

In this way, the review did not aim at investigating the causes and/or the background of the criticality accident; rather it was designed to focus on the current safety activities that JCO has dedicated itself to in post-accident response, with the objective of eliminating possible factors related to the occurrence of problems in the future.

#### **4. Period and Outline of Review**

(1) Date:

April 16 (Tue.) to April 19 (Fri.), 2002

(2) Formation of Review Teams

A group: Japan Nuclear Fuel Limited; Tohoku Electric Power Company, Inc.;  
Toshiba corporation

B group: Kyushu Electric Power Company, Inc.; Hitachi Zosen Corporation

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

With regard to safety activities, the entire JCO organization was the target of the review.

However, the controlled areas, such as Bldg. No. 1, Bldg. No. 2 (former reversion plants), and storage areas for retained waste, among others, were the main targets as job-site facilities.

## 5. Schedule of Review

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

		A Group	B Group		
4/16 (Tue.)	AM	<b>Opening</b> (Greetings, Introduction of Members etc.)			
		1. Organization/ administration	-Effective organization management - Cultivating safety culture/ Efforts to improve morale <b>[Document Examination]</b>	4. Operation/ maintenance	- Ensuring safe work - Facilities and equipment management and inspections <b>[Document Examination]</b>
	PM	1. Organization/ administration	- Cultivating safety culture/ Efforts to improve morale - Reflecting problematic events and the human factor <b>[Document Examination]</b>	4. Operation/ maintenance	- Facilities and equipment management and inspections <b>[Document Examination]</b>
			- President - General Manager <b>[Interview]</b>		- Engineering of nuclear fuel processing facilities <b>[Document Examination]</b>
4/17 (Wed.)	AM	2. Emergency measures	- Emergency plans - Emergency training <b>[Document Examination]</b>	5. Radiation protection	- Confinement of radioactive substances and monitoring - Dose control <b>[Document Examination]</b>
		1. Organization/ administration	-The human factor <b>[Field Observation]</b>	6. Serious accident prevention	-Accidents caused by fires/explosions <b>[Document Examination]</b>
		2. Emergency measures	-Emergency equipment/ resources <b>[Field Observation]</b>		
	PM	3. Education/ training	- Implementation of trainings <b>[Document Examination]</b>	6. Serious accident prevention	-Accidents caused by fires/explosions <b>[Document Examination]</b>
		2. Emergency measures	- Responsible person <b>[Interviews]</b>	4. Operation/ maintenance	- Interlock devices - A storehouse of nuclear fuel materials <b>[Field Observation]</b>
				5. Radiation protection	- Radiation monitoring panel <b>[Field Observation]</b>
		3. Education/ training	-Responsible person <b>[Interviews]</b>	6. Serious accident prevention	-Accidents caused by fires/explosions <b>[Field Observation]</b>
4/18 (Thu.)	AM	1. Organization/ administration	- Manager - Responsible person <b>[Interviews]</b>	4. Operation/ maintenance	- Responsible person <b>[Interviews]</b>
				6. Serious accident prevention	- Manager <b>[Interviews]</b>
	Opinion exchange related to activities for fostering of safety culture				
	PM	<b>Verification of Facts</b>		<b>Verification of Facts</b>	
4/19 (Fri.)	AM	<b>Verification of Facts</b>			
		<b>Closing</b>			

## **6. Methods and Items of Review**

### **6.1 Methods of Review**

The review investigated the various activities carried out by JCO 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 JCO, and interviewing employees, as shown below.

In addition, the latter half of the review schedule included an opinion exchange based on the theme “Effective activities related to the fostering of a safety culture and approaches toward their realization,” in which all personnel related to this review participated. With the detailed safety activities currently carried out by JCO as the subject matter, a discussion was held aiming at further improving the level of such activities. Through such a process, examples of model activities were introduced, such as the status of safety activities carried out at the reviewers’ companies and good practices from past peer reviews, with opinions being exchanged regarding the fostering of nuclear safety culture.

#### **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 by 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 carried out.

##### **(3) Interviews**

Interviews based on the following objectives were conducted with the president, the general manager, managers and responsible persons.

- a. Examining the level of the effort and awareness toward the safety culture development, including nuclear safety measures
- 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 actually being implemented or whether they are merely carried out in name only.

### **6.1.2 Standpoint of selecting 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 JCO 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 Field 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.

### Section 1: Organization/administration

This area was investigated from the perspectives of, related to the securing of safety in the nuclear industry, whether the 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. Efforts to improve morale
- c. Transmission of information to local areas and regions
- (3) Incorporation of examples of problems and the human factors
  - a. Past examples of problems and their incorporation
  - b. Further consideration of human factors

### Section 2: Emergency Measures

The Special Measures Law for Nuclear Disasters is not applicable to JCO. An emergency here means a case where 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 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. Dissemination of information to employees
- (2) Emergency Training
  - a. Execution of accident training

### 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 Training
  - a. Systems of education and training (including Technology (know-how) transfer)

### Section 4: Operation/Maintenance

In this review, “Safe operations” corresponded to the area of “Safe work of storage and management of equipment and machinery, and when carrying out work related to the handling of solid waste in controlled areas,” while “Safe maintenance” corresponded to “Safe work at the time of facility equipment maintenance

management.” 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<sup>v</sup>
  - b. Facilities safety management
  - c. Facilities and equipment 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<sup>vi</sup>
  - 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, and 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 JCO Tokai Plant, we have not found any item that would lead to a serious accident unless immediate remedies were taken in the nuclear safety field.

After the criticality accident, JCO established its “Company Action Plan” in February of 2000. In the “Company Action Plan,” JCO declares that safety is the first priority. In May of the same year, JCO carried out reorganization of its operations and systematic reform, creating a system able to focus on post-accident response. In addition, in conjunction with completion of the transport of the uranium from the facility, in November of the same year, the facility obtained a license from the government, that would allow no possibility of criticality, even with all nuclear fuel material gathered in one place.

Based on the deep remorse over the accident, in May of 2000, JCO developed as its JCO Action Guidelines the principles of “Safety First, No More Accidents” and “We respect essential rules and act under essential rules.” Over the subsequent two or so years since, top management at the level of president and below took the lead and made efforts to adjust various safety activities, such as ensuring acceptance of compliance among staff members, and making “reporting, communicating, and consulting” activities more thorough. This review confirmed the fact that such activities are in the process of steady permeation to all staff members.

Additionally, it was confirmed in this review that JCO has been developing new efforts, including activities to foster a safety culture, for example, safety lectures by the Tokai Plant Director (hereinafter referred to as “Director”) at morning meetings, nuclear power safety quizzes, safety panel discussions, and the like. Other efforts include enhancement of such programs as repeated education concerning criticality

safety and study group regarding laws and ordinances, as well as strengthened training for emergencies, such as the establishment of an emergency summoning system and an emergency organization, as well as reporting to outside related organizations.

On the other hand, in light of the fact that JCO activities are limited to post-accident response, it was confirmed that, as motivation for the above activities, the company was making efforts to recover trust and faith by continuing to attain short-term goals.

In the future, it is hoped that JCO will work to steadily incorporate the present safety activities, and continue and strengthen its voluntary efforts aiming at the fostering of an even more effective safety culture. And by so doing, it is hoped that this will lead to restored faith in nuclear power.

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.

- Strengthening of consciousness regarding compliance, based on safety audit results

Compliance is one of the safety activity elements focused on by JCO following the criticality accident. Based on the audit results of compliance carried out by Sumitomo Metal Mining Co., Ltd., JCO's parent company, a study group regarding law and ordinance was formed centered on safety and health committee members. At each workplace, these committee members work on the horizontal development of compliance consciousness, achieving an increase among all staff members.

- Development of various safety-culture fostering activities led by top management

In order to secure safety and restore faith in the company, JCO has positioned safety-culture fostering activities at the center of all its corporate activities. In concrete detail, based on results of organization into nine concrete images of a "detailed appearance of the Company when a safety culture becomes firmly rooted," top management is taking the lead in efforts at various detailed activities, thereby achieving permeation into the workplace. It is particularly hoped that the company's own efforts, such as nuclear power safety quizzes planned by the Director, as well as safety panel discussions by staff members, prove to be effective.

- Establishment of JCO Action Guidelines by "Individual KY sheets" and "Safety cards"

In everyday work, danger points are extracted with “Individual KY sheets” and “Safety cards” on an individual basis. The JCO Action Guidelines are clearly delineated on the “Individuals KY sheets” and “Safety cards,” in consideration of motivation regarding safe work and the heightening of safety consciousness, becoming generally established as common awareness shared among all workers.

- Development of active fire-prevention management measures by the “Fire Prevention Management Committee” centered on fire-prevention managers

As a committee that deliberates items related to fire-prevention management, the Fire Prevention Management Committee was established in February 2002, with a fire-prevention manager as the committee chair, and this body initiated active efforts related to fire prevention. In addition, reflecting examples of fires at outside facilities, various detailed measures have been established, such as the development of countermeasures for eliminating chemicals and scrapping equipment and machinery not planned for use, and cutting grass and planting trees to serve as a forest block for the prevention of fires, and so on.

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

- Further acceptance by clarifying and codifying the positioning of activities to reflect examples of problems

Activities to reflect examples of problems are a sign of the strong will to make concrete efforts to realize “Safety First, No More Accidents” and “We respect and obey essential rules,” which are included in the JCO Action Guidelines, and the actual situation showed that there were sufficient understanding and permeation of such activities. In the future, in order to make these tangible at higher levels, it is hoped that preparations will be made toward systematic organization, such as by clearly defining the position of each of the activities, and through codification, achieving an even higher level of acceptance.

- Systemization of education and training and establishment of individual career management

The review confirmed that education and training are sufficiently conducted according to each fiscal year’s plan, and that the results are appropriately recorded. However, from the prospect of an even higher level of steady and effective education and training in the future, it is hoped that systemized planning is

established with a view to long-term education of staff members, after clear regulations are established for the department that puts in order all the education and training programs.

In addition, it is hoped that a database will be created on individual education and training experience and careers, and that the database is fully utilized, including being reflected in license acquisition plans and education and training plans, and the like.

- Deployment of work procedure instruction sheets and other documents to all work sites

The work procedure instruction sheets for analysis and other work are deployed at the particular work site, making it possible to ascertain the work procedures and directly confirm the status of adherence to the procedures. On the other hand, despite the fact that the work procedure instruction and work instruction sheets for facility management work are permanently located in the work arrangement room, which is the on-site work station, enabling the confirmation of work procedures, the documents are not necessarily brought onto the work site. Therefore, just as in the case of analysis work, facility management work should involve either deploying or carrying of such documents as the work procedure instruction sheets and work instruction sheets.

- Clarification of the positioning of record keeping documents such as for on-site inspections

With respect to the facilities that are in the controlled areas, every day including holidays, the department in charge of facility management, the department in charge of safety management, and the department in charge of security carry out inspection rounds of the facilities utilizing inspection sheets, thereby attaining safety on a daily level. However, it is hoped that the positioning of the records used in the inspections and the recordkeeping documents utilized for the work is clarified, such as attaching the forms to the work procedure instruction sheets.

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

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- i JCO criticality accident: Related information is available on the following sites.  
Agency of Natural Resources and Energy:  
<http://www.atom.meti.go.jp/siraberu/anzen/07/index05k.html>  
Nuclear Safety Commission: [http://nsc.jst.go.jp/anzen/sonota/nscnews\\_jco\\_f.htm](http://nsc.jst.go.jp/anzen/sonota/nscnews_jco_f.htm)  
Federation of Electric Power Companies: <http://www.fepc.or.jp/jco.html>
- ii 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  $^{235}\text{U}$  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% and 4 kilograms-U for that of 5% to less-than-20%.  
The mass of enriched uranium, which JCO is permitted to utilize is far less than even half as much as this minimum for critical mass, and could not produce criticality
- iii 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  $^{235}\text{U}$  is prescribed: 1.2 kg $^{235}\text{U}$  for enrichment levels below 5% and 0.7 kg $^{235}\text{U}$  for enrichment levels equal to or at least 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 JCO 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.
- iv Criticality safety: To safely control facilities, such as nuclear fuel production plants and spent fuel reprocessing plants which handle fissile material in a way so that such fissile material do not reach a criticality state, causing criticality accidents (excerpted from “Nuclear Dictionary: The Nikkan Kogyo Shimbun Ltd.”)
- v Interlocks: Mechanical and electrical locking systems enabling the commencement of prescribed operation for certain equipment only when certain conditions for components in serial or parallel linkage are fulfilled (cited as synonymous with the Japanese “intarokku” in “Dictionary of Nuclear Science and Technology”, published by Nikkan Kogyo Shimbun, Ltd.)
- vi 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.