

Regulatory Failures of Nuclear Safety in Japan –The Case of Fukushima Accident

Hideaki Shiroyama
The University of Tokyo

Introduction

After the Fukushima Nuclear Power Plant accident caused by the Great East Japan Earthquake in 11th March 2011, various processes for accident investigations and arguments for the reform of nuclear safety regulation were announced. In the government, in addition to setting up the Investigation Committee on Accident, parallel process for institutional reform was undertaken.

In the process for institutional reform, “Basic Concept of Structural Reform of Nuclear Safety Regulations” was adopted at the Cabinet Meeting of August 15, 2011. It advocated the launch of a new safety regulatory body, on the basis of the principle of “separating regulation from utilization.” The nuclear safety regulatory divisions of NISA will be separated from the Ministry of Economy, Trade and Industry; and a “*Nuclear Safety and Security Agency* (tentative name)” would be established as an external agency of the Ministry of Environment by integrating into it the functions of the NSC. The opposition party, LDP (Liberal Democratic Party), is proposing an alternative model of nuclear safety regulation in the form of more independent administrative committee based on Article 3 of the National Government Organization Act, whose members are appointed upon obtaining consent of both Houses of Diet. Those two proposals were negotiated in the Diet House and it was finally agreed in June 2012 that Nuclear Regulatory Commission, an independent administrative committee based on Article 3 of the National Government Organization Act, would be set up.

In the history of nuclear safety regulations in Japan, two major reforms were undertaken after the two accidents, that is, Mutu nuclear ship accident in 1974 and JCO criticality accident in 1999. It is important to have historical perspective to understand what will happen this time after the Fukushima accident. So first, this article will review the historical progress of nuclear safety regulation in Japan in response to two accidents. After that, this article discusses about the lessons we can learn from the “regulatory failures” of nuclear safety regulation uncovered by Fukushima accident in March 2011, and about the possible future institutional issues of nuclear safety regulation in Japan.

1. Historical Background - Progress of Nuclear Safety Regulation in Japan

Looking broadly at the historical progress of nuclear safety regulation in Japan, it can be divided roughly into three periods as follows.

(1) The first period (1957-1978)

We can classify into the first period the two decades from 1957, when Japan established the Law for the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors (the Nuclear Reactors Regulation Law), to 1978, when this Law was revised.

In this period, the Prime Minister had authority to approve licenses of nuclear business. Actually, the Director-General of the Science and Technology Agency had regulatory authority through its assistance to the Prime Minister. As for commercial nuclear power reactors and commercial marine reactors, however, administrative measures including construction permit by the Prime Minister required the consent of the competent ministers (Article 71 of the Nuclear Reactors Regulation Law), in this case these were the Minister of the Ministry of International Trade and Industry (MITI) and the Minister of Transport, because these reactors had already been regulated by the Old Electricity Business Act and the Ship Safety Act. In addition, some regulatory approvals and inspections of these two types of reactors including approvals of design and construction plan, inspections of facilities and their performance, pre-service inspection and periodic inspection were exempted from the application of the Nuclear Reactors Regulation Law and were left to the existing regulations (Article 73).

Meanwhile, the Nuclear Reactors Regulation Law also stipulated that the Prime Minister should listen to and respect the opinions of the Atomic Energy Commission of Japan (AEC), which was established under the Prime Minister's Office based on Article 8 of the National Government Organization Act, including matters concerning safety regulation (Paragraph 2, Article 4). The Director-General of the Science and Technology Agency had taken on the position of chairperson of the AEC and this Agency had dealt with the office work of the Commission. There had been controversy as to whether the AEC should be set up as an organization prescribed in Article 3 of the National Government Organization Act or Article 8 of that, the former is a decision-making organ and the latter is an advisory one. After all, the AEC was established as a decision-making organ *de facto* despite its legal nature was a very strong advisory council¹.

¹ Masatsugu Ito, *Nihon Gata Gyousei Inkaei no Keisei: Soshiki to Seido no Gyousei Shi (Formation of Japanese Model of Administrative Committee System: Administrative History of Organization and Institution)* 244-249 (2003).

In the first period, almost one administrative agency – legally the Prime Minister, but actually the Science and Technology Agency – had exclusively implemented nuclear safety regulation, even though some consents were required by relevant ministries. Additionally, the AEC had been established as a highly independent advisory council whose members were appointed upon obtaining consent of both Houses of Diet. It was thought to be the reason why the AEC had been granted a great deal of independence that the AEC should ensure peaceful use of nuclear energy, as the purpose of its establishment was to do “democratic control of public affairs” (Article 4 of the Atomic Energy Basic Law and Article 1 of the Act for Establishment of the Atomic Energy Commission).

(2) The second period (1978-1999)

The radiation leakage accident of Mutsu in 1974, the first and the only nuclear-powered ship in Japan, invited the public mistrust of Japanese nuclear administration as a whole. Japanese government established the Advisory Committee on Atomic Energy Administration under the Prime Minister on February 1975, whose chairman was Hiromi Arisawa, Emeritus Professor of the University of Tokyo, for reexamining the institution of nuclear-related organizations. Based on the report of the Committee, the Nuclear Reactors Regulation Law was revised in 1978. We can regard as the second period about twenty years from that time to 1999 when the JCO (a nuclear fuel company) nuclear critical accident occurred and the nuclear regulatory institution was reformed as a result of the reorganization of the central government.

The Arisawa Advisory Committee submitted the report on July 1976 including the opinions about reform and enhancement of nuclear administration in Japan. Three assertions and purposes closely linked with the nuclear safety regulation were pointed out in this report as follows;

- To separate the functions related to nuclear safety from those which the AEC had had and to establish a new committee which shall deal with nuclear safety and double-check the safety reviews by the administrative agencies for enhancing institutional framework of securing nuclear safety
- To implement safety regulation consistently according to the types of reactors for clarifying the responsibility of administrative agencies for ensuring safety of nuclear reactors – the Minister of the MITI is responsible for the regulations of commercial nuclear power reactors, the Minister of Transport is for those of commercial marine reactors, and the Prime Minister is for those of research and test reactors and those in the stage of research and development
- To implement some government measures such as holding public hearings and symposium for dispelling the public concerns over nuclear safety and obtaining

public understanding and cooperation for nuclear energy development²

Based on these recommendations, the Nuclear Reactors Regulation Law was revised in 1978 as described below. First, this revision assured consistency of safety regulation with respect to each type of reactor for ensuring safety of them as follows; commercial nuclear power reactors are regulated by the Minister of the MITI, commercial marine reactors are regulated by the Minister of Transport, and research and test reactors and those in the stage of research and development are regulated by the Prime Minister. Next, the functions relevant to safety were separated from the AEC and the Nuclear Safety Commission of Japan (NSC) was newly established which should exercise jurisdiction over nuclear safety issues. Still, the legal position of the NSC falls into the category of “Councils etc.” prescribed in Article 8 of the National Administrative Organization Act as well as the AEC. As a result of this reform, the competent ministers had become required to listen to and respect the opinions of the NSC about the safety-related issues when he/she designates activities and issues permissions and the NSC states its opinion in the form of double-checking safety reviews of the competent ministers of regulation. Meanwhile, the NSC hadn’t had its own secretariat as well as the AEC, so that the Science and Technology Agency had dealt with the office work of the Commission.

With regards to the institutional form of the NSC and that of the AEC whose reform was also re-examined at that time, the controversy as to whether an Article 3 organ or an Article 8 organ be adequate had been rekindled. The Arisawa Committee concluded that the NSC and the AEC should be “advisory committee” although the Socialist Party of Japan, the Japanese Communist Party and The Federation of Electric Power Related Industry Worker's Unions of Japan proposed changing these institutional forms to “administrative committee” which has executive authority such as the Japan Fair Trade Commission. The Arisawa Committee provided two reasons to support their conclusion as follows;

- Under the form of administrative committee, the AEC and the NSC couldn’t sufficiently play their roles as “the guardian of the Atomic Energy Basic Law” and would lose their ability to monitor the government because to become administrative committees means to be part of the government.
- What to think first could be to secure the neutrality of both committees from the government from the viewpoint of ensuring peaceful use of nuclear energy which was the starting point for Japanese nuclear energy development³.

² Genshiryoku Anzen Iinkai (The Nuclear Safety Commission of Japan), Genshiryoku Anzen Nenpou Shouwa 51 nen (Annual Report of Nuclear Safety 1981) (1981).

³ Genshiryoku Journalist no Kai (Forum of Nuclear Energy Journalists), Journalist no Shougen: Genshiryoku 25 nen no Kiseki (Testimonies of Journalists: Trajectory of

In addition to these, the problems of the scope of authority was taken into account, that is, administrative committees couldn't deal with any issues other than their own administrative affairs authorized clearly by law, then there was a possibility that they couldn't cover all the safety-related issues unless the laws prescribe the contents of authority very broadly, and that, making a broad stipulation could overlap other governmental agencies' authorities⁴.

Furthermore, two public hearings had got held at the siting process of nuclear power plants (NPPs); the primary public hearings are held by the MITI concerning various issues related to construction of NPPs before the Electric Power Development Coordination Council (so-called "Den-Chō-Shin") decides the Electric Power Development Master Plan for building new commercial nuclear power reactors, and the secondary public hearings are held by the NSC on the occasion of double-checking safety review documents submitted by the MITI⁵.

In this second period, the regulatory authorities had been decentralized and several governmental agencies including the ministries which had held jurisdiction over the development and promotion of nuclear business had also regulated nuclear safety according to the types of business because the centralized regime of safety regulation in the first period had been judged not to work sufficiently. However, it can be said that these changes had made integration strengthening inside each type of business, which meant the level of integration between promotion side and regulation side had been enhanced. On the other hand, independent advisory committee had become responsible for preliminary review of regulation by the regulatory agencies. Against the background of separation the NSC from the AEC, there had existed growing public concerns over nuclear safety.

(3) The third period (since 1999)

The JCO (a nuclear fuel production company) nuclear criticality accident in September 1999 killed two workers, who are the first victims in the history of nuclear energy development in Japan, and brought radiation release which forced the evacuation of nearby residents. The report of "Investigation Committee on the Criticality Accident at Uranium Processing Plant" proposed some points related regulation issues as follows;

Nuclear Energy for 25 Years) 133 (1981).

⁴ Hiromi Arisawa, Kihon Hou no Kaisei to Korekara no Genshiryoku Gyousei (Revision of the Basic Law and Future Nuclear Energy Administration) 5 (1977).

⁵ Genshiryoku Anzen Iinkai (The Nuclear Safety Commission of Japan), Genshiryoku Anzen Nenpou Shouwa 51 nen (Annual Report of Nuclear Safety 1981) (1981).

- Strengthening and enhancement of the capacities of regulatory agencies
- Strengthening the independency of the NSC and the capacities of the NSC secretariat and ensuring expert groups from a variety of fields
- Improving regulatory guides and making multi-layered and mutually complementary regime of safety regulation function more effectively
- The regulatory agency's and the NSC's responding to the requests from society and to the demands of the present age

The NSC in response to this report demonstrated its directions for ensuring nuclear safety in the Basic Policies for the Near-Term Initiatives of the NSC (NSC Decision in November 1999) as follows;

- To devote more attention to the viewpoint of operation management in the safety review of basic design with adding experts of this field
- To verify the conditions in the operation stage as to whether the operators maintain their technical capabilities and take safety measures appropriately with realizing the concepts at the time of safety review, through receiving reports from the regulatory agencies on the compliance status of operational safety program and the implementation status of periodic inspection and conducting on-site inspection by the NSC itself

As for the secretariat of the NSC, it was transferred to the Prime Minister's Office from the Nuclear Safety Bureau of the Science and Technology Agency since April 2000. This change had brought enhancement of human resources and improvement of the secretariat's capability to conduct expert investigation through assigning experts from a wide range of areas as technical advisors and so on, although it had been a transitional institution before the regime shift to the Cabinet Office in 2001. In addition, the NSC institutionalized "the subsequent regulation review" of post-license regulations, which means the regulations after approval of installation for nuclear facilities, including verification by on-site inspection for confirming the status of implementation of safety measures at construction and operation stages. The NSC published "The Basic Policies for the Near-Term Initiative of the NSC" (NSC Decision in June 2000) based on some trial implementations, since then, the NSC had started to implement fully the subsequent regulation review.

At the beginning of November 1999, there was a movement strengthening the NSC as an organization prescribed in Article 3 of the National Government Organization Act in the Administrative Reform Task Force of the LDP (Liberal Democratic Party)⁶, but it

⁶ Toshiya Kitayama, Genshiroku Kantoku Taisei no Sasshin (Reform of Supervisory Framework of Nuclear Energy) 132 (Masaru Mabuchi & Toshiya Kitayama eds., Seikai Saihen Ji no Seisaku Katei (Policy Process at the Time of Political Realignment 2008).

didn't come about.

Furthermore, due to the reorganization of central government ministries, the regulation of commercial power reactors, reactors at the stage of research and development and nuclear fuel facilities etc. had become under the jurisdiction of the Minister of the Ministry of Economy, Trade and Industry (METI). However, the regulation of commercial marine reactors had become under the jurisdiction of the Minister of Land, Infrastructure and Transportation from the Minister of Transport., and that of test and research reactors had become under the jurisdiction of the Minister of Education, Culture, Sports, Science and Technology from the Prime Minister (substantially from the Director-General of the Science and Technology Agency). And, in accordance with the abolishment of the Prime Minister's Office and the establishment of the Cabinet Office, the AEC and the NSC had become under the Cabinet Office, and the NSC had become to have its independent secretariat in the Cabinet Office.

Also, organizations inside the METI were restructured at that time. The Nuclear and Industrial Safety Agency (NISA) was newly established as an organization under the METI – its legal position is a “Special Organ” attached to the Agency for Natural Resources and Energy of METI. We can appreciate this reform because whose purpose had been to clarify the mission and the responsibility of the agency in charge of nuclear safety administration with ensuring independence to some extent although it has still been under the METI⁷.

It can be said that this government reorganization gave the NSC greater independence because it had been transferred to the Cabinet Office which had higher position than the other Ministries from the Prime Minister's Office which had been at the same level as the other Ministries, and the NSC had become to have its own secretariat. However, the original stipulation of “respect for decisions” prescribed in Article 3 of the Act for Establishment of the Atomic Energy Commission and the Nuclear Safety Commission was deleted by the revision in 1999. It would seem that the administration reform had got rid of the provision of respecting their decisions from advisory councils without exception.

The NSC's involvement in the post-license regulations was institutionalized as “the Subsequent Regulation Reviews (SRR)” in the third period in response to the JCO

⁷ Tatsujiro Suzuki, Hideaki Shiroyama & Setsuo Takei, Anzen Kisei niokeru “Dokuritsu” to Shakaiteki Shinrai – Beikoku Genshiryoku Kisei Innkai wo Sozai toshite (“Independence” and Social Trust in Safety Regulation: the Case of Nuclear Regulatory Commission in the US), 4 Shakai Gijutsu Kenkyu Ronbun Shu (Sociotechnica) 166 (2006).

criticality nuclear accident, after its embryo stage in the second period. Since then, the SSR has been implemented and progressed in response to various incidents etc. On October 29, 2002, for the first time since its establishment in 1978, the NSC submitted to the Minister of the METI through the Prime Minister, “Recommendations for Restoring the Confidence of Nuclear Safety” based on Article 24 of the Act for Establishment of the Atomic Energy Commission and the Nuclear Safety Commission in response to the misconducts that the Tokyo Electric Power Company had concealed and falsified inspection records. In addition, the regulatory agencies have been required to inform periodically the NSC of the status of implementation of subsequent regulation since the amendment of the Nuclear Reactors Regulation Law in 2002 (Paragraph 3, Article 72). Moreover, this law amendment required the nuclear operators and their subcontractors which conducted maintenance and inspection to cooperate with the NSC’s inspection in response to the reports from the regulatory agencies.

On March 3, 2003 the NSC established new “Subsequent Regulation Review Implementation Guidelines” reflecting a stronger monitoring and oversight function for the subsequent regulation. This guideline set the performance goal of the SSR as “to clarify the responsibility of government and operators” for prompting the regulatory bodies to develop the continuous upgrading of qualities, effectiveness and transparency of the post-license regulation activities⁸.

2. Two Regulatory “Failures” – Systemic Causes of Fukushima Nuclear Accidents

The Fukushima nuclear accident reveals two “failures” in nuclear safety regulation in Japan.

(1) “Failure” of interdisciplinary communication

First is the “failure” of interdisciplinary communication. The Fukushima accident has made it clear that there has been a severe delay in implementing tsunami countermeasures as a result. Why then Japan couldn’t succeed in applying necessary measures against tsunami?

In Japan, there had been a delay in taking actions not only on tsunami but also on seismic risks. However, the first decade of this century has seen some progress in earthquake countermeasures. In September 2006, the Nuclear Safety Commission in Japan (NSC) revised the Regulatory Guide for Reviewing Seismic Design of Nuclear

⁸ Genshiryoku Anzen Iinkai (The Nuclear Safety Commission of Japan), Genshiryoku Anzen Hakusho Heisei 14 nen (White Paper on Nuclear Safety 2002) (2002).

Power Reactor Facilities in accordance with the results of the 5 years study in the Subcommittee for the Regulatory Guide for Reviewing Seismic Design, which was established under the NSC in July 2001. With this revision, the Nuclear and Industrial Safety Agency (NISA) instructed nuclear operators to evaluate seismic safety of existing nuclear facilities (so-called “back-checks”) and reviewed its results. In addition, the Chuetsu-oki Earthquake in July 2007, which shook the Kashiwazaki- Kariwa nuclear power plant with the maximum seismic accelerations exceeding the values assumed in the design, had made such efforts more intensive.

However, a series of these processes had seemed not to be going smoothly⁹. Particularly, there was a communication gap between the expert community of nuclear reactor safety, which consisted mainly of engineering field, and that of earthquake resistant, which was made up of scientific field.

As to the tsunami issues, electric utilities in Japan have also responded in incremental ways. For example, the Tsunami Evaluation Subcommittee of the Japan Society of Civil Engineers (JSCE) published “Tsunami Assessment Method for Nuclear Power Plants in Japan” in February 2002. The basic concept of this assessment method is to evaluate the design water level based on the evaluations of historical tsunamis which can be identified in historical records and on some calculations with parameter variation. All the power companies which had nuclear power plants in Japan devised voluntary countermeasures against tsunami based on this assessment method¹⁰.

However, Japanese nuclear community couldn’t catch up accurately with the rapid progress in understanding tsunami. For instance, in August 2002, the Earthquake Research Committee of the Headquarters for Earthquake Research Promotion, led mainly by scientific researchers, pointed out the possibility of earthquakes centered in plate boundary ocean areas which can be stronger than historical ones¹¹. In addition, new simulation methods combined with sedimentological studies brought some new findings on the Jyogan earthquake in Tohoku area in 9th century which was mentioned

⁹ Tokyo Denryoku Fukushima Genshiryoku Hatsudensho niokeru Jiko Chousa Kensho Iinkai (Investigation Committee on Accident of Tokyo Electric Power Company Fukushima Power Plant), Chukan Hokoku (Interim Report) 382-388 (December 26, 2011).

¹⁰ Tokyo Denryoku Fukushima Genshiryoku Hatsudensho niokeru Jiko Chousa Kensho Iinkai (Investigation Committee on Accident of Tokyo Electric Power Company Fukushima Power Plant), Chukan Hokoku (Interim Report) 375-381 (December 26, 2011).

¹¹ Tokyo Denryoku Fukushima Genshiryoku Hatsudensho niokeru Jiko Chousa Kensho Iinkai (Investigation Committee on Accident of Tokyo Electric Power Company Fukushima Power Plant), Chukan Hokoku (Interim Report) 382 (December 26, 2011).

in reliable historical records. Based on these findings, some tsunami experts estimated possible tsunami heights in Fukushima coastal area which can be higher than its earlier predictions¹². Such advances in tsunami research have made the uncertainty of tsunami predictions more obvious in the tsunami experts' community. Nevertheless, their recognition of uncertainty was not transmitted to the nuclear safety community.

Moreover, in the Revised Regulatory Guide for Reviewing Seismic Design of Nuclear Power Reactor Facilities, as mentioned above, the tsunami is treated as one of the "accompanying phenomena" of earthquakes despite some subcommittee members' claim that the tsunami required particular attention in its revision process. The revised guide has only ambiguous stipulation about tsunami as follows: "Safety functions of the Facilities shall not be significantly impaired by tsunami which could be reasonably postulated to hit in a very low probability in the service period of the Facilities." Having taken measures to seismic risks to some extent, the nuclear safety community was placing importance on tsunami risks too. For example, the Japanese Nuclear Energy Safety Organization (JNES), one of the technical support organizations of nuclear safety in Japan, began to study about the tsunami probabilistic safety assessment (PSA) but it was still in the premature stage.

We can see from the above that incomplete interdisciplinary communication is one of the background factors of the delay in taking actions against tsunami risks. When utilizing a complex technology system such as nuclear technology, we are required to develop the sensitivity to the trends in broad range of knowledge construction. Nevertheless, we would have to say that Japan' government lacks a refined "antenna" which can detect constantly recent findings in different expert communities. Fundamentally, it can be said that it is one of the expected functions of regulatory body.

(2) "Failure" of voluntary safety efforts

Second is the "failure" of voluntary safety efforts of private nuclear utilities. The nuclear safety regulation in Japan has had a tendency toward relying heavily on operator's voluntary safety efforts. The current institutional design, where the NISA is located under the Ministry of Economy, Trade and Industry (METI), has been well-adapted to such attribute of regulation.

Behind other countries, Japan also introduced the severe accident management (measures to deal with accidents beyond design basis) in 1992. However, under the regulatory scheme of voluntary safety efforts, accident management measures were

¹² Tokyo Denryoku Fukushima Genshiryoku Hatsudensho niokeru Jiko Chousa Kensho Inkaikai (Investigation Committee on Accident of Tokyo Electric Power Company Fukushima Power Plant), Chukan Hokoku (Interim Report) 90-91 (December 26, 2011).

been basically regarded as voluntary efforts by operators, not legal requirements. Moreover, in Japan, it was decided in keeping with the intention of operators that the PSA (Probability Safety Assessment), which provides the basis of accident management, limited its subject to internal events, and excluded external events including earthquakes in the meantime. It is said that there had been operator's considerations from the viewpoint of public acceptance in siting areas as well as technical challenges of evaluations of external events¹³.

Severe accident management as voluntary measures, however, became subject to informal evaluation by the regulatory body in the periodic safety review (PSR), which is one of the quality assurance activities taken by operators voluntarily every 10 years. Through this informal evaluation, severe accident management had gradually expanded its subject matters to external events such as fires. We might say that such voluntary safety efforts had played some roles to an extent.

However, when the NISA made the PSR obligatory as a requirement of operational safety regulations after some scandals of involving TEPCO's cover-ups of cracks in the shrouds in 2002, the NISA left the PSA-related matters as voluntary requirements because of insufficient technical expertise of PSA. As a result, the NISA no longer evaluates severe accident management informally, and also the PSA stopped the expansion of its scope¹⁴. This can be regarded as an adverse effect of institutionalizing voluntary safety efforts.

Operators had taken voluntary measures against tsunami risks too. It was the electricity industry that supported a series of JSCE (Japan Society of Civil Engineers)'s studies on tsunami assessment technologies as mentioned above. Electronic power companies also showed their concern to the new simulation studies on the Jyogan tsunami, and tried to find countermeasures with making contact with the researchers of the Jyogan tsunami research project¹⁵.

¹³ Tokyo Denryoku Fukushima Genshiryoku Hatsudensho niokeru Jiko Chousa Kensho Iinkai (Investigation Committee on Accident of Tokyo Electric Power Company Fukushima Power Plant), Chukan Hokoku (Interim Report) 419-420 (December 26, 2011).

¹⁴ Tokyo Denryoku Fukushima Genshiryoku Hatsudensho niokeru Jiko Chousa Kensho Iinkai (Investigation Committee on Accident of Tokyo Electric Power Company Fukushima Power Plant), Chukan Hokoku (Interim Report) 426-427 (December 26, 2011).

¹⁵ Tokyo Denryoku Fukushima Genshiryoku Hatsudensho niokeru Jiko Chousa Kensho Iinkai (Investigation Committee on Accident of Tokyo Electric Power Company Fukushima Power Plant), Chukan Hokoku (Interim Report) 399-400 (December 26, 2011).

As a consequence, though, such voluntary efforts were too slow to prevent this accident caused by the earthquake and tsunami. In addition, the delay in accident responses is assumed to be due also to the circumstances that it was hard for the operator to vent voluntarily without the government's involvement in practice. Considering these points, we have to say that there have been some real limitations to the conventional ways of voluntary safety efforts.

It doesn't necessarily mean that the official regulation system by the regulatory body is completely effective. As for the responses to tsunami risks, it was not the electricity industry but the regulatory body that should have commissioned the studies on tsunami assessment technologies to JSCE. But the regulatory body has given less attention to recent findings in related fields than operators.

3. Direction of Institutional Reforms and Remaining Issues

Based on the lessons from those "failures", then, which direction we should take for the institutional reforms of nuclear safety regulation?

(1) Strengthening the independence

First, many argue the necessity of strengthening the independence of nuclear regulatory authority body. If one of the causes of this accident is the compromising attitude to voluntary safety efforts by industry, this argument stands to reason. In addition, as long as this accident and its responses have undermined confidence in the regulatory bodies in reality, to secure their independence is a necessary requirement for rebuilding the confidence.

In the past, when the radiation leakage incident of the atomic-powered ship Mutsu in September 1974 increased the public's mistrust, the institutional design of atomic energy administration was put on the review. As a result, the NSC was established in 1978 and the so-called "double-check" system was institutionalized in Japan: direct regulation of nuclear operators by the government regulatory agencies (the former Ministry of International Trade and Industry, etc.), and supervision/auditing of those agencies by the NSC for ensuring highly credible nuclear safety. In January 2001, the NISA was newly established under the METI as a "Special Organ" attached to the Agency for Natural Resources and Energy in response to the JCO critical accident in September 1999. With this reform, the primary regulatory agency of nuclear safety secured "some" degree of independence in the METI who are also in charge of promoting

peaceful utilization of nuclear power¹⁶.

These attempts at securing the independence of nuclear safety regulatory bodies, however, have coexisted with the tendency to depend on operators' voluntary safety efforts and to enhance collaboration and coordination with operators. These conventional ways had definitely some merits such as flexibility, saving regulatory cost and so on. Still, in case of the crisis management of severe accident like the Fukushima accident, such institutions of nuclear safety regulation brought clearly the delay in taking actions due to unclear division of work between the role of operators and regulatory bodies.

(2) Ensuring integrative capabilities

Second, some claim that it is essential for the regulatory body to ensure integrative capabilities around nuclear safety. They are stating that although the independence is important for the regulatory body, it is required to have not only institutional independence but also integrative expertise and to ensure substantive independence. In fact, we can say that the U.S. Nuclear Regulatory Commission (NRC) has integrative expertise which exercises jurisdiction comprehensively over nuclear safety, security and safeguards for non-proliferation and has more than 3,000 staffs. Similarly in France, L'Autorité de Sûreté Nucléaire (ASN) keeps those three areas under control in a comprehensive manner.

Of course, to ensure capabilities in nuclear safety regulation has been consistently an important issue in Japan too. Actually, after the JCO critical accident and the reorganization of government ministries under the Hashimoto administration reform, the NISA had been reinforced and the JNES was established under the NISA in 2003 which has several functions transferred from some public-interest corporations etc. These regulatory agencies have been conducting mid-career recruitment from manufacturers for acquiring technical expertise. Furthermore, the NSC has strengthened its Secretariat's functions after the JCO accident¹⁷.

Despite these efforts, the NISA, the JNES and the NSC have been facing a similar challenge of human resource development. The mid-career staffs from manufacturers were certainly experts of parts of nuclear technology, but they could not always succeed in regulating in a comprehensive way, nor could they get the skills as regulatory professionals enough to deal with operators.

¹⁶ Hideaki Shiroyama, Genshiryoku Anzen Inkaï no Genjo to Kadai (Current Status and Issues of Nuclear Safety Commission), 1399 Jurist (2010).

¹⁷ Hideaki Shiroyama, Genshiryoku Anzen Inkaï no Genjo to Kadai (Current Status and Issues of Nuclear Safety Commission), 1399 Jurist (2010).

In addition to these, there is also a problem with the adequacy of distribution of regulatory resources, that is, whether it is truly effective or not to establish two sets of regulatory bodies, the NISA and the JNES which are primarily in charge of safety regulation and the NSC which conduct “double-checks”, within the limitation of resources after a series of administrative reforms. Moreover, both the radiation dose regulation and the safeguard, the former can be said to set an overall goal of nuclear safety regulation and the latter is essential for non-proliferation, are under the Ministry of Education, Culture, Sports, Science and Technology (MEXT). It means that the authorities related to the nuclear safety in its broad sense have been widely dispersed (Refer to the table 1 for the numbers in each organization). Such dispersion of regulatory agencies led to a situation where the chief Cabinet secretary had no choice but to constantly be out in front and to explain the changing circumstances in detail right after the outbreak of the Fukushima accident even though he was not an expert in any nuclear fields.

Under these circumstances, it is considered necessary to establish an integrative regulatory authority for nuclear safety and to utilize human resources in an integrated manner from the standpoints of efficient development of regulatory capabilities and of ensuring experts' careers.

(3) Ensuring interdisciplinary sensitivity

These directions of institutional reform as mentioned above are consistent with those which had been pointed out in the discussion among interested parties even before the Fukushima accident. However, there are still some doubts about whether these reforms can be solutions to the “failures”.

We can point out the problem whether or not the integration of regulatory bodies can develop an interdisciplinary sensitivity. It is certainly significant to integrate nuclear safety, security and radiation regulations into a whole regulation system. In addition, it can be a prerequisite for legislating severe accident management to make the radiation regulation a goal of whole safety regulation and to change the legislative purpose of safety regulation from “preventing hazards” to “preventing radiation damage of public”. Besides, some measures for nuclear safety and nuclear security can overlap considerably particularly in the thermal management of spent fuels and in the distributed arrangement of emergency diesel generators and water pumps for cooling purpose. Furthermore, broad experiences in various aspects of nuclear safety fields can be useful for regulatory officials to develop interdisciplinary communication skills.

However, as noted earlier, one of the “failures” revealed by the Fukushima accident

is the lack of sensitivity to the issue of seismic risks, tsunami risks. Those risks and volcano risk, which seems to be one of the possible future challenges of nuclear safety, are risks dealt with directly under different jurisdiction. That is, attention must be focused on how to develop sensitivity beyond the jurisdiction of the integrated regulatory authority and how to ensure interdisciplinary communication among such segmented fields.

(4) Carrier pattern of experts

The other problem is, as the Fukushima accident has made clear the limitations of voluntary safety efforts, whether it would be truly possible for the integrated regulatory body to strengthen its regulatory expertise. That means how it can ensure capabilities independently of operators.

In the case of the United States, the Navy, which has lots of nuclear submarines, has played an important role as an excellent source of nuclear professionals other than power companies. In fact, many nuclear experts from the Navy have been employed by the NRC (Nuclear Regulatory Commission) and the Secretariat of the Institute of Nuclear Power Operations (INPO) which is a self-regulating organization among nuclear operators¹⁸. In Japan, it can be said that some research institutes under the former Science and Technology Agency such as the former Japan Atomic Energy Research Institute (JAERI: currently a part of Japan Atomic Energy Agency: JAEA) had played a role somewhat similar to the U.S. Navy. However, these institutes have had a tendency to downsize their operations under conditions that the Japanese science and technology policy places more emphasis on the studies which have high possibilities of application for meeting societal needs.

In Japan, with specializing in the civilian use of nuclear energy, whether or not we can make the careers of risk managers who have interdisciplinary orientation could be a key point for ensuring human resources and capabilities continuously in nuclear safety regulation and eventually for the substantial independence of the regulatory body.

In June 2012, after long discussion, the law for the establishment of Nuclear Regulatory Commission (NRC) passed the Diet in Japan, and NRC in Japan as an independent administrative committee based on Article 3 of the National Government

¹⁸ Tatsujiro Suzuki, Hideaki Shiroyama & Setsuo Takei, *Genshiryoku Anzen Kisei niokeru Beikoku Sangyokai no Jishukisei Taisei tou Minkan Kikan no Yakuwari to Sono Unyou Keiken: Nihon nitotteno Shisa (Role of Private Institutions in the US Industry Self Regulation of Nuclear Safety and Their Operating Experience: Implications for Japan)*, 3 *Shakai Gijutsu Kenkyu Ronbun Shu (Sociotechnica)* (2005).

Organization Act was set up in September in 2012. The NRC is administrative committee based on article 3 of the National Government Organization Act and located in the Ministry of Environment, separated from the Ministry of Trade Economy and Industry in charge of nuclear energy promotion. In that sense, the NRC has more independent status than before. In addition, the NRC incorporated both the former NISA, the former NSC, and functions related to the Radiation Council and nuclear non-proliferation/ security. In that sense, the NRC integrated human resource which had been scattered before, even though the JNES (Japan Nuclear Energy Safety Organization) still remains as an independent administrative organization. But whether the new NRC can implement effective regulations or not depends on the operational management and human resource development strategy of this new organization.

<Table 1> Dispersion of Regulatory Agencies/ Institutions

	Organization	Num	
1	NSC (Nuclear Safety Commission)	100	*2
2	NISA (Nuclear and Industrial Safety Agency) of METI (Ministry of Economy, Trade and Industry)	330	*3
3	JNES (Japan Nuclear Energy Safety Organization)	450	*2
4	AIST (National Institute of Advanced Industrial Science and Technology)	35	*1
5	Nuclear Safety Association	80	*2
6	MEXT (Ministry of Education, , Culture and Sports Science and Technology) Policy Bureau	75	*1
7	MEXT R&D Bureau - safeguard	40	*1
8	JAEA (Japan Atomic Energy Agency)	200	*1
9	Nuclear Safety Tech Center	150	*3

10	Secretariat of Radiation Council	5	*2
11	Japan Radioisotope Association	20	*1
12	National Inst of Radiological Sciences	50	*1
13	Nuclear Material Management Center	165	*2
	Total	1700	

*1 : Direct Employee

*2 : Including Indirect Employee/ Management

*3 : Unclear

<References>

Hiromi Arisawa, Kihon Hou no Kaisei to Korekara no Genshiryoku Gyousei (Revision of the Basic Law and Future Nuclear Energy Administration) 5 (1977).

Genshiryoku Anzen Inkai (The Nuclear Safety Commission of Japan), Genshiryoku Anzen Nenpou Shouwa 51 nen (Annual Report of Nuclear Safety 1981) (1981).

Genshiryoku Anzen Inkai (The Nuclear Safety Commission of Japan), Genshiryoku Anzen Hakusho Heisei 14 nen (White Paper on Nuclear Safety 2002) (2002).

Genshiryoku Journalist no Kai (Forum of Nuclear Energy Journalists), Journalist no Shougen: Genshiryoku 25 nen no Kiseki (Testimonies of Journalists: Trajectory of Nuclear Energy for 25 Years) (1981).

Masatsugu Ito, Nihon Gata Gyousei Inkai no Keisei: Soshiki to Seido no Gyousei Shi (Formation of Japanese Model of Administrative Committee System: Administrative History of Organization and Institution) (2003)

Toshiya Kitayama, Genshiroku Kantoku Taisei no Sasshin (Reform of Supervisory Framework of Nuclear Energy) (Masaru Mabuchi & Toshiya Kitayama eds., Seikai Saihen Ji no Seisaku Katei (Policy Process at the Time of Political Realignment 2008).

Hideaki Shiroyama, Genshiryoku Anzen Inkai no Genjo to Kadai (Current Status and Issues of Nuclear Safety Commission), 1399 Jurist (2010).

Tatsujiro Suzuki, Hideaki Shiroyama & Setsuo Takei, Genshiryoku Anzen Kisei niokeru Beikoku Sangyokukai no Jishukisei Taisei tou Minkan Kikan no Yakuwari to Sono Unyou Keiken: Nihon nitotteno Shisa (Role of Private Institutions in the US Industry Self Regulation of Nuclear Safety and Their Operating Experience: Implications for Japan), 3 Shakai Gijutsu Kenkyu Ronbun Shu (Sociotechnica) (2005).

Tatsujiro Suzuki, Hideaki Shiroyama & Setsuo Takei, Anzen Kisei niokeru “Dokuritsu” to Shakaiteki Shinrai – Beikoku Genshiryoku Kisei Iinkai wo Sozai toshite (“Independence” and Social Trust in Safety Regulation: the Case of Nuclear Regulatory Commission in the US), 4 Shakai Gijutsu Kenkyu Ronbun Shu (Sociotechnica) (2006).

Tokyo Denryoku Fukushima Genshiryoku Hatsudensho niokeru Jiko Chousa Kensho Iinkai (Investigation Committee on Accident of Tokyo Electric Power Company Fukushima Power Plant), Chukan Hokoku (Interim Report) (December 26, 2011).