V. Items to be Considered in Terms of Prevention of Accidents and Expansion of Damage

This Chapter, subsequent to Chapter VI of the Interim Report, provides details of scientific findings concerning earthquakes and tsunami along the Japan Trench, regulatory approach to severe accidents (SA), the details of the discussion in building existing nuclear disaster response structure, international laws and standards, and organizations involved in nuclear safety regulation.

Before going to the main topics, this Chapter provides an overview of the safety standards of the International Atomic Energy Agency (IAEA), which is closely concerned with SA countermeasures and other items[1].

1. Safety Standards of the International Atomic Energy Agency (IAEA)

Based on the IAEA Statute, the IAEA establishes nuclear safety standards and other guidelines and carries out activities to ensure nuclear safety, including the promotion of intergovernmental legal instruments concerning nuclear safety[2]. The nuclear safety standards are formulated[3] as the IAEA Safety Standards, and they contribute to international consensus building and development of each country's national laws and regulations concerning safety standards[4].

The IAEA safety standards since 1996 are organized in three layers: safety fundamentals, safety requirements, and safety guides (Figures V-1 and V-2), and cover five categories: general safety, nuclear safety, radiation safety, waste safety, and transport safety. Of these categories, four areas excluding general safety are dealt with by the Nuclear Safety Standard Committee (NUSSC), Radiation Safety Standard Committee (RASSC), Waste Safety Standard Committee (WASSC), and Transport Safety Standard Committee (TRANSSC), respectively. These committees are in charge of reviewing draft safety standards concerning their respective areas of expertise. After going through reviews at the four aforementioned committees, these draft safety standards undergo final reviews at the Commission on Safety Standards (CSS) and are

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1 For details of Japan's nuclear safety regulations, see Chapter VI 1. of the Interim Report.
2 For details, see the Statute of the IAEA (http://www.iaea.org/About/statute.html).
3 Pursuant to the IAEA Statute III A 6, concerning the authority to establish international safety standards.
4 Besides the IAEA Safety Standards, IAEA also establishes technical documents (TECDOC, Guidelines, etc.), which serve as a technical basis for the Safety Standards or guidelines for safety review services.

approved following the established procedures (Figure V-3). IAEA Safety standards cover general safety, nuclear safety, radiation safety, transport safety, and waste safety, and these are coded GS, NS, RS, WS and TS respectively. Also, Draft Standard and Document Preparation Profile are coded DS and DPP, respectively.

Fig. V-1. Classification of the IAEA Safety Standards

Source: JNES, *Report of FY2009 Investigation concerning the International Safety Standards for Nuclear Facilities* (August 2011).

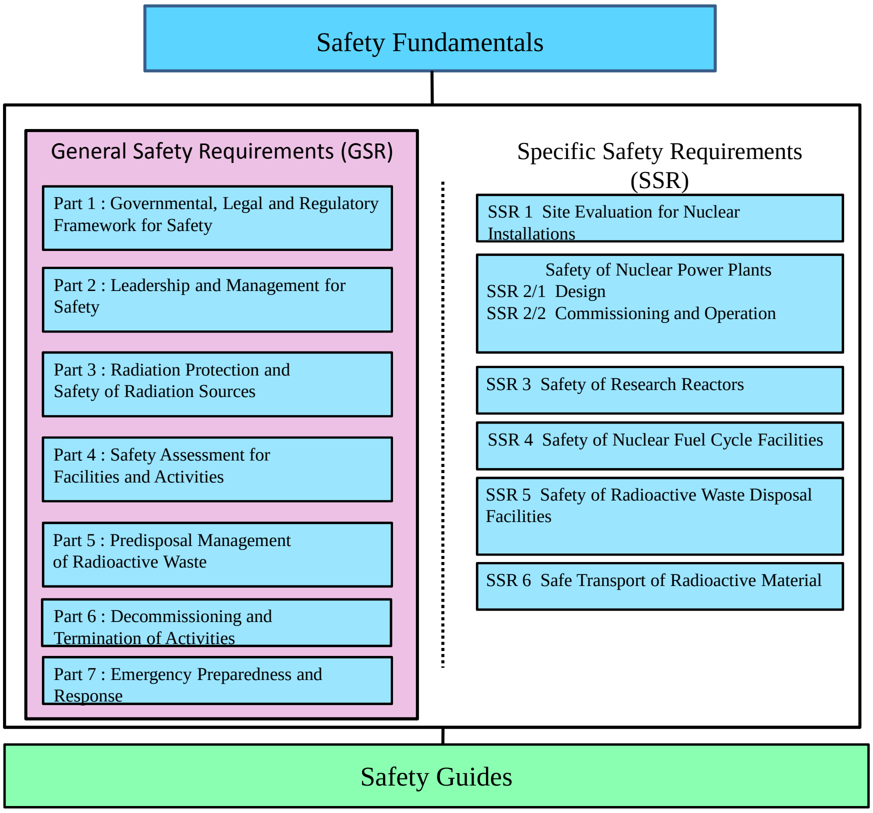

Fig. V-2. Long-term structure of the IAEA Safety Standards

Source: NISA, *31st Meeting of the IAEA Commission on Safety Standards (CSS)* (Document No.1 from the 20th Meeting of the Nuclear Safety Commission) (April 26, 2012).

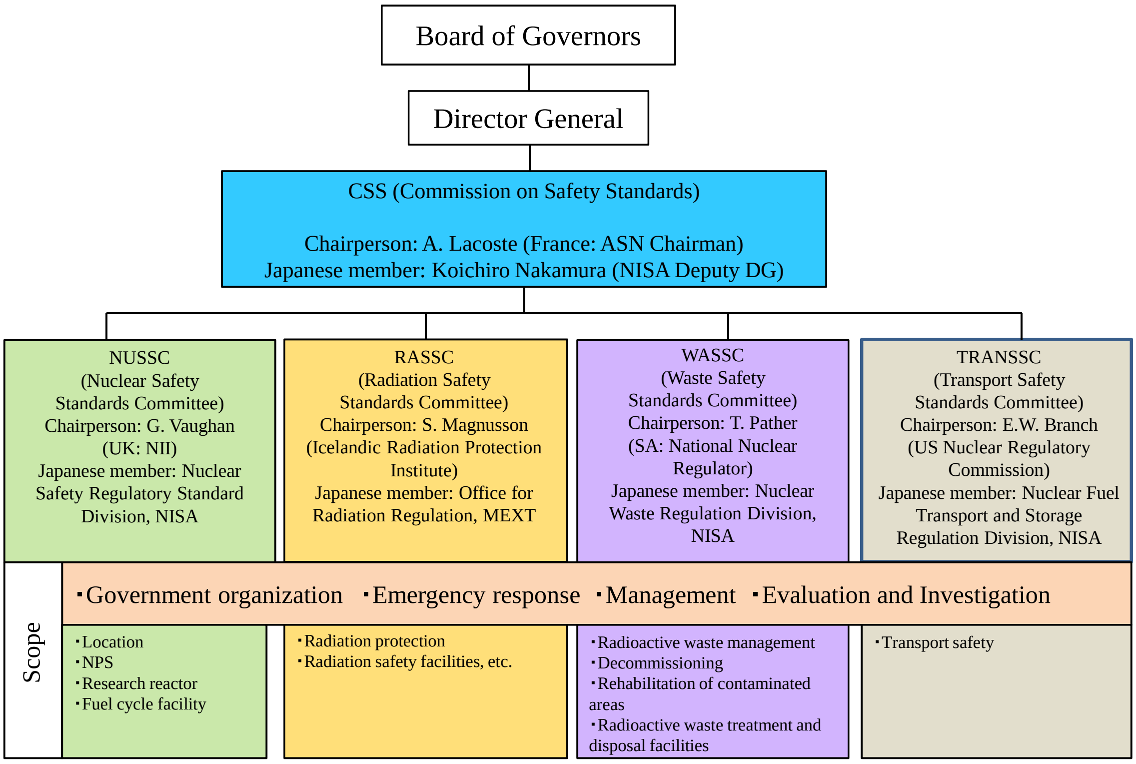

Fig. V-3. Organizations for the IAEA Safety Standards (June 2011)

Notes: ASN = L'Autorité de sûreté nucléaire; NII = Nuclear Installations Inspectorate. UK = United Kingdom; NISA = Nuclear and Industrial Safety Agency; MEXT = Ministry of Education, Culture, Sports, Science and Technology; SA = South Africa.

Source: NISA, *29th Meeting of the IAEA Commission on Safety Standards (CSS)* (Document No.5 from the 43rd Meeting of the Nuclear Safety Commission) (June 16, 2011) (excluding Notes).

Table V-1 lists major IAEA Safety Standards in publication. Member States are not obliged to adopt the IAEA Safety Standards for use in national regulations: Member States are allowed to decide at their own discretion whether or not to adopt the standards in their national regulatory scheme. Nevertheless, as the IAEA Safety Standards is intended to be used for IAEA's own operations, the safety fundamentals and safety requirements are written as "shall" statements (obligations), and the safety guides are written as "should" statements (recommendations)[5].

[5] Safety Fundamentals and Safety Requirements are approved by the IAEA Board of Governors, while Safety Guides are approved by the IAEA Director General.

Table V-1. Major IAEA Safety Standards Series in publication (*1)

Classification under the new system(*2)		Document number	Document name	Year of publication and other information
Safety Fundamental	SF-1	SF-1	Fundamental Safety Principles	2006
General Safety Requirements (GSRs)	GSR Part 1	GSR Part 1	Governmental, Legal and Regulatory Framework for Safety	2010
		GS-R-1	*Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety*	*2000 (Renewed as GSR Part 1)*
	GSR Part 2	GS-R-3	The Management System for Facilities and Activities	2006
	GSR Part 7	GS-R-2	Preparedness and Response for a Nuclear or Radiological Emergency	2002
Specific Safety Requirements (SSRs)	SSR-1	NS-R-3	Site Evaluation for Nuclear Installations Safety Requirements	2003
	SSR-2/1	*SSR-2/1(*3)*	*Safety of Nuclear Power Plants: Design*	*2012*
		NS-R-1(*3)	Safety of Nuclear Power Plants: Design	2000
	SSR-2/2	*SSR-2/2(*4)*	*Safety of Nuclear Power Plants: Commissioning and Operation*	*2011*
		NS-R-2(*4)	Safety of Nuclear Power Plants: Operation	2000
General Safety Guides (GSGs)	S1(*5)	GSG-2(*6)	Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency	2011
Specific Safety Guides (SSGs)	S2(*5)	SSG-9	Seismic Hazards in Site Evaluation for Nuclear Installations	2010
		NS-G-3.3	*Evaluation of Seismic Hazards for Nuclear Power Plants*	*2003 (Renewed as SSG-)*
		*SSG-18 (*7)*	*Meteorological and Hydrological Hazards in Site Evaluation for Nuclear Installations*	*2011*
		NS-G-3.4 (*7)	Meteorological Events in Site Evaluation for Nuclear Power Plants	2003
		NS-G-3.5 (*7)	Flood Hazard for Nuclear Power Plants on Coastal and River Sites	2003
		NS-G-2.15	Severe Accident Management Programmes for Nuclear Power Plants	2009

*1 For details, see the IAEA's List of all valid Safety Standards (http://www-ns.iaea.org/standards/documents/), JNES's IAEA Safety Standards Database (http://www.jnes.go.jp/database/iaea/iaea-ss.html) (in Japanese).

*2 Following the publication of the Fundamental Safety Principles (SF-1) in 2006, the Safety Standards has been gradually reorganized into a new structure, in consideration of the ways not to hinder the operation of the existing system.

*3 SSR-2/1 was published in July 2011. As of March 11, 2011, NS-R-1 was the valid Safety Requirement.

*4 SSR-2/2 was published in February 2012. As of March 11, 2011, NS-R-2 was the valid Safety Requirement.

*5 S1 refers to Safety Guides applied to all types of nuclear facility and activity, and S2 refers to Safety Guides for nuclear power plants.

*6 GSG-2 was published on March 17, 2011. As of March 11, 2011, GSG-2 was still under preparation.

*7 SSG-18 was published in December 2011. As of March 11, 2011, NS-G-3.4 and NS-G-3.5 were the valid Safety Guides (see 5. (1) c. in this Chapter).

The following is the precise procedure for establishing IAEA Safety Standards. It generally takes two to three years to publish one safety standard document, starting from planning[6].

i. Proposal of a Document Preparation Profile

ii. Approval of the Document Preparation Profile by the respective safety standard committees

iii. Approval of the Document Preparation Profile by the CSS

iv. Drafting of a Draft Standard

v. Primary approval of the Draft Standard by the respective safety standard committees (approval for submission to Member States for comments)

vi. Submission to Member States for comments

vii. Approval of the revised Draft Standard by the respective safety standard committees

viii. Approval by the CSS

ix. Approval by the IAEA Board of Governors (or Director General)

Japan regards the IAEA Safety Standards as a reference in promoting coherent regulation in harmony with international practices, and has been contributing in various ways to the review of the standards[7]. In Japan, the Nuclear and Industrial Safety Agency (NISA) plays a central role in dealing with the establishment of the IAEA Safety Standards. NISA's Technical and Scientific Support Organization, Japan Nuclear Energy Safety Organization (JNES), holds meetings entitled "IAEA Safety Standards Review Panel" with the Nuclear Safety Commission (NSC), the Ministry of Education, Culture, Sports, Science and Technology (MEXT), NISA, and the Ministry of Land, Infrastructure and Tourism (MLIT) (Figure V-4). NISA and JNES also hold meetings with the NSC and the MEXT to discuss policies for the CSS meetings.

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[6] JNES, Report of FY2009 Investigation concerning the International Safety Standards of Nuclear Facilities (August 2011).

[7] Framework for Nuclear Energy Policy (approved on October 11, 2005 by the Atomic Energy Commission, and on October 14, 2005 by the Cabinet). Section 5-2-3 of the Framework (Participation in and Cooperation with International Organizations) states, "Japan should… continue active participation in their activities, with due consideration to the importance of involvement from the early stages such as the planning stage;" "It is important to actively participate in the international conferences… and in the development of standards, policies, etc."

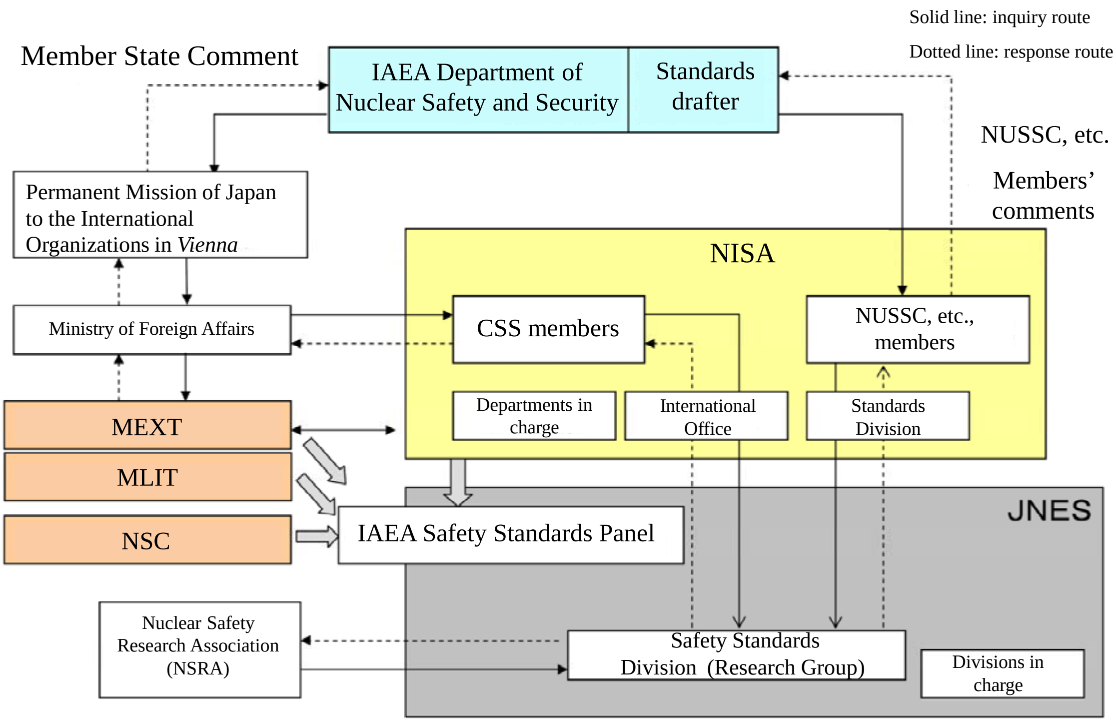

Fig. V-4. Secretariat of the IAEA Safety Standards Review Panel, involving the NSC, MEXT, NISA, and MLIT

Note: International Office refers to International Affairs Office, Policy Planning and Coordination Division, NISA; Standard Division refers to NISA's Nuclear Safety Regulatory Standard Division, and IAEA Safety Standards Panel refers to IAEA International Safety Standards Review Panel. JNES's Safety Standards Division (Research Group) initially acted as the Secretariat of the Panel, but the function of the Secretariat is currently performed by JNES's Policy Planning and Coordination Department (Safety Standards and Rulemaking Coordination Group) and Nuclear Fuel Cycle and Radioactive Waste Management Safety Department (Planning Group) following the FY2008 reorganization. Nuclear Safety Research Association (NSRA) was an incorporated foundation under the jurisdiction of the MEXT and the Ministry of Economy, Trade and Industry (METI) (became a public interest incorporated foundation on April 1, 2011).

Source: JNES, *Trends of the Development of International Nuclear Safety Standards and JNES's Policies* (Document No.2 from the 18th meeting of the NSC Special Committee on Nuclear Safety Research) (November 6, 2007) (Excluding Note).

2. Scientific Findings Concerning Earthquakes and Tsunami along the Japan Trench

(1) Opinions of seismologists concerning earthquakes and tsunami along the Japan Trench before the 2011 Tohoku Region Pacific Coast Earthquake

As mentioned in Chapter VI 3. (6) b. of the Interim Report, several evaluations have been conducted by relevant administrative agencies concerning tsunami that may affect the Pacific coasts of Hokkaido and Tohoku Region. The Headquarters for Earthquake Research Promotion (hereafter the “Promotion Headquarters”) produced the report “The Long-term Evaluation of Seismic Activities in the Region from Sanriku-oki to Boso-oki” (hereafter the “Long-term Evaluation”) in July 2002, and the Central Disaster Management Council produced the report “Committee for Technical Investigation on Counter-Measures for the Trench-type Earthquakes in the vicinity of the Japan Trench and Chishima Trench” (hereafter the “Central Disaster Investigation Committee Report”) in 2006. While the Long-term Evaluation pointed out the possibility of major interplate earthquake (tsunami earthquake) happening anywhere along the Japan Trench from the northern Sanriku-oki to Boso-oki, including the areas with no record that tsunami earthquake had occurred in the past, like the coastal area of Fukushima Prefecture, the Central Disaster Investigation Committee Report excluded the aforementioned tsunami earthquake from the scope of the discussion about disaster countermeasures. In consideration of these facts, the Investigation Committee interviewed several seismologists to know what opinions seismologists had concerning earthquakes and tsunamis before the Tohoku Region Pacific Coast Earthquake, and confirmed largely consistent views among seismologists on this matter as follows.

Hypocenters along the Japan Trench were divided into the offshore-near trench zone and the land-side zone, as shown in the hypocenter zone chart in the Long-term Evaluation (Figure V-5). The hypocenters in the land-side zone are further divided into several segments.

First of all, generally speaking, it was not expected that an M9-class earthquake would happen in the zones along the Japan Trench. Many seismologists accepted the hypothesis, based on the “relative plate convergence theory”, that M9-class earthquakes occur along young plates with relatively low density and an obtuse angle; in other words, plates that have just begun converging, as in the case of the coastal areas of Chili and Alaska.

While the “relative plate convergence theory” was accepted by many seismologists, there was also a generally accepted opinion that earthquakes repeat past patterns and that what had not happened in the past would not happen in the future. For this reason, as of 2002, earthquakes that might occur off the coast of Fukushima Prefecture were expected to be of

M7.5-class at the very most in the land-side zone, such as the 1938 Fukushima-ken Toho-oki Earthquake which occurred off the coast of Shioyasaki, based on the historical record of the past four centuries. From around 2008, the tsunami source model of the ninth-century Jogan Earthquake was gradually taking shape but uncertainties were included in the scale of the tsunami that reached the coastal areas of Fukushima Prefecture in the wake of the Jogan Earthquake and in the geographic extent of the seismic source.

Meanwhile, with regard to tsunami earthquakes in the offshore zone near the Japan Trench, opinions were split between those supposing that an M8-class earthquake could occur anywhere along the coast from Sanriku-oki to Boso-oki, as suggested in the Long-term Evaluation, and those supporting the conventional theory that this would occur in the specific areas alone. Dr. Kunihiko Shimazaki, the Chair of the Coordinating Committee for Earthquake Prediction (CCEP), supported the former opinion that an M8-class earthquake could occur anywhere along the coast from Sanriku-oki to Boso-oki. Dr. Shimazaki argued that, as the historical record covered only a very limited time span, there was no reason to deny the possibility of a tsunami earthquake occurring off the coast of Fukushima Prefecture. "As tsunami earthquakes occur where plate adherence is weak," he said, "the relative plate convergence theory, which holds that the age of plate determines the degree of adherence, cannot be applied to tsunami earthquake." Dr. Shimazaki concluded that a tsunami earthquake of such scale could happen anywhere along the coast from Sanriku-oki to Boso-oki, regardless of the age of the plate in each region[8]. On the other hand, in light of the divided opinions concerning the possibility of tsunami earthquake occurring in the said area, Japan Society of Civil Engineers (JSCE)[9], was studying the probabilistic tsunami hazard assessment. This was a follow-up study to the Tsunami Assessment Method for Nuclear Power Plants in Japan (hereafter "Tsunami Assessment Method") formulated in February 2002. The tsunami assessment method used a logic tree incorporating tsunami occurrence patterns for both cases: the case that it might occur anywhere between Sanriku-oki and Boso-oki and the case that it could only occur in specific

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8 Dr. Shimazaki retracted this theory after the 3.11 earthquake, since the earthquake resulted in tsunami despite the strong plate adherence. Currently, Dr. Shimazaki admits that the mechanism is unresolved as to the occurrence of tsunami earthquake.

9 As mentioned in Chapter VI 3. (3) of the Interim Report, the JSCE formulated the Tsunami Assessment Method for Nuclear Power Plants in Japan in February 2002.

areas[10].

The 2011 Tohoku Region Pacific Coast Earthquake is currently regarded by some as a combination of two types of earthquake tsunami that were hitherto studied separately: the Meiji Sanriku Earthquake-type tsunami occurring further south towards the Japan Trench, and the Jogan Earthquake-type tsunami occurring nearer the coast. However, it was not envisaged in academic circles that the two types of tsunami would happen simultaneously. As far as chain-reaction earthquakes are concerned, the 2004 Sumatra–Andaman Earthquake and the earthquakes along the Nankai Trough were examples of several earthquakes occurring in series in the land-side zone. In fact, the Tohoku Region Pacific Coast Earthquake was the first actual case in which two tsunami earthquakes were supposed to have occurred simultaneously in the offshore zone near the ocean trench and in the land-side zone.

[10] As stated in Chapter VI 5. (1) i. of the Interim Report, Tokyo Electric Power Company (TEPCO) conducted risk assessment for the Fukushima Dai-ichi Nuclear Power Station based on the result of JSCE's probabilistic tsunami hazard analysis. However, TEPCO concluded that, as the probability of tsunami exceeding the design basis tsunami was of the order of 10-4/year, the risk incurred by tsunami is not high from the viewpoint of core damage frequency (CDF).

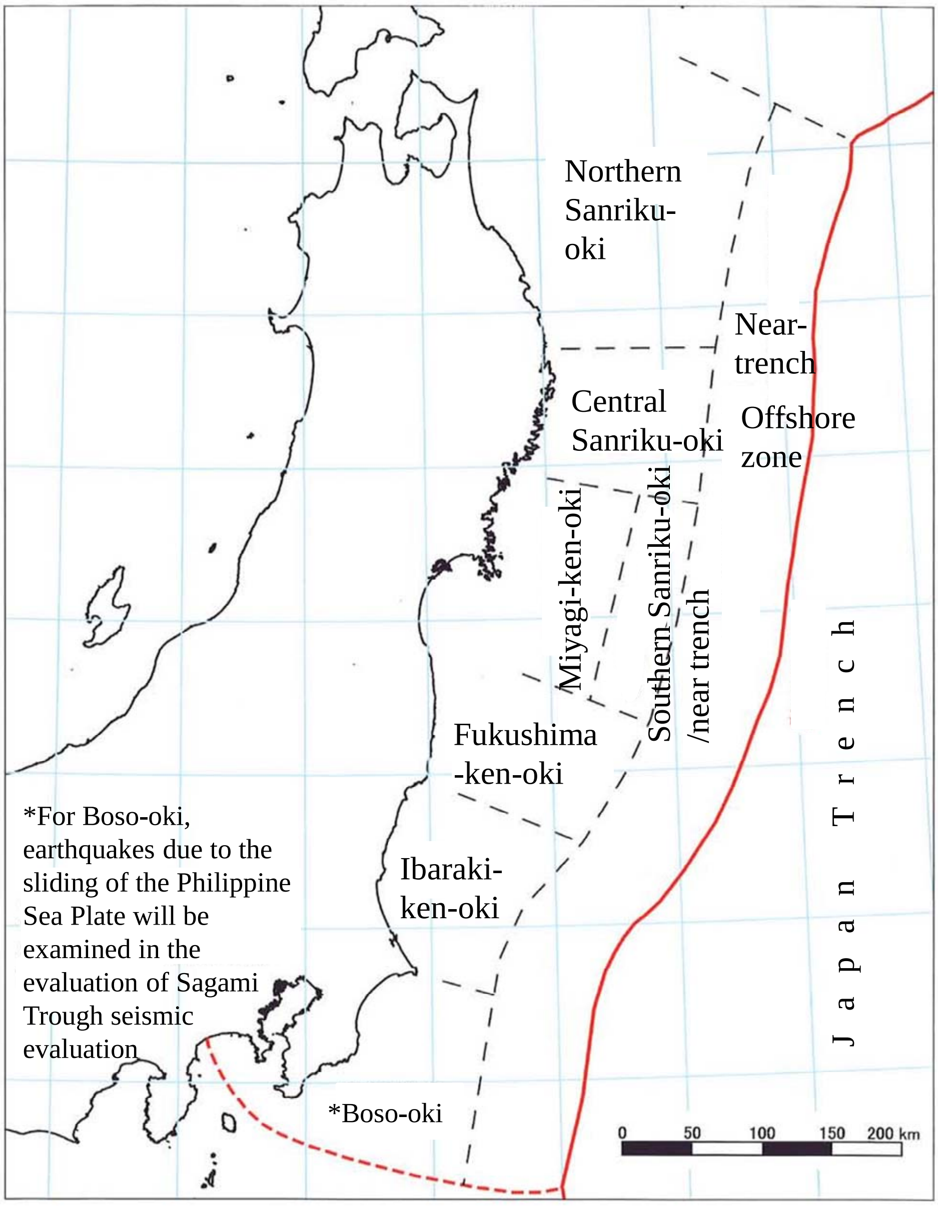

Fig. V-5. Zones for evaluation from northern Sanriku-oki to Boso-oki

Source: Headquarters for Earthquake Research Promotion, *The Long-term Evaluation of Seismic Activities in the Region from Sanriku-oki to Boso-oki* (July 31, 2002)

(2) Details leading to the exclusion of tsunami earthquakes suggested by the Long-term Evaluation from the discussion of disaster countermeasures at the Central Disaster Management Council

As mentioned in (1) above, the Long-term Evaluation pointed out the possibility of large-scale interplate earthquakes (tsunami earthquake) occurring anywhere along the ocean trench from northern Sanriku-oki to Boso-oki, including areas like offshore Fukushima where there was no historical record of tsunami earthquake[11]. However, the Central Disaster Investigation Committee Report excluded this type of earthquake from the scope of discussion about disaster countermeasures. The Central Disaster Management Council convened a panel of experts for investigating ocean-trench earthquakes occurring near the Japan Trench and the Chishima Trench 17 times from October 2003 to January 2006, and produced a report based on the discussion at the meetings. At the second panel meeting, the secretariat of the Council (hereafter the "Secretariat") submitted a proposal as to what types of earthquakes should be included in the scope of discussion about disaster countermeasures (hereafter "earthquakes for disaster countermeasures"). It was not until the 10th meeting that the earthquake for disaster countermeasures was finalized.

At the second meeting, the Secretariat proposed to divide the zone along the Chishima Trench and the Japan Trench into (i) zone with history of frequent large-scale earthquakes, (ii) zone with very few large-scale earthquakes, and (iii) zone with no past record of large-scale earthquake, and to include earthquakes occurring in (i) and (ii) zones in the scope of disaster countermeasure discussion. Concerning (iii), the conclusion was postponed with the statement, "As there is no past record of large-scale earthquakes, it is impossible to affirm that such an earthquake would happen in the near future. However, with regard to the areas where the possibility of large-scale earthquake cannot be ruled out, this approach will be supplemented or revised as needed based on future research findings." The idea behind this approach was that the same kind of approach was taken in the past in considering Tokai earthquakes. However, the

[11] In creating the Long-term Evaluation in July 2002, several sentences were added to the preface of the Evaluation at the request of the Disaster Management Division of the Cabinet Office, stating, "This evaluation was created using what are thought to be the best methods based on the latest information currently available. However, there are limits for gathering sufficient materials to be used in the evaluation relating to past earthquakes, some errors are included in values used for predictions of the likelihood and the size of an earthquake occurring. This must be kept firmly in mind when using the evaluation results for discussion on disaster countermeasures." The reason why the Cabinet Office asked for this additional sentences was that the text is written as general description based on the results of long-term evaluations taking place all over the country, regardless of the quality and quantity of that data, and there was, as such, the general awareness of a need to differentiate the reliability of the figures representing the likelihood of an earthquake, that is to say, reliable and less reliable. The preface does not refer to the reliability of information with regard to the possibility of a tsunami earthquake occurring in the regions from the northern part of the Sanriku-oki to the marine trenches of the Boso-oki in particular.

difference from Tokai earthquakes was recognized: while the Tokai earthquakes in the past mostly concentrated in the (i) zone, earthquakes along the Japan Trench and Chishima Trench were quite diverse. At the second meeting, it was pointed out that the Long-term Evaluation recognized the possibility of tsunami earthquakes occurring anywhere along the ocean trench from northern Sanriku-oki to Boso-oki, including areas where there was no past record of earthquakes. Many argued that earthquakes occurring in the (iii) zone should also be included in the scope of discussion about disaster countermeasures, from the point of preemptive disaster countermeasures, based on the idea of seismic gap area.

In light of these opinions, the Secretariat decided to reconsider the scope of earthquakes for disaster countermeasures. Later, at the third meeting, a proposal was submitted to include in the scope of discussion the south side of the seismic center of the Showa Sanriku Earthquake, which constituted the area pinpointed by some panel members at the second meeting as the area requiring a review of possible earthquakes similar to the surrounding areas. However, the Hokkaido working group estimated the scale of tsunami in case of an earthquake in the said area[12], and excluded the earthquakes of that kind from the scope of earthquakes for disaster countermeasures, on the grounds that "there is no sufficient scientific knowledge about the possibility of its occurrence." The final Central Disaster Investigation Committee Report stated that selection of earthquakes for disaster countermeasures would be considered based on the earthquakes that actually occurred in the past, as a basic policy. Concerning earthquakes for which seismic pattern was not made clear enough to establish a tsunami simulation model, the Report stated that it would discuss how to deal with this subject waiting for the progress to be made in the investigation of tsunami deposits.

Regarding the reason for taking such an approach, the Secretariat explains that once the scope of disaster countermeasures is decided through a series of discussion, next comes the legal obligation to formulate corresponding disaster countermeasure plans, and this kind of administrative action would require persuasive and sufficient grounds. It explains why the Hokkaido working group determined the scope of earthquakes for disaster countermeasures

[12] The same working group examined the tsunamsi generated by the Meiji Sanriku Earthquake (1896), Showa Sanriku Earthquake (1933), and other earthquakes, in addition to ocean-trench earthquakes occurring near Hokkaido. For each of these earthquakes, the working group examined the fault model and other elements.

after having re-examined fault model, instead of directly importing the outcome of the Long-term Evaluation. The group needed to use a reliable fault model as a basis, in order to make the report persuasive enough to demand administrative action. The Long-term Evaluation only indicated the probability of occurrence but showed no specific fault model. In addition, scientific findings obtained after the release of the Long-term Evaluation were included as an additional reference in the process of discussion.

(3) Response to TEPCO's request to modify expressions upon the revision of the Long-term Evaluation

As mentioned in Chapter VI 3. (8) c. (b) of the Interim Report, upon the revision of the Long-term Evaluation, TEPCO asked the MEXT[13] on March 3, 2011, concerning the main text, "to describe the Jogan Sanriku-oki Earthquake as an earthquake whose seismic source has not been identified yet, and to think of modifying part of the expressions describing the Jogan Sanriku-oki Earthquake because the text in the draft revision reads as if the earthquakes had frequently occurred."

To this request, MEXT responded that it would consider modifying expressions that might be potentially misleading, for the sake of clarity. This was due to the judgment, as the secretariat of the Promotion Headquarters, that expressions potentially misleading should be reconsidered to make them easier to be understood, without changing factual information based on scientific findings. The text as of March 3, 2011 was completely rewritten following the Tohoku Region Pacific Coast Earthquake of March 11, 2011, and was released in November of the same year. With regard to the relation with the Jogan Earthquake, the report states that it was an earthquake of the same type as the Tohoku Region Pacific Coast Earthquake that repeats with the average interval of about 600 years. The revision was made without reflecting TEPCO's request.

3. Countermeasures against severe accidents

This section outlines the technical progress of probabilistic safety assessment (PSA), a method accepted as being useful in considering severe accident (SA) countermeasures. As detailed in Chapter VI 4. (1) a. (c) of the Interim Report, SA countermeasures developed since

[13] MEXT serves as the secretariat of the Headquarters for Earthquake Research Promotion.

1992 focused only on internal events. This section also explain the background leading to the decision to leave out accident management (AM) for external events such as earthquakes, as detailed in Chapter VI 4. (3) - (6) of the Interim Report.

Furthermore, concerning station blackout (SBO) included in the scope of SA countermeasures, this section explains how TEPCO assessed SBO durability at 8 hours in the Abnormal Operating Procedures (event base) for the Fukushima Dai-ichi Nuclear Power Station (hereafter "Fukushima Dai-ichi NPS"), as detailed in Chapter VI 4. (1) b. of the Interim Report. It also refers to security measures[14] taken in the United States (U.S.) Nuclear Regulation Commission (NRC), the so-called "B.5.b[15]."

(1) Technical level of probabilistic safety assessment (PSA) for accidents due to earthquakes

The PSA method had not been established in Japan as of 1992 for accidents arising from external events such as earthquakes. PSA Review Working Group was established under the Common Issues Discussion Group of NSC (see Interim Report Chapter VI 4. (2) b.) to review the knowledge related to PSA methodologies of the time and examine SA countermeasures for the reactor containment vessel. The Common Issues Discussion Group and the PSA Review Working Group took up the NRC Report, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants (NUREG-1150)" (December 1990) (hereafter "NUREG-1150"), with

[14] In Japan, nuclear security refers to "protection, detection and response to criminal acts or acts of deliberate violations against nuclear materials, other radioactive materials, related facilities and activities including transport," according to the report, "Strengthening of Japan's Nuclear Security Measures" (submitted by the JAEC Advisory Committee on Nuclear Security on March 9, 2012).

In Japan, regarding the policies on the use of nuclear energy, the NSC handles those concerning regulations for ensuring safety, while the AEC handles those concerning measures for nuclear security.

As to nuclear security in Japan, AEC made decision to (i) become a party to the Convention on the Physical Protection of Nuclear Material (CPPNM) and (ii) develop necessary legislations for becoming a party to the said Convention in 1987, after going through the discussion about joining the CPPNM. Following this decision, the Government partially amended the Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors (hereafter the "Nuclear Reactor Regulation Act"), and joined the CPPNM in November 1988. The framework for the protection of nuclear materials in Japan consists of international agreements such as the CPPNM, and the Nuclear Reactor Regulation Act, which serves as a domestic legislation. International commitments here consist of (i) the CPPNM (INFCIRC/274/Rev.1 of 1980 and the revised CPPNM of 2005 (GOV/INF/2005/10-GC(49)INF/6)), (ii) IAEA's "Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities" (INFCIRC/225), and (iii) bilateral agreements.

[15] Section B.5.b. of the NRC's "Order for Interim Safeguards and Security Compensatory Measures," issued on February 25, 2002 to the power plant operators following the terrorist attacks of September 11, 2001. As mentioned in (3) b. in the later section, the content of the document, including the existence of section B.5.b., was not made public as of 2002.

regard to PSA for external events such as earthquakes[16].

NUREG-1150 reviewed probabilistic risk assessments (PRAs) for five nuclear power plants[17]. Among them, two power plants underwent core damage frequency (CDF) analysis for a broad range of external events, including lightning, aircraft impact, tornados, and volcanic activities. As a result, earthquakes and fire were found to be potentially major contributors to the CDF and thus were analyzed in detail. Concerning the seismic analysis for Surry Nuclear Power Station, there is a statement that a site-specific contributor to the CDF is: the failure of anchorage welds of the buses for supplying emergency AC power from the offsite power as well as emergency power; the failure of the diesel generators and associated load center anchorage failures. The report states that these welded anchorages do not have sufficient margin to withstand (with high reliability) earthquakes in the range of four times the safe shutdown earthquake (SSE[18]) level[19].

Dr. Shunsuke Kondo, Professor of Engineering at the University of Tokyo, who chaired the PSA Study Working Group at that time (current Chairman of JAEC; hereafter "Chairman Kondo[20]") replied at the Investigation Committee hearing concerning this matter. Chairman Kondo said, "Although NUREG-1150 states that an earthquake with the strength four times the SSE might result in power failures, we thought that the outcome of the AM assessment based on internal event PSA could be used even in the case of earthquake, as long as plant state does not go over the cliff-edge."

In September 2000, the NSC established the Special Committee on Safety Goals to study and discuss safety goals. The Committee aimed to discuss important matters related to safety goals, including setting quantitative goals using the PSA and other available means. The first meeting of the Special Committee was held in February 2001, and it was decided to release expert views

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[16] The draft of NUREG-1150 was released in 1987. It has been confirmed that "Comments to NUREG-1150" dated August 1987 states, "Considering the extent of uncertainty concerning external events such as earthquakes, as well as the variation of the outcome of sensibility analysis…" The said document was used as Document 2-3 in the second meeting of the Common Issues Discussion Group (Committee on Examination of Reactor Safety).

[17] As explained in Chapter VI 4. (1) a. (c) of the Interim Report, what Japan calls "probabilistic safety assessment (PSA)" is called "probabilistic risk assessment (PRA)" in the United States.

[18] Safe shutdown earthquake (SSE) and operating basis earthquake (OBE) are defined in the U.S. the Code of Federal Regulations (CFR 10-50).

[19] See 8.4.4. of NUREG-1150.

[20] Chairman Kondo also chaired the Drafting Working Group, which had been established under the Common Issues Discussion Group to formulate a draft of the interim report of the said Discussion Group.

on risk and safety goals from the subsequent meeting. At the second meeting in April 2001, Dr. Seiji Abe, the then Director of Department of Reactor Safety Research at the Japan Atomic Energy Agency (JAEA) Tokai Research and Development Center presented a document entitled, "Overview of the Probabilistic Safety Assessment and Items to be Discussed for Establishing Safety Goals." The procedure for seismic PSA was described in the document. In this way, discussion at the meetings was based on individual plant examination for external events (IPEEE) such as earthquakes.

Chairman Kondo, who chaired the Special Committee on Safety Goals at the time[21] said in the interview: "In the Special Committee discussion, there was no discussion about tsunami. What we discussed about external events at that time besides earthquake were just fires and volcanic activities." To the question, "Don't you think the technical progress of seismic PSA at the time was high enough to be used for developing AM?" Chairman Kondo answered, "Yes, we were at that stage." To the question, "Don't you think it was possible to propose the development of AM based on seismic PSA?" He answered, "We could have made such a decision. The question was when to make that decision. With regard to seismic PSA, we intended to start it on the occasion of the periodical safety review (PSR)[22]. Although the first-round PSR reviewed only internal event PSA, we had no choice about that, I intended to include external event PSA in the second-round PSR 10 years later. On that premise, I asked the people concerned (the PSA researchers) to prepare the methodology of external event PSA."

As is noted in Chapter VI 4. (4) g. of the Interim Report, the Special Committee on Safety Goals approved the report "Interim Report on the Discussion about Safety Goals" at the meeting in December 2003. The report took up external events, such as earthquake and tsunami, flood, and aircraft impact, as the subjects to be reviewed and proposed a provisional safety goal that the health risk resulting from the use of nuclear energy should not exceed around 10^{-6}/year. Chairman Kondo made comments on the discussion led by the Special Committee, stating, "I regarded safety goals as the topmost priority issue, and discussed the issue at the Special Committee on Safety Goals." "The issue was left behind in the course of the discussion after the

[21] Chairman Kondo chaired the Special Committee on Safety Goals from February 2001 to January 2004. As of 2001, Chairman Kondo was also the chair of the Nuclear and Industrial Safety Subcommittee under the Ministry of Economy, Trade and Industry (METI) Advisory Committee for Natural Resources and Energy.

[22] See Interim Report Chapter VI 4. (4) b.

interim report of December 2003 was produced. I don't understand the NSC's approach on this matter. No matter what it is, let alone earthquakes, it is said that the alpha and omega of nuclear safety is to think 'How safe is safe enough?'[23] I don't understand why the NSC didn't give priority to this concept."

Later, the Atomic Energy Society of Japan (AESJ) Standards Committee established the Seismic PSA Subcommittee at the meeting of the Power Reactor Technical Committee held in May 2004[24]. The Subcommittee started discussion for establishing academic standards for seismic PSA.

Meanwhile, the Nuclear and Industrial Safety Subcommittee of the METI's Advisory Committee for Natural Resources and Energy established the Study Group on Use of Risk Information in December 2004. The Study Group was commissioned a task: to discuss "Basic Ideas Concerning the Use of Risk Information in Nuclear Safety Regulation (Draft)"; formulate an action plan concerning the use of risk information; consider developing the guidelines required for regulation. The development status of private sector codes (PSA methodology) in the United States and Japan was reported on at the first Study Group meeting held in February

[23] In terms of his way of thinking about the safety goals, Chairman Kondo said, "The experts, who were not involved in nuclear-related activities, criticized the approach of setting probabilistic safety goals as benchmarks to determine the adequacy of safety measures, saying that we should be prepared for the worst possible case wherever the disaster potential is high, and that it is a mistake to disregard worst case scenario because of low probability. In the face of this criticism, we answered, 'Speaking of worst case scenario, the scenario itself is predicted based on a certain probability. So no matter what the worst case scenario you may offer, I am sure we can come up with even worse scenario.' Our stance was that 'How safe is safe enough?' could only be determined by repeating the process of gathering data on failures and abnormal incidents, making to the best of our knowledge a list of scenarios leading to undesirable consequences within the extent that human wisdom can envisage, proposing countermeasures for the scenarios which do not meet goals, reconsidering scenarios based on the modified system, and making further improvements for the scenarios which do not meet the goals. But this process cannot be repeated forever; what will be the basis for determining where to stop is the so-called safety goals. That is what we explained. But then some would say, 'We understand your point, but we hate radiation exposure no matter what. We can't stand unless the probability of large-scale accident is as low as the probability of gigantic meteorite hitting Tokyo.' Since the experts say the probability of such an incident to occur in a year is 1/100,000,000, the discussion continues saying that the safety goals should be set to match such a figure. If the safety measures, which were developed based on this goals, turned out to be insufficient to cope with some very rare accident, we will be obliged to develop safety measures enough to prevent damage even for this very rare accident. And we need to sum up hundreds of such scenarios. So in the end I think 1/1,000,000 is the limit of what the human wisdom can achieve."

[24] The minute of the May 2004 meeting of the Power Reactor Technical Committee says, "The guidelines on seismic safety design will be revised by the end of March 2005 by the NSC. In this context, it is very likely that some form of probabilistic approach would be required for comprehensive seismic safety assessment and for establishment of benchmark seismic motion. Should that be the case, then relevant private codes or standards would be required."

2005. Then, at the second meeting held in March of the same year, the secretariat distributed the document entitled, "Current Status of the PSA Methodology and Data"(JNES), which stated "The development of Level 1-3 PSA methodology as well as available data for internal events and seismic events are being matured from the technical standpoint, although there is a need to advance the PSA techniques by embracing latest findings."

And in March 2007, as described in VI 4. (4) of the Interim Report, the AESJ Standards Committee published the "Implementation Standards for Probabilistic Safety Analysis for Events Induced by Earthquakes at Nuclear Power Stations (2007)" (AESJ-SC-P006: 2007).

(2) The Background of the failure to include external events such as earthquakes in AM

a. Legislation on Periodic Safety Review (PSR)

As stated in VI 4. (4) e. of the Interim Report, in response to TEPCO's misconduct including the falsification of its voluntary inspection record, which NISA made public in August 2002, NISA decided to make PSR a requirement in the operational safety program. In September 2003, NISA revised the Rules for the Installation, Operation, etc. of Commercial Power Reactors to make PSR a legal requirement to be enforced from October 2003[25].

(a) The background of the legislation on PSR

Immediately after NISA made public the TEPCO's falsification of voluntary inspection records on August 29, 2002, NISA set up the Subcommittee for the Institution of Nuclear Safety Regulation ("Safety Regulation Subcommittee") under the Nuclear and Industrial Safety Subcommittee to study nuclear safety regulations and legislation. The subcommittee held its first meeting presided over by the Chair Kondo on September 13, 2002 and examined measures to prevent similar misconduct.

At the Safety Regulation Subcommittee's first and second meetings, the discussion covered problem points related to the misconduct, analysis of causes that acted in the background, selection of issues to be discussed and measures to prevent the misconduct from happening again. PSR was not discussed as a separate topic. At the third meeting on September 26, the

[25] Ordinance of the Ministry of Economy, Trade and Industry No.113 of 2003. Pursuant to article 15-2 of the Rules for the Installation, Operation, etc. of Commercial Power Reactors, following revision.

Secretariat presented a rough draft of Safety Regulation Subcommittee report which shaped previous discussion results into a set of preventive measures against such misconduct, containing material for further discussion. Taking PSR as one of the concrete measures for nuclear operators to prevent the recurrence of misconduct by establishing its quality assurance system for safety-related activities, the rough draft says, "The Periodic Safety Review, which thus far have been carried out on a voluntary basis, should be incorporated into a mechanism for letting nuclear operators conduct assessment of their own activities related to the safety of nuclear power plants on a regular basis and should be prescribed as a requirement in the 'operational safety program." The Safety Regulation Subcommittee did not take up PSR as a separate issue at the subsequent meetings. On October 1, 2002, the subcommittee set out a draft report and, following public comment, published the "Interim Report by the Subcommittee for the Institution for Nuclear Safety Regulation of the Nuclear and Industrial Safety Subcommittee under the Advisory Committee for Natural Resources and Energy" (hereinafter referred to as the "Safety Regulation Subcommittee Interim Report") on October 31, 2002. The Safety Regulation Interim Report says that nuclear operators should establish a quality assurance system for their own safety-related activities, as a specific measure for preventing recurrence of similar misconduct, while leaving the description about PSR as described in the above-mentioned rough draft of Safety Regulation Subcommittee Interim Report.

Subsequently, the Study Group on Inspection Practices[26], which had been discussing a policy on the inspection system relating to nuclear power facilities and fuel cycle facilities, started a discussion on enshrining PSR in legislation based on the Safety Regulation Subcommittee Interim Report[27]. As stated in VI (4) e. of the Interim Report, although NISA made PSR a legal requirement, it discontinued receiving reports on PSA and AM in the framework of PSR as well as carrying out its own verification and evaluation of the report submitted by nuclear operators

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[26] The Study Group on Inspection Practices produced a report entitled "Interim Summary by the Study Group on Inspection Practices: The Course of Action to Review the Inspection System" in June 2002, and subsequently the secretariat presented the "Approaches to Future Deliberation (Draft)," but these reports did not refer to PSR.

[27] In response to the Safety Regulation Subcommittee Interim Report, the Cabinet approved the "Bill to partially amend the Electricity Business Act and the Act on Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactor" on November 5, 2002. This bill is intended to make it mandatory for operators of electrical facilities relating to nuclear power generation to record the results of voluntary inspections conducted on regular basis, and also set out measures that included tougher penalties. After partial amendments in the House of Representatives, this bill passed and was came into force on December 11, 2002 and was published on December 18, 2002.

by getting comments from experts[28]. On the other hand, nuclear operators subsequently conducted PSA for internal events in operating and shutdown conditions, which had been conducted on a voluntary basis, on every occasion of PSR as part of the safety inspection, and published an outline of the inspection results[29].

At the Investigation Committee hearings, regarding the reason why NISA ceased to evaluate PSA within the framework of PSR, a NISA official concerned stated, "Certainly, the Government was losing the opportunity to directly examine the content of PSA on the occasion of PSR every 10 years, and so in that respect I was concerned about," and "I was aware that we would no longer be able to assess PSA and AM reports directly, but I believed that this time, it would be effective to make PSR a legal requirement as part of quality assurance and have the overall PSR conducted properly."

Additionally, at the Investigation Committee hearing, the Chair Kondo, who was the Chair of the Subcommittee for the Institution of Nuclear Safety Regulation as well as a member of the Study Group on Inspection Practices, said that "As a result of the record falsification issues that dated back to TEPCO's falsification of inspection record of welding (in 2002), NISA officials were completely preoccupied with: how to ensure the credibility of regulation; how to correct problem areas; in any case, whether or not to create new systems; whether or not to review all records of welding; whether or not to go on-site and observe inspections. For NISA officials, PSA was not a priority in PSR." "Furthermore, as a result of discussion, PSA assessment in PSR, which was expected to get feedback from the experts, turned into a simple confirmation of the assessment results by nuclear safety inspectors."

As stated in VI 4. (4) d. and e. of the Interim Report, when PSR was made a legal requirement, nuclear operators were requested to conduct PSA on a voluntary basis as in the past. In this request, NISA asked for an inclusion of shutdown PSA, but did not include seismic PSA. With regard to this point, at the Investigation Committee hearings, NISA officials concerned said, "I remember that seismic PSA did not reach such a stage as shutdown PSA which had been included in the scope of PSA in 2002 and whose relevant procedures had been

28 See the Interim Report, Fig. VI-9.

29 As NISA requested in December 2003 that nuclear operators submit PSA for shutdown condition, PSA for shutdown condition had been already implemented in PSR reports submitted to NISA by nuclear operators in July 2002.

developed. At that time, I thought of it as probably a future issue[30].”

(b) AM review by safety inspectors following the legal enforcement of PSR

In order to examine the feasibility of the implementation methods for carrying out safety inspection which included PSR as a legal requirement, in March 2005 NISA implemented safety inspections at the Hamaoka Nuclear Power Station (hereinafter referred to as “Hamaoka NPS”) owned by the Chubu Electric Power Co., Inc. (hereinafter referred to as "Chubu Electric") as “model safety inspections.” With the aim to make it a rule to include PSR in the safety inspection, NISA had five inspectors from its Nuclear Power Inspection Division and three inspectors from other Nuclear Safety Inspectors Offices (hereinafter referred to as “Safety Inspectors Offices”) participate in carrying out[31] the model safety inspection. Moreover, through implementing safety inspections, each Safety Inspectors Office confirmed that operation procedures concerning SA measures for internal events had been created at all nuclear power stations.

The safety inspections in PSR conducted by Nuclear Safety Inspectors was designed to confirm that nuclear operators had defined the implementation system and implementation procedures, and had implemented PSR following their own plan to improve the quality of safety initiatives. However, the renovated safety inspection did not offer an opportunity to directly encourage TEPCO to improve the content of its AM in consideration of the progress of PSA technology for external events. As stated in VI 4. (6) of the Interim Report, TEPCO did not investigate AM measures that addressed beyond-design-basis external events, such as earthquakes, as part of its voluntary activities.

b. Review of AM implementation policy for Tomari Nuclear Power Station Unit 3 owned by Hokkaido Electric Power Company

[30] As noted in Chapter IV 4. (4) d. and the Interim Report, the Atomic Energy Society of Japan Standards Committee published “PSA procedure for a nuclear power plant in shutdown conditions” (AESJ-SC-P001:2002) in February 2002 and “Implementation Standards for Probabilistic Safety Analysis for Events Induced by Earthquakes at Nuclear Power Stations (2007)” (AESJ-SC-P006: 2007) in March 2007.

[31] The document entitled “Periodic Reviews (PSR & PSL) – Outline of the Implementation of the 3rd Model Safety Inspection (March 2005, NISA Nuclear Power Inspection Division, Hamaoka Nuclear Safety Inspectors Office)” referred to PSA for internal events including both operating and shutdown conditions as items and contents to be included in PSR

Regarding Unit 3[32] of the Tomari Nuclear Power Station (hereinafter referred to as "Tomari NPS") whose Establishment Permit was issued in 2003, Hokkaido Electric Power Co., Inc. (hereinafter referred to as "Hokkaido Electric") submitted a document entitled "Report on the Review of Accident Management (AM) Measures at Unit 3 of Tomari NPS" to NISA in line with the NSC decision[33]. NISA instructed JNES to conduct PSA relating to AM measures at Tomari NPS Unit 3 and compared JNES's PSA with the PSA carried out by Hokkaido Electric for evaluating AM measures at Tomari NPS Unit 3. By conducting comparative analysis of those PSAs, NISA confirmed that the nuclear operator's assessment of the effectiveness of AM measures at Tomari NPS Unit 3 was appropriate and reported these assessment results at the NSC meeting on October 6, 2008.

The NSC decided to set up a Discussion Group on Accident Management for Unit 3 at Hokkaido Electric's Tomari NPS (hereinafter referred to as the "Tomari NPS Unit 3 Discussion Group") in order to identify future challenges and make a proposal through the examination of AM for Tomari NPS Unit 3, taking into consideration the outcome of NSC's previous studies and the discussion on AM issues in the international nuclear community. All five NSC commissioners, including Atsuyuki Suzuki, the then Chair of the NSC (hereinafter referred to as "Chairman Suzuki"), together with four external experts, took part in a meeting held by the Tomari NPS Unit 3 Discussion Group on October 29, 2008. At the Discussion Group meeting, there was an opinion saying, "When it comes to AM, this is our first time to receive a report prior to fuel loading and examine the report. You are encouraged to point out whether there is room for improvement and which types of improvements should be made." Additionally, the NSC secretariat reported on the background of existing AM improvements and the documents referred to in the discussion of existing AM. The secretariat also made a reference to the IAEA's "Safety Standards Severe Accident Management Programmes for Nuclear Power Plants

[32] With regard to Hokkaido Electric's Tomari NPS Unit 3, an application for amending the reactor establishment license was approved on July 2, 2003, and the construction plan (for starting construction work) was approved on November 21, 2003.

[33] 3. (1) of "Accident Management for the Severe Accidents at Light Water Nuclear Power Reactor Facilities" (Decided on May 28, 1992, partly revised on October 20, 1997) states that "For a new nuclear reactor facility to be established in the future, the nuclear operator shall receive reports from the competent authority about enforcement policies for accident management (specific measures for facilities, preparation of manuals, training of personnel, etc.), from the earliest stage of detailed design of the reactor facility. Based on the outcome of this consideration, the nuclear operator shall prepare accident management measures prior to initial fuel loading at the reactor facility."

(DS385 Draft 2 dated 2007-05-14)[34] and expounded its chief points: “the need to include external events”, “the need to consider the impact of external events on AM resources (water sources etc.)” and “the need to consider human- induced external and internal events.”

The meeting of the Tomari NPS Unit 3 Discussion Group was held only once. The NSC made a decision entitled “Accident Management (AM) Measures at Unit 3 of Tomari NPS” at the NSC meeting on January 19, 2009, taking into consideration the comments and answers offered after the Tomari NPS Unit 3 Discussion Group meeting. At the NSC meeting, the secretariat reported on a document produced by itself entitled “Future Challenges Relating to the Preparation of Accident Management: The Opinions of External Experts who Took Part in the discussion of Accident Management at Tomari NPS Unit 3” (hereinafter referred to as “Opinions on Unit 3 of Tomari NPS”). Those Opinions on Unit 3 of Tomari NPS pointed out six points including “reconsideration of the regulatory approach to AM,” “improvement of reliability relating to the verification of AM effectiveness” and “inclusion of external events.” In terms of “improvement of reliability relating to the verification of AM effectiveness,” the document stated that “Furthermore, it is important for the Government to prepare regulatory guides in order to indicate fundamental ideas relating to the formulation of AM measures and assessment methods.” Furthermore, regarding “inclusion of external events” the document stated that “The AM improvements that have been considered by nuclear operators thus far are limited to internal events. These AM improvements may be effective for external events as well as internal events, but there exist points for consideration that are unique to external events. Currently, the study of responses to external events, and in particular to large earthquakes, are promoted earnestly, including PSA. There is no doubt that, as a future task, it will be necessary to develop the AM that takes into account the impact of external events, such as major earthquakes. Furthermore, there is a global trend toward implementing PSAs for fires and floods in addition to earthquakes. Accordingly, it should be encouraged to perform these types of PSAs and implement additional (AM) measures regarded as rational. Moreover, subsequently it should be encouraged to perform PSAs assuming multiple events/conditions including earthquakes, fires, shutdown condition and apply PSA results to AM improvements as well as operational management, including the determination of implementation procedures in

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[34] For DS385 see c. later in this Chapter.

regular inspection and Allowed Outage Times (AOT)."

However, at the above-mentioned meeting, there was no opinion about regulatory approach to AM, AM guidelines or AM for external events. Chairman Suzuki only stated that "I suppose the external experts suggest that we should take this opportunity to think over how to cope with AM including regulatory approach to AM, now that the NSC has compiled its opinions on NISA's first assessment results based on the AM implementation policy for a new reactor. We would like to revisit such opinions in our future discussions." The Investigation Committee has yet to confirm that the formation of the Tomari NPS Unit 3 Discussion Group offered an opportunity to push the NSC to start discussion about fundamental policies on approaches to AM.

Toshio Fujishiro, Special Advisor to the Research Organization for Information Science and Technology[35], participated in the Tomari NPS Unit 3 Discussion Group as an external expert. At the Investigation Committee hearing, he said "AM until then had focused on internal events and the question was whether it was adequate to postulate internal events alone. I suggested that earthquakes should be adequately reflected in AM, given that protection against earthquake was being reexamined. A NISA official replied that he understood my opinion and that the challenges were great and would be tackled in the long term[36]." In addition, with regard to the status of AM improvements in Japan and U.S., the special adviser said "Apart from the extent of AM improvements being taken into account, the U.S. has begun discussions on measures to deal with external events, including terrorist attacks. In addition, European countries including France were much worried about floods resulting from river overflows, possibly not so much worried about earthquakes, among external events. I think Japan had fallen behind them." With regard to the priority given to either seismic safety or AM, he stated that "I believe AM should be implemented after taking sufficient measures for seismic safety. This is because, without well-established basic design, it is impossible to ensure safety even if every measure is taken to protect against the events that exceed the accidents postulated in the basic design. First things

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[35] As four external experts participated in the Tomari NPS Unit 3 Discussion Group, Mr. Fujishiro took part in the Discussion Group as an advisor. Mr. Fujishiro also explained a document entitled "Future Challenges Relating to the Preparation of Accident Management: The Opinions of External Experts who Took Part in the Consideration of Accident Management at Tomari NPS Unit 3" at an NSC meeting on January 19, 2009.

[36] For NISA's response see d. later in this Chapter.

first, I believe plenty of resources should be expended on basic design. However, the postulated tsunami and the assumed time period of loss of external power supply were lenient. I believe these lenient assumptions constituted the lenient basic design. In this respect, it was a sensible approach to discuss seismic safety first. Having said that, I wish a little more emphasis would have been placed on AM as a preparation for contingencies."

At the Investigation Committee hearing after that, regarding the reason why the NSC did not discuss AM, Chairman Suzuki said, "That is because the principal point in question was to seek the best way to review reactors facilities with the aim to further increase safety margins for new reactors to be built in future. According to the schedule at that time, there were no plans to build new reactors, and in addition we were busy with seismic back-checks[37]. These circumstances explain why we did not reach a conclusion to include AM in the basic policy." Additionally, regarding Japan's AM, the Chair Suzuki said, "From an international perspective, it had been said for years that we should take a regulatory approach, for example, like the classic AM proposed by INSAG[38]. Whether or not such regulatory approach should be taken as it was, each country was taking a different approach. Each country has its own circumstances and difficulties resulting from its social structure. For example, if an attempt had been made to tackle AM seriously in Japan, it would have resulted in a monumental task and would have got out of control." "Whether it is about AM or tsunami, it is impossible to escape from the typically Japanese reality that priority should be placed on local sentiment. It takes at least 10 years to gain local approval for building a nuclear reactor, after the first explanation of a plan to local communities. On the other hand, technology advances during the course of gaining the local approval. If you attempt to embrace the technological advances, you might have to make an explanation different from what you first explained to the local communities. Although we try to use the latest technologies at the time of construction, it is not necessarily possible. Regulatory approach differs between Japan and other countries, and in some countries it is possible to adjust the actual design taking into account technological advances. Frameworks differ in this way, and it explains why Japan was left behind in adopting the AM approaches

[37] Assessments of the seismic safety for existing nuclear power facilities based the revised version of the NSC Regulatory Guide for Reviewing Seismic Design of Nuclear Power Reactor Facilities. See VI 3. (5) a. of the Interim Report.

[38] The current IAEA International Nuclear Safety Group.

taken in other countries."

c. The IAEA's Safety Guide NS-G-2.15 "Severe Accident Management Programmes for Nuclear Power Plants"

The IAEA Safety Guide NS-G-2.15 "Severe Accident Management Programmes for Nuclear Power Plants" (Since the draft standard was coded DS385, hereinafter the draft standard is referred to as "the DS385"), which was published in 2009, requires the development of AM not only for all internal and external events, including at shutdown and low power conditions, but also for fuel damage accidents in spent-fuel pools.

As for DS385, its Document Preparation Profile was approved at the 19th NUSSC meeting in May 2005 and at the 17th CSS meeting in June 2005. The IAEA secretariat submitted the DS385 (Draft (28 Feb., 2007)) to NUSSC members in February 2007.

The fourth meeting of the IAEA Safety Standards Review Panel (see Figure V-4), a domestic panel for discussion on the IAEA Safety Standards, was convened in March 2007, and discussed a general policy for the 23rd NUSSC meeting in April 2007 and created comments on the issues included in the agenda of the NUSSC meeting. Citing the difference in AM between IAEA and Japan, one of the documents presented at the panel meeting says, "external events such as fires, earthquakes, floods and other natural disasters are included in the DS385 (Only internal events at operating condition are included in Japan)."

At the 23rd NUSSC meeting in April 2007, Japan submitted comments requesting an amendment to DS385, but these comments did not include any comment related to the above-mentioned difference in AM preparations.

Subsequently, in response to the comments submitted by Member States, the IAEA presented an amended text of the DS385 to the Member States. The 6th IAEA Safety Standards Review Panel meeting was convened in April 2008 to discuss a general policy for the 25th NUSSC meeting in May 2008 and comments on the issues included in the NUSSC meeting agenda. One of the documents presented at the panel meeting noted that the DS385 requested that consideration be given to AM for shutdown condition and for fuel damage accidents in spent-fuel pits[39] as well as AM for other events leading to a significant radioactive release, such as large radioactive releases from radioactive waste treatment system. The documents also noted that the DS385 refers to the availability of water sources necessary for the measures taken to mitigate external events.

Japan submitted comments to the 25th NUSSC meeting in May 2008 requesting technical revisions, but these did not include any comment relating to the above-mentioned documents presented at the 6th IAEA Safety Standards Review Panel meeting.

Subsequently, in response to the comments submitted by Member States, the IAEA again presented an amended text of the DS385 to the Member States. In August 2008, the CSS24 Meeting Response Panel (see 1. above), a domestic panel for discussion, was held to discuss a general policy for the 24th CSS meeting and comments on the issues included in the agenda of the CSS meeting. It was decided that DS385 was acceptable except for the text related to the comments on technical revisions.

Subsequently, the DS385 was approved at the 24th CSS meeting in September 2008.

d. Further progress in recent years

As described in VI 4. (4) h. of the Interim Report, NISA endorsed the report entitled "Summary of Challenges in Nuclear Safety Regulation" at the Basic Safety Policy Subcommittee of the Nuclear and Industrial Safety Subcommittee in February 2010. The report noted that it was appropriate to study an inclusion of AM in the regulatory system and the regulation of AM in the legal system, now that several countries were leading a discussion to require design measures for severe accidents in the regulation of new reactor designs.

On the other hand, in December 2009 NISA and JNES set up a review panel on measures against severe accidents with the aim to study SA measures for their own use. The panel confirmed regulatory developments relating to SA in other countries and the IAEA Safety Standards and gathered information on the design margins associated with existing facilities against SA, applying the results from SA-related safety research results conducted by JNES.

[39] They are facilities for storing spent fuel. At PWR plants they are referred to as spent fuel pits, and at BWR plants they are referred to as spent fuel pools.

Based on these initiatives, the panel led a discussion to develop requirements[40], and based on the discussion, in April 2010 produced a report entitled "Regulatory Approach to Severe Accident Measures in Japan: Interim Report by the Review Panel on Severe Accident Measures in Japan (NISA, JNES)[41]." This report describes: (1) the policy on regulation, (2) the required level of SA regulation[42], and (3) legal aspects of back-fitting[43]. Subsequently, NISA exchanged opinions with the NSC and the Federation of Electric Power Companies of Japan, with the initiative of NISA's in-house SA review team. NISA also held hearings with nuclear power plant vendors and conducted a detailed evaluation of the technical and institutional aspects of SA measures[44].

NISA Director General Nobuaki Terasaka said at the Investigation Committee hearing that "It is tough to explain severe accident measures to local communities. The phrase 'absolutely safe' was kind of a taboo and shall not be used. If asked whether a nuclear power plant was safe or not safe, we replied that of course it was safe. Particularly, in communicating with locals, it was extremely difficult to explain that there was a risk based on the results of probabilistic assessments such as PSA or PSR. Even those who were in favor of nuclear energy were critical of such explanation, asking why we were saying that such problems left unresolved, despite our past explanation that nuclear safety would be enhanced step-by-step with every effort. Furthermore, those who were critical of nuclear energy naturally argued that our explanation was not what we had said before, and ended up asking, provided that there were some elements which would undermine safety despite having reassured the locals about safety, what measures

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[40] The report entitled "Future Challenges Relating to the Preparation of Accident Management: The Opinions of External Experts who Took Part in the Consideration of Accident Management at Tomari NPS Unit 3" that was presented at the NSC meeting on January 19, 2009 (see b. above) was also used as reference materials in these deliberations.

[41] NISA is the English abbreviation for the Nuclear and Industrial Safety Agency.

[42] With regard to the seismic safety of AM facilities, the report states that "At present seismic safety of AM facilities is not required, and there is a possibility that these facilities would not function effectively after an impact of an earthquake. Currently, as the introduction of standard seismic ground motion Ss is in progress, it will be important to examine seismic classes of the existing facilities and AM facilities, including an assessment of the possibility for an accident to occur after the impact of an earthquake."

[43] The document states that it will be necessary to determine measures for existing reactors.

[44] Prior to the Great East Japan Earthquake, the SA deliberation team had planned to set up the "Working Group to Consider the Regulation of Severe Accident" and had discussion in public on March 18, 2011. Also, this WG planned to discuss its interim report from summer to autumn of 2011, along with compiling technical details related to regulation in summer 2012. Note that the NSC planned a symposium on nuclear safety entitled "Basic Policies for Near-Term Initiatives of the NSC: Aiming at the Reasonably Achievable Highest Safety Level" on March 16, 2011, and SA was to be discussed as a fundamental topic of the use of risk information.

would be taken to deal with those elements. Under these circumstances, we explained the reason why it was safe, but the discussion never turned into a frank discussion. Afterwards we came to feel that a positive atmosphere was being created and appeared to encourage us to discuss issues such as probabilistic theory and residual risks, for example, in the Seismic Design Regulatory Guide[45], but I thought it was still difficult to discuss the issues face to face. Furthermore, a discussion of probability is quite difficult in our society. The Fukushima accident was precisely the good example of this difficulty: even if you say the accident probability is only 10^{-7}, the general perception is whether it happens or does not happen, that is, a probability of ½. Although on the surface it appears to be allowed to discuss how to utilize a figure like 10^{-7}, and how to make it work, in any case, there has been little discussion on this issue from various angles in reality."

(3) Station blackout (SBO)

a. The background of setting the DC battery life at eight hours during an SBO in the emergency operating procedure (event-based) for the Fukushima Dai-ichi NPS

As described in VI 4. (1) b. of the Interim Report, the Safety Design Regulatory Guide for Light Water Nuclear Power Reactor Facilities established the requirement for the Design Considerations against Loss of Power[46], which regarded as acceptable the design with a system to cool the core for boiling water reactors (BWR) or the primary system for pressurized water reactors (PWR) during a 30-minute SBO, including the capacity of the DC power needed to control these systems.

On the other hand, in the middle of the investigation, it became clear that the DC battery life during an SBO was set at 10 hours for Unit 1 and eight hours for Units 2 through 4 (hereinafter referred to as "eight hours etc.") in the emergency operating procedure (event-based) for the Fukushima Dai-ichi NPS. Here we will discuss the background of that.

In July 1980, the NRC raised SBOs as Unresolved Safety Issue (USI) A-44 and tackled this issue, because of a large number of previous incidents involving loss of off-site power and DG

[45] This refers to the "Regulatory Guide for Reviewing Safety Design of Light Water Nuclear Power Reactor Facilities" that was revised on September 19, 2006. (See VI 3. (4) b. of the Interim Report).

[46] As stated in VI 4. (1) b. of the Interim Report, prior to the revision of the Safety Design Regulatory Guide in 1992 there was "Guideline 9: Design Considerations against Loss of Power."

start-up failures in the U.S. In May 1985 the NRC staff released a draft rule that plants have the capacity to withstand the SBO for four hours or eight hours, depending on the reliability of the off-site power and the emergency AC power.

At that time, in Japan, as stated in VI 4. (1) b. of the Interim Report, the “Guideline 9: Design Considerations against Loss of Power” in the then Safety Design Regulatory Guide required that plants have the ability to withstand a short-term (about 30 minutes) SBO. The plant under safety review was subject to the evaluation about whether the plant possessed the ability to withstand the SBO for around 30 minutes.

Based on the above-mentioned NRC draft rule, TEPCO as well as nuclear power plant vendors, such as Toshiba Corporation (hereinafter referred to as “Toshiba”) and Hitachi, Ltd. (The business of Hitachi Ltd.’s Nuclear System Division was later succeeded by the current Hitachi-GE Nuclear Energy, Ltd., and hereinafter is referred to as “Hitachi”) conducted evaluations of typical domestic BWR plants. If these BWRs were subject to the above-mentioned NRC draft rule, they had to withstand the SBO of four hours. Those evaluation results showed that, in reality, they had a resistance of around eight hours[47].

In 1988 the NRC amended 10 CFR 50.63 to include SBO regulations, which required the design to to cope with “the SBO for a specified duration[48].” Following this, the NRC issued the Regulatory Guide 1.155 SBO, and it became a requirement that plants in the U.S. withstand the SBO for two, four, six or eight hours, depending on the design aspects of each plant.

In March 1989, on the occasion of scheduled battery-change at the Fukushima Dai-ichi NPS Unit 4, TEPCO conducted a study entitled “ A Study of Probabilistic Safety Assessments for BWR,” which covered BWR-3, BWR-4 and BWR-5 designs including Units 1 through 4 at the Fukushima Dai-ichi NPS. TEPCO entrusted this study to Toshiba and Hitachi.

According to that study, if the NRC Regulatory Guide 1.155 SBO was applied to domestic plants, the required SBO duration was hours due to the highly reliable DGs and relatively well-designed off-site power supply. Although TEPCO had only to prove the SBO capability to be equal to or more than four hours, a study was carried out to confirm whether those plants had

[47] TEPCO testified to the Investigation Committee that it explained the evaluation results to the then Ministry of International Trade and Industry in February 1986.

[48] Please see Chapter VI 4. (1) of the Interim Report.

a higher level of SBO coping capability, that is, eight hours. Plant design conditions, such as battery discharge time, were four hours. However, the study showed that systems/components required to be operated during loss of offsite power proved to be eight hours, given that actual capabilities were evaluated based on actual operational conditions including water sources, environmental temperatures and battery capacities, etc.

In August 1990, based on the report on this study, TEPCO supplemented the emergency operating procedures (event-based) by including the procedures for total loss of AC power accident in which the DC battery life during an SBO was as long as eight hours.

Afterwards, as stated in VI 4. (1) b. of the Interim Report, in a June 1993, the NSC endorsed the report produced by the Working Group on Total AC Power Loss Event under the Deliberation Committee on Analysis and Evaluation of Accidents and Failures in Nuclear Installations, and examined the frequency of SBO and the ability to withstand SBO (battery life and cooling water sources during an SBO) for typical plants in Japan, in reference to the requirements under the NRC's SBO rule. As a result, the NSC determined that the SBO rule is satisfied on the grounds that: offsite power sources and emergency DG are found to be highly reliable in Japan, and (the practical requirement in the Safety Review was only thirty minutes) the actual SBO durability was more than five hours for pressurized water reactors (PWR) and more than eight hours for boiling water reactors (BWR). However, in contrast to the SBO requirements which postulated external events such as snowfalls, hurricanes, or tornadoes (earthquakes and floods are not included), the possibility of an SBO caused by external events was not discussed at the meetings held by the above-mentioned Working Group. The JAEA, TEPCO and Kansai Electric Power Company ("KEPCO") participated in the working group discussions as external participants. According to the documents made public by the NSC regarding the production of the report of the working group, although the secretariat of the group created the conclusion of the report, nuclear operators took charge of part of the report, specifically the sections concerning plant design for SBO, implementation status of plant operation management, connection with Safety Review and plant operation management, and countermeasures. In addition, in a questionnaire dated October of that year under the name of the Nuclear Safety Investigation Section[49], there is a request concerning short-term SBO, saying, "Please write the reason why there is no problem with SBO of around 30 minutes currently and in the future (why it is not necessary to think about mid- to long-term SBO)." In response, in November of that year KEPCO answered in writing; "It is not possible to firmly establish the basis for the 30 minute specified in this report," whereas TEPCO answered[50], "As long as margins are not reduced in the future, it is OK." In the report dated June 1993, the TEPCO's answer was not copied verbatim but the content was very similar between them. The TEPCO's answer is supposed to be used for reference. The precise background of the situation 20 years ago is not clear. There is a possibility that the nuclear operators were asked to explain their reasoning in writing, and that the working group did make the necessary evaluation and judgment of its own because TEPCO's reasoning was not entirely duplicated but merely used as a reference. At the least, the conduct asking nuclear operators to write part of the report and to write a composition on their reasoning can be said to be an inappropriate action as a regulatory body.

b. B.5.b in the NRC

So-called B.5.b is security measures used by the NRC and is one of the countermeasures often mentioned in relation to the Station Blackout (SBO). It should be noted that the investigation in this section has certain limitations due to the nature of the information involved[51].

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[49] It is supposed that this refers to the Nuclear Safety Investigation Section of the now defunct Science and Technology Agency. The Science and Technology Agency functioned as the secretariat for the NSC at the time.

[50] "According to PSA results, the SBO in Japan is not a prominent contributor to core damage frequency, thanks to the high reliability of both offsite power supply and D/G, coupled with the availability of relevant procedures. Regarding the conformance of Japanese plants to U.S. R.G.1.155, required capability is four hours. However, Japanese plants withstand the SBO of at least five hours, despite the design requirement of the SBO of 30 minutes. Taking into consideration design margins and the performance showing high reliability of D/G, sufficient safety can be ensured" (reproduced from the report).

[51] As is described later, B.5.b is designated as Safeguard Information (SGI), and NISA does not possess it. Also with regard to part of the aircraft impact information possessed by the NISA, it is classified as Confidentiality class 4 Information and Confidentiality class 3 Information based on the Information Security Management Standard for Ministry of Economy, Trade and Industry (22.03.2006 Shi No.1) due to an agreement with the NRC. As far as the Ministry of Economy, Trade and Industry concerns Confidentiality class-4 Information corresponds to the type of information possibly subject to non-disclosure provisions in each paragraph in Article 5 of the Administration Organs Information Disclosure Act (hereinafter, the "Information Disclosure Act"), and is classified as information of high confidentiality, which has a potential to damage the national safety and benefit, and is described as so-called "Strictly confidential". The Confidentiality class-3 Information corresponds to the

Details of Section B.5.b as of February 2002 are still unknown, because the contents of B.5.b were designated as Safeguard Information (SGI[52]). Despite that, the outline of B.5.b is described in the materials presented at the NRC committee meeting held after the Tohoku Region Pacific Coast Earthquake. According to the materials, a three-phased approach is required by Section B.5.b.: Phase 1 – Preparing equipment and staff; Phase 2 – Taking measures to maintain and recover the functionality of spent fuel pool; Phase 3 – Taking measures to maintain and recover the functions of core cooling and containment[53]. As is described later, in March 2009, the NRC included "similar requirements[54]" similar to Section B.5.b security requirements, in the safety requirements for nuclear energy.

In response to the terrorist attacks in the U.S. in September 11, 2001[55], the NRC issued a security order, which was a provisional compensatory measure for security which contained Section B.5.b.[56] Details of the order, namely its structure and contents including the fact that there was the Section B.5.b, were not disclosed to the public at that time. It was made public in June 2006 that there was the Section B.5.b in the order[57], but the contents of the order remain still undisclosed.

In February 2005, the NRC staff provided Phase-1 guidance for implementing Section B.5.b of the ICM Order, but this fact was not announced at that time. Whilst this fact was released after the Tohoku Region Pacific Coast Earthquake[58], details have not been released during the

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type of information possibly subject to non-disclosure provisions regulated in each paragraph in Article 5 of the Information Disclosure Act, and is classified as the information with highly confidential information, excluding the Confidentiality class-4 Information, which is described as so-called "Confidential."

52 U.S. Code of Federal Regulations. 10 CFR 73 "Physical Protection of Plant and Materials".

53 Presentation materials and meeting minutes of the NRC Meeting on April 28, 2011 (http://www.nrc.gov/reading-rm/doc-collections/commission/tr/2011/).

54 As Federal Register, 74FR13926 (2009-03-27) says, "Requirement similar to these were previously imposed under Section B.5 of the February 25, 2002, ICM order; specifically, the "B.5.a" and the "B.5.b provisions", it is described as "similar requirements" in this report. However, the content of the B.5.b has not been disclosed at the time of writing this report. As mentioned later, the "NEI 06-12, Revision 2, 'B.5.b Phase 2 & 3 Submittal Guideline'" was made public after the Tohoku Region Pacific Coast Earthquake.

55 In Japan, following the revision of INFCIRC/225 (INFCIRC/225/Rev.4) in June 1999 and the September 2011 attacks, the Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactor was amended to strengthen the cooperation with the Security Authority for nuclear power stations and the revision of the and tighten the standard of the nuclear material protection (enacted in May 2005 and enforced in December 2005).

56 Federal Register 67FR9792 (2002-03-04).

57 Federal Register 71FR36554 (2006-06-27).

58 "NRC BULLETIN 2011-01: MITIGATING STRATEGIES" (ML111250360) (May 11, 2011, NRC). The Phase 1 guidance published by the NRC on February 25, 2005 included the best practices for mitigating losses of large areas of the plant, and measures to mitigate fuel damage and minimize releases.

time of this report being written.

In March 2006, Shin Aoyama, Deputy Director General of the Nuclear and Industry Safety Agency (NISA), visited the NRC and had an opportunity to gain information on the U.S. efforts to address aircraft impact against nuclear power plants. After that, in January 2007, NISA obtained the material that the NRC showed during NISA's visit to the NRC in March 2006.

In December 2006, the U.S. Nuclear Energy Institute submitted the "NEI 06-12, Revision 2, 'B.5.b, Phase 2 & 3 Submittal Guideline.'" In the same month of that year, the NRC approved the proposed strategies related to Section B.5.b as feasible measures, whilst this was not announced at that time. Those facts were made public in March, 2009[59], while details were released to the public in May, 2011 after the Tohoku Region Pacific Coast Earthquake[58,60].

In September 2007, for an aircraft impact assessment, the NRC released a draft regulation that included "similar requirements" equivalent to Section B.5.b security requirements in safety requirement[61]. This announcement revealed that Section B.5.b required mitigation strategies to avoid or mitigate the effects of an aircraft impact, addressing core cooling capability, containment integrity and spent fuel pool integrity, in order to cope with the loss of large areas of the plant due to explosions and fires caused by various factors including a beyond-design-basis aircraft impact.

In May 2008, Akira Fukushima, the then Deputy Director-General for Safety Examination of NISA (hereinafter, "Chief Executive Fukushima") and other officials visited the NRC to exchange opinions on the U.S. approach to address aircraft impact against the nuclear facility. After this visit, NISA requested that the NRC provide it with the materials used at the meeting in May and other materials such as the main text of B.5.b, however, its request was not granted[62].

At the Investigation Committee hearing, Chief Executive Fukushima said, "Although it is almost impossible to convey precise meaning and nuances, as far as I remember, the NRC

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59 Federal Register 74FR13926 (2009-03-27).

60 "NEI 06-12, Revision 2, 'B.5.b Phase 2 & 3 Submittal Guideline'" is a guide aiming to maintain core cooling and containment function as well as cooling capabilities of the spent fuel pool and recover these functions. This guide was disclosed after the 2010 off the Pacific Coast of Tohoku Earthquake (ML070090060) (http://adams.nrc.gov/wba/).

61 Federal Register 72FR56287 (2007-10-03).

62 The NISA made another request to the NRC after this.

replied that their review on the issue of aircraft impact had produced some results and that they could hold a briefing on the results, without distributing materials, on the condition that we neither take a note nor record a speech on tape, adding that if we agreed to those terms we could come.

In March 2009, NISA at the 29th meeting of the Nuclear and Industrial Safety Subcommittee announced that NISA would study U.S. and global trends of discussion about aircraft impact issue[63]. By November in the same year, in cooperation with the JNES, NISA conducted an impact assessment on aircraft impact against a nuclear power plant[64].

In March 2009, following the draft regulation as of September 2007, the NRC included "similar requirements" equivalent to Section B.5.b security requirement in safety requirement for nuclear facility[65,59]. For the purpose of maintaining or recovering core cooling function, containment integrity and the spent fuel pool cooling function to cope with the loss of large areas of the plant due to explosions or fires, those requirements comprised the measures putting emphasis on 14 points[66] categorized into the following three groups: 1. Firefighting, 2. Measures to mitigate fuel damage, and 3. Measures to minimize radiation release. The NRC mentioned that those requirements were the same as the "similar requirements" previously

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63 Section "(2) Aircraft impact" in "2. Promotion of complementary activities with main nuclear power countries" included in the material 7 entitled, "The Recent International Trends of Nuclear Safety", distributed at the 29th meeting of the Nuclear and Industrial Subcommittee on 9 March 2009 states as follows: "Since the Terrorist Attacks on September 11, 2001, the NRC has been investigating the aircraft impact. In February this year, the NRC approved a draft regulation that would require an aircraft impact assessment for every newly designed plant. From now on, applicants of a newly designed plant are required to conduct an impact assessment on four important safety functions (core cooling function, containment integrity, SFP cooling function, and SFP integrity). As a provision for the future, Japan will conduct research on the international trends including that of the U.S."

64 As described in the Interim Report VI. (1). c, whether or not an aircraft crash needs to be included in the design as an "postulated external event caused by humans" was stated in the "Criterion for Evaluation of the Aircraft Drop Probability to a Commercial Power Reactor Facility (bylaw)," which was formulated by the NISA in 2002. Upon a partial revision of this bylaw in June 2009, re-assessment was conducted at every nuclear power station. In June 2010, NISA stated, "The assessment results for commercial nuclear power stations are acceptable in that the aircraft crash probability was below the standard (10-7), which should be used to determine whether an aircraft crash needs a consideration in the design as an 'postulated external event caused by humans' as indicated in the bylaw. Therefore, it has been decided that an aircraft crash does not have to be taken into account."

65 10 CFR 50.54(hh)(2).10 CFR 50.54 is an abbreviation for Conditions of licenses.

66 The details of (i), (ii), and (iii) are listed as follows: (i) Procedures for implementing integrated fire response strategy, assessment of mutual aid fire-fighting assets, designated staging areas for equipment and materials, system of command and control, and training of response personnel; (ii) Protection and use of personnel assets, communication environment, minimizing fire spread, procedures for implementing integrated fire response strategy, identification of readily available and pre-staged equipment, training on integrated fire response, spent fuel pool mitigation measure; (iii) Water spray scrubbing, dose to onsite responders, etc.

mentioned in the Interim Safeguards and Security Compensatory Measures in 2002, and that the existing facilities in the U.S. had already fulfilled those requirements.

From December 2009 to December 2010, NISA conducted an internal review on future plan based on the results of the above-mentioned impact assessment conducted in November 2009. In January 2011, NISA decided on the plan called the "Approach to the review of aircraft impact," which intended to take a step-by-step approach towards making regulations, after taking advice from the NRC. In addition, in the month of March, 2011, NISA requested that the NRC create an opportunity for an opinion exchange regarding the outcome of the study in Japan up to this point, and was coordinating and scheduling for the opinion exchange.

At the Investigation Committee hearing, regarding the background of NISA's handling of the aircraft impact issue until then, NISA officials concerned said, "We were concerned about whether our study was adequate. The U.S. was well ahead with this issue, and it was also the U.S. that gave us the first opportunity for our study. Our study has been conducted in parallel with collecting relevant information in the U.S. as possible, and (we thought) it would be the best way to ask the U.S. for the information on other countries and for U.S. advice on whether we were heading a wrong direction;" "Given that the NRC gave us information and advice during our visit to the NRC, it was important what measures should be taken based on its advice. Then, it was necessary to involve nuclear operators and start to discuss, for example, what measures would be necessary for which individual nuclear operator's facilities. To do this, it would become important how to deal with confidential information, and therefore an information management system should be established first. Dealing with this issue was challenging. Only after the issue was resolved, we could move forward, and thus, we thought it would probably not be feasible to tell any prospect by summer (2011)[67]"; "Regarding the priority, in general, we thought the risk of a terrorist attack in Japan, in comparison with the U.S., was most likely to be lower. In Japan, police officers are stationed at nuclear power stations. However, in comparison with the U.S. where security guards carry an automatic rifle, it seemed rather natural that we were relatively slower in tackling this issue, after all." "Honestly speaking, there was a manpower shortage, despite the fact that it was an essential

[67] As described previously in (2) d., the NISA conducts an examination of the regulation of SA measures and was attempting to publish an interim report or similar during the period between summer and autumn in 2011.

task. There is a limit to what one person can handle. So, in this sense, with a few more people and depending on the number of them, we can pick up the pace."

On the other hand, the Director of Nuclear Emergency Preparedness Division, NISA, who is in charge of AM (Accident Management), talked about his understanding of Section B.5.b after the accident in Fukushima. He said, "Firstly, the AM that we had been considering since 1992 was to make use of any equipment or machines available. To put it more precisely, it was an approach in which we were supposed to make effective use of such equipment and machines already existed in power plants or on sites for the purpose they were not originally intended for. This means that the idea of AM was to use any items in plants or on sites effectively for the not postulated events and mitigate the impact of such events;" "Therefore, whilst AM is supposed to be a flexible approach, we did not have a thought from a different angle that we could bring something in from outside the site to take response measures;" "Concerning its usefulness, at that time my ideas about AM were such as placing pumps away from the site, bringing heavy equipment into the site or cleaning up the wreckage of an aircraft. However, having observed the accident situation in Fukushima on the first and the second days, I realized what materials were needed and how they could be used against such events, and what if there were any of these materials actually on the site, which made me become well aware of its significance during the two days."

At the 19th meeting of the International Conference on Nuclear Engineering (ICONE-19) held in October 2011, Dr. Nils J. Diaz, former Chairman of NRC, gave a lecture, saying: "Section B.5.b-type safety enhancement, if effectively and timely implemented in Japan, would have mitigated the events, which faced the operation staff of the Fukushima Dai-ichi NPS, and would have dealt properly with 'station blackout' and cooling of the core and fuel pools in particular[68]." At the Investigation Committee hearing, Dr. Kondo, the Chairman of the Atomic Energy Commission, who participated in the conference, expressed his opinion as follows: "The U.S. in the past did not talk so openly (about Section B.5.b). It is definitely a huge change that they talk about that at a conference in this way. But, I also felt that they could have told us

[68] The lecture materials from the Keynote Session at "The 19th International Conference On Nuclear Engineering in Osaka (ICONE19 Osaka)" which was held on October 24 and 25, 2011. (http://www.icone19.org/documents/2_Diaz_Speech-Japan-Reflections_on_Fukushima.pdf)

earlier;" "If what Dr. Nils J. Diaz said is true, the catastrophe might have been prevented. However, last year (2011) at the Commission meeting of the NRC, the U.S. mentioned that they had informed Japan and other countries of their policy regarding Section B.5.b of the U.S. and so I asked relevant officials and learned that the U.S. had informed NISA. Due to NSC's refusal, the Atomic Energy Commission has no choice but to take charge of making basic policy on nuclear security. Since this practice is not well-known outside Japan, such security-related information has not been circulated to me." "After getting the information, NISA should have shared the information with those who were in charge of safety, and should have applied complementary measures with a beneficial effect from a safety standpoint to the spent fuel pool and other facilities. At least, from the safety point of view, they should have discussed internally the way to deal with the information.

4. Details of the Process of Discussion on the Nuclear Emergency Preparedness System

(1) Discussion during the process of establishing the Act on the Special Measures Concerning Nuclear Emergency Preparedness

The Act on the Special Measures Concerning Nuclear Emergency Preparedness (hereinafter, "the Emergency Preparedness Act") is a law that was enacted in 1999 for the purpose of protecting the lives, bodies and properties of the citizens by reinforcing the measures against nuclear disaster following the criticality accident at the nuclear fuel fabrication facility owned by JCO Ltd. in 1999 (hereinafter, "JCO Criticality Accident").

The Investigation Committee held hearings on the situation back then, inviting those who were involved in the creation of the Emergency Preparedness Act and gained the information described in the following paragraphs.

In the first place, the drafting of the Act was conducted, keeping an eye on the progress of the response to the accident, while reflecting on the problems with the existing acts such as the Disaster Countermeasures Basic Act. The first thing to be pointed out is that there are various differences between general disaster counter measures and nuclear emergency countermeasures, even though the nuclear disaster countermeasures used to be one of the disaster countermeasures within the framework of the Basic Acts on Disaster Control Measures. For example, whilst the head of the local government has the prime responsibility for general disaster countermeasures, the national government should exercise greater responsibility for nuclear emergency countermeasures on its own initiative. In addition, since the radiation is invisible, the initial conditions for emergency classes were clearly defined as dose rate measured outside the nuclear facilities, regardless of the conditions in the reactor, enabling an effective and swift response in the initial stage of an accident. Besides, the emergency response system was designed to automatically establish a Nuclear Emergency Response Headquarters and declare the State of Nuclear Emergency.

Furthermore, since a variety of information related to nuclear emergency is gathered mostly in the local area where the accident occurred, the emergency response system assumed that the organization established in the local area should take the initiative to plan response activities. Namely, an operation mechanism was designed to enable the officials from national, prefectural and municipal governments establish the Joint Council for Nuclear Emergency Response at the Offsite center and make practical decisions. Through this mechanism, the Director-General of the Joint Council for Nuclear Emergency Response, with the delegation of authority, principally takes response measures, while consulting on important issues with the Nuclear Emergency Response Headquarters in Tokyo.

With regard to the nuclear emergency measures in which the NSC is involved, the ultimate responsibility rests with the regulatory authorities. However, taking into account the limits of administrative officers' technical abilities to respond to emergencies, the Act for Establishment of the Atomic Energy Commission and for the Nuclear Safety Commission were revised to establish the Emergency Response Technical Advisory Body, with the aim to involve experts with technical knowledge or academic experience in emergency measures. Unlike a collective decision-making committee, each member of the Emergency Response Technical Advisory Body (hereinafter, "a member of the Advisory Body") is appointed as an individual, allowing him/her to conduct advisory activities individually. Also, the system allowed the most appropriate people can work on the site or at the headquarters in Tokyo depending on the situation of an accident, thanks to a variety of specialized areas among academic experts. According to the emergency response manual for the NSC and the Emergency Technical Advisory Body (NSC) formulated by the NSC, each member's area of activity within the NSC is clarified, along with his/her duty station, that is to say, who is summoned to Tokyo office and who is dispatched to the site depending on the location of the accident site.

Natural disasters such as an earthquake are included as a cause of nuclear disaster. When it comes to nuclear disaster, the basic idea of emergency response system was that appropriate measures have to be taken as early as possible after radioactive release from nuclear facilities, regardless of the cause of the accident and the conditions in the nuclear reactor. It was a prerequisite to deal with any kinds of emergency situation. For example, assuming that an Offsite center becomes unavailable by a rare accident, there is a provision that an alternative facility (Paragraph 12, Article 16 of the Act on Special Measures Concerning Nuclear Emergency Preparedness) should be prepared.

(2) The idea of the Emergency Preparedness Zone (EPZ)

As described in Chapter III 5. and V 3. of the Interim Report, the Fukushima nuclear accident led to a situation in which the Offsite center did not function as initially intended and residents of extensive areas were forced to evacuate for an extended period of time. Behind these unexpected difficulties, there might be some possibility of underestimating the accident which was postulated for reviewing the nuclear emergency preparedness system. Therefore, the Investigation Committee probed into the way of thinking in which the size of the Emergency Preparedness Zone (EPZ) was established and, in addition, examined the background of discussion in Japan in responding to the discussion led by the IAEA in recent years. According to the "Regulatory Guide for Emergency Preparedness for Nuclear Facilities" (NSC RG T-EP-II.01") produced by the NSC, the EPZ is defined as an area that is determined by postulating a serious accident in advance and identifying the size of the area affected under the accident situation with an addition of margins deemed to be sufficient from a technical point of view, taking into account the characteristics of nuclear facilities."

a. Method of setting the EPZ

According to the Regulatory Guide for Emergency Preparedness for Nuclear Facilities, the generic distance of the EPZ, which represents a distance in radius from a nuclear facility is determined by postulating a serious accident most unlikely to occur from a technical viewpoint and adding sufficient margins, ignoring the sufficient safety measures taken at the nuclear facility. Specifically, protection measures such as sheltering and evacuation proved to be unnecessary outside the EPZ, even if the amount of radioactive materials released into the environment exceeds the amount calculated from the hypothetical accident, which was supposed not to occur in reality in the Safety Review of the nuclear facility. In addition, the Investigation Committee examined the connection with the serious accident in the past such as the JCO Criticality Accident in Japan and the Three Mile Island Accident in the U.S. (hereafter referred as the "TMI accident"). Based on these studies, the EPZ for a nuclear power station such as the Fukushima Dai-ichi NPS operated by TEPCO was determined to be approximately an 8-10km radius of the nuclear power station. The explanatory part of the regulatory guide gives details, saying "the sheltering outside the areas 8km and 10km from the point of release is not necessary, unless the amount of radioactive release from a reactor containment vessel into the environment exceed the amount calculated on the assumption that 100% of noble gases and 50% of iodine as a share of core inventory of fission products are released into the reactor containment vessel."

At the Investigation Committee hearing, a testimony on this point was given as follows. The Regulatory Guide for Emergency Preparedness for Nuclear Facilities postulates hypothetical accident on the condition that the containment vessel does not fail and that C/V vent operation is not carried out. In the evaluation of the amount of radioactive release, noble gas and iodine are released from the reactor vessel into C/V and further into the environment, on the presumption that those nuclide are released through leakage paths of the intact C/V. On the other hand, according to the findings by the PSA (Probabilistic Safety Assessment), the amount of radioactive materials released in case of severe accidents is estimated to exceed the amount that requires sheltering outside areas 8-10km from the point of release. In addition, noble gases and iodine are the only nuclides released into the environment, because it is based on the presumption that radioactive materials are released through filters, and therefore it is not anticipated that solid particles such as cesium are released.

Hence, the existing nuclear emergency measures include an accident, which is far more serious than the accident that should be postulated in the Establishment Permit of nuclear facilities, in order to determine the range of the EPZ. However, the range of EPZ depicted in the nuclear emergency measures was calculated assuming that the C/V does not fail, let alone excluding the situation in which multiple reactors are damaged simultaneously, like the Fukushima Dai-ichi reactors.

b. Precautionary Action Zone (PAZ) described in the IAEA documents

(a) Approach by the IAEA

The IAEA published the Safety Requirement GS-R-2 "Preparedness and Response for Nuclear or Radiological Emergency" (hereinafter, "GS-R-2") in 2002 and the Safety Guide GS-G-2.1, and the "Arrangement for Preparedness for a Nuclear or Radiological Emergency" (hereinafter, "GS-G-2.1") in 2007. These documents proposed to designate Precautionary Action Zone (PAZ) and Urgent Protective action planning Zone (UPZ) to lower the risk of severe deterministic effect by implementing emergency measures within these two areas before or immediately after the release of radioactive materials based on the conditions of a nuclear facility. PAZ is an area in which provision must be made for the implementation of the precautionary emergency protective actions, while UPZ is an area in which provision must be made for the implementation of the emergency protective actions.

As for the protective measures implemented inside the PAZ, it is stated that sheltering and evacuation of the residents living inside the PAZ should be carried out for the purpose of preventing or reducing the deterministic effects on the residents before or immediately after the release of radioactive materials. The idea behind this IAEA's approach is: first of all, the reactor suffers core damage; then the C/V loses containment function; and only after that, the accident situation gives rise to exposure possible to cause serious deterministic effects. It is stated that, in order to prevent residents from being exposed to such high radiation level, the best solution is to take precautionary measures including immediate evacuation of the residents living inside the PAZ immediately after a fact or a symptom of core damage are identified. Also, when it comes to the implementation of the protective actions before or immediately after the release, it is hard to predict radioactive release from the containment vessel, in case of the damage done to the containment vessel by physical phenomena such as hydrogen explosion and steam explosion. In comparison, whether the core has been damaged or is likely to be damaged can be determined from various parameters by the operators in a relatively early accident stage. It means that precautionary measures including an evacuation could be taken in an early accident stage.

Whilst it is desired to take such precautionary measures prior to the release, it is stated that such measures could be taken immediately after the release in consideration of the possibility of a rapid progress of the phenomenon in the form of an explosion.

On the other hand, the UPZ is a concept that the environmental radiation monitoring in emergencies is conducted first after the occurrence of an accident, in order to grasp the concentration and the path of the radioactive plume and, if any, identify the areas where the residents living outside the PAZ should be evacuated. The idea behind this concept is that the UPZ gives a little more time to spare than the PAZ in terms of the implementation of protective measures. In addition, the protective measures in the UPZ aim not only to avoid the deterministic effect but also to reduce the stochastic effects as low as reasonably achievable. The GS-G-2.1 proposes that the range of the PAZ and the UPZ be 3-5km (5km is recommended) and 5-30km respectively for a commercial reactor with thermal power equal to or more than one million kW.

(b) Domestic discussion based on the approach by the IAEA

Following the approval of the DS105, a draft for the safety guide GS-G-2.1, at the CSS meeting in 2005, the NSC held the first meeting of the Working Group for Reviewing the Regulatory Guide for Emergency Preparedness for Nuclear Facilities (the Chair: Toshio Fujishiro, who was Special Advisor to Research Organization for Information Science and Technology) on March 29, 2006 to review the Regulatory Guide for "Emergency Preparedness for Nuclear Facilities" (T-EP-II.01) based on the international discussion about nuclear disaster prevention.

The Working Group for Reviewing the Regulatory Guide for Emergency Preparedness for Nuclear Facilities led the discussion, initially aiming to introduce the concept of the PAZ into Japan. However, the group met with a strong opposition from NISA which pointed out that: in Japan it was extremely unlikely that a serious accident leading to a release of large amount of radioactive materials would occur; even if such an accident occurred, it was unlikely to continue for a long period of time, and thus, there was no need to immediately evacuate residents within a 5-km radius of a nuclear power station in line with the PAZ concept; if IAEA's approaches such as the concept of the PAZ are introduced into Japan, the local communities around a nuclear power station and the local residents there would be forced to consider relocation of their residence, Offsite center and other facilities; this would cause significant social confusion and foster a perception that the existing disaster prevention measures based on the EPZ is insufficient, which may arouse the feeling of insecurity about nuclear safety among the people in Japan. The NSC did not recognize as rational the reason given by the NISA that the introduction of the PAZ would incite a feeling of fear among the local residents[69]. Nevertheless, the NSC also expressed that the concept of PAZ is originally based on the U.S. system, and the concept would not function in Japan only by setting up an area called the PAZ unless a system equivalent to the system of Emergency Action Levels (EALs), which in the U.S. is supposed to be specified by nuclear operators, is created for the classification of emergency situations[70]. Therefore, considering the fact that measures similar to the emergency protective measures in the PAZ had already been taken in our Nuclear Emergency Response Drill, it was decided that the PAZ should be introduced into Japan in the next step, after getting used to those measures similar to the measures taken in the PAZ and after the discussion on the EAL led by the IAEA reached a conclusion[71]. In these discussions, however, with regard to the domestic light water

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[69] Member of the NSC Shizuyo Kusumi explained that during a working lunch between the NSC and NISA senior officials on May 25, 2006, Kenkichi Hirose, the then head of NISA, expressed opposition, saying, "Don't wake a sleeping child," "Now that the public is finally reassured that necessary countermeasures have been taken with regard to the JCO criticality accident, why dare to stir anxiety by starting this sort of discussion again?"

[70] In the Nuclear Energy Disaster Prevention Drill implemented from the fiscal year 2000 to 2006, an exercise for sheltering and evacuation before and after the release of radioactive materials had been already conducted, and the evacuation area was set for a ring-shaped area with a radius of 1-3km from an accident facility. However, at the hearing with the members of the Working Group for Reviewing the Regulatory Guide for Emergency Preparedness for Nuclear Facility conducted by the Investigation Committee, the reason why the measure similar to the urgent protective action taken in the PAZ was taken as part of the Nuclear Emergency Response Drill in Japan was simply because the scenario for evacuation before the release of radioactive materials was to convince local residents who would not agree the evacuation after radioactive release. Based on the statement at the hearing, it was revealed that, assuming that there would be no damage to the containment and little increase in radioactive release, the exercise had not aimed to avoid deterministic effects but had aimed to completely avoid exposure to radiation. In fact, at the meeting of the Special Committee on Nuclear Emergency Preparedness for Nuclear Facilities in April 2007, the Prefectural Government Association on Nuclear Power expressed, "In the Nuclear Emergency Response Drill, each local government currently evacuates local residents before or immediately after the release of radioactive materials, but it is not a precautionary measure to set evacuation area based on the idea of the PAZ. Thus, please amend relevant expressions in appendix to avoid misperception." At the same hearing, a person stated that since the possibility of evacuation outside the accident site as response measures would be almost none if containment integrity was confirmed, and therefore the person did not think that the containment integrity as a premise is nor reasonable in nuclear emergencies.

[71] The "Criteria for use in preparedness and response for a Nuclear or Radiological Emergency" (GSG-2), General Safety Guide, IAEA indicates examples of EAL as criteria for emergency classifications in general and facility-dependent criteria for determining the classification, but this safety guide was established and published only on March 17, 2011.

reactors, the scale of accident equivalent to the Fukushima Dai-ichi nuclear accident was not postulated, while the affected area was expected to be limited to the area within the range of the EPZ provided in the previous guide. As a result, the concept and the range of the PAZ were not directly mentioned in the revised Regulatory Guide for Emergency Preparedness for Nuclear Facilities, but instead the following sentence was included in the main text: "Depending on the local circumstances and the conditions of the emergency, it is also effective to implement precautionary measures such as sheltering or evacuations before or immediately after the release of radioactive materials." At the same time, the PAZ was mentioned in the Appendix and described as, "As an emergency response inside the EPZ, an emergency drill is being implemented including protective measures before or immediately after the release of radioactive materials based on the condition of each facility, in consideration of specific circumstances with each local government, on the basis of the existing Regulatory Guide for Emergency Preparedness."

In the discussion at the meetings of the Working Group for Reviewing the Regulatory Guide for Emergency Preparedness for Nuclear Facilities, the focus was placed on the introduction of the PAZ into Japan, and the UPZ rarely came up for discussion from the beginning. The UPZ was viewed as an emergency zoning proposed with almost the same purpose as that of the EPZ. On the grounds that the facility types and the radius of the EPZ indicated in the Regulatory Guide for Emergency Preparedness satisfied the requirements proposed in the IAEA document and that there was no significant difference in the size between Japan and foreign countries, a review of the EPZ size was not specifically performed.

(3) Response to a complex disaster of massive natural disaster and nuclear emergency combined

As described in Chapter VI 6. (1) of the Interim Report, a fire was caused by the Niigata-Chuetsu-oki Earthquake at the Kashiwazaki-kariwa Nuclear Power Station (hereinafter, "Kahiwazaki-kariwa NPS") operated by TEPCO in 2007 and the fire motivated the NISA to produce the draft report "Points of concern for the creation of a nuclear emergency preparedness manual dedicated to a complex disaster of massive natural disaster and nuclear emergency combined (draft)." This draft faced criticism from relevant national agencies and local governments. In October 2010, NISA decided to apply the existing disaster prevention scheme to the complex disaster countermeasures. At the same time, the NISA consulted about the need for preparation against a complicated disaster where different kinds of disasters including a nuclear emergency occur at about the same time and about what disaster management system, as a whole, should be established to prepare against such complex disasters, with the Cabinet Office (hereafter in this section referring to a division under the Director General for Disaster Management)[72]. As a result, it was decided that NISA would plan to coordinate relevant matters with a prospect of consultation with the Central Disaster Management Council and that, after the determination of the direction for a further move, it would begin working on tasks required for expanding the nuclear emergency system while coordinating with relevant organizations.

Based on the above-mentioned plan, NISA requested to the Cabinet Office on March 8, 2011 that they would discuss complex disasters at the Central Disaster Management Council. Regarding the Cabinet Office's response to this request, the Cabinet Office says that the meeting was closed shortly due to Cabinet Office's time constraint and that it only suggested consulting each other as needed when more details about complex disasters became available. On the contrary, NISA says that the request was rejected by the Cabinet Office for the reason that the topic was irrelevant to the Central Disaster Management Council. Accordingly, the Investigation Committee was not able to identify the details of the talks between them.

Despite that, the Disaster Countermeasures Basic Act which falls within the jurisdiction of the Cabinet Office gives a definition of a disaster, and Article 1 of the order for enforcement of this law states that a disaster includes damages caused by "the release of considerable amount of radioactive materials." At the Investigation Committee hearing, the Cabinet Office gave the following statements: "In the past, disaster prevention was generally dealt with by the former National Land Agency from the beginning. After the JCO Criticality Accident, the Act on Special Measures Concerning Nuclear Emergency Preparedness was enacted, and specific matters, in particular practical and highly technical matters were purposely separated from NLA's," "It might have been judged that we should recognize what was being discussed but

[72] The Director General for Disaster Management served as the secretariat for the Central Disaster Management Council.

should not be involved in practical and highly technical matters until relevant discussion matured to some extent, because we were not a specialist in nuclear power," "In general the Central Disaster Management Council deals with the issue as a whole, but we expect them (the NISA) to take the initiative to formulate nuclear-related matters and to combine their results with non-nuclear matters." The Cabinet Office also said that, once a nuclear emergency occurs, the Minister of Economy, Trade and Industry should make a practical judgment on the details as to whether that nuclear emergency falls under the provision of nuclear emergency situation and, immediately after this judgment, the Cabinet Office would deal with office procedure for issuing the Declaration of a Nuclear Emergency and establishing the Nuclear Emergency Response Headquarters. That is to say, this is a statement that the Cabinet Office presides over emergency response in the manner similar to the Cabinet Affairs Office, which handles the general affairs of the Cabinet, suggesting their stance that the Cabinet Office will not be involved in the substance of nuclear emergency response.

In addition, the Cabinet Office states that prior to the Tohoku Region Pacific Coast Earthquake there had not been much discussion about disaster prevention against different types of disasters combined, including a nuclear disaster. Regarding the background of this statement, the Cabinet Office mentioned that it had given priority to the disaster prevention of an individual disaster and that it wavered in deciding what scenario should be postulated in terms of complex disasters. The Cabinet Office also said that it was difficult to deal with the disaster prevention against complex disasters due to the shortage of human resources.

5. Relationship with International Convention and International Standards

(1) Approach to a harmonization of the international and national standards

a. Domestic discussion about the IAEA fundamental safety principles

In 2006, the IAEA established the "Fundamental Safety Principles" by integrating various existing safety principles documents[73] and determined 10 safety principles that are consistent and do not contradict each other on the basis of fundamental safety objectives to protect people

[73] As there is no name of Japanese government officials listed as collaborators for drafting the principles or reviewing them, it cannot be confirmed that Japan actively contributed to the formulation of the "Fundamental Safety Principles."

and the environment from the harmful effects of ionizing radiation. Among these principles, those related the safety of nuclear power facilities are as follows:

Principle 1: Responsibility for safety: The prime responsibility for safety must rest with the person or organization responsible for facilities and activities that give rise to radiation risks.

Principle 2: Role of government: An effective legal and governmental framework for safety, including an independent regulatory body, must be established and sustained.

Principle 3: Leadership and management for safety: Effective leadership and management for safety must be established and sustained in organizations concerned with, and facilities and activities that give rise to, radiation risks[74].

Principle 8: Prevention of accidents: All practical efforts must be made to prevent and mitigate nuclear or radiation accidents[75].

Principle 9: Emergency preparedness and response: Arrangements must be made for nuclear emergency preparedness and response for nuclear or radiation incidents

However, at that time the NISA had given an instruction to nuclear operators regarding the back-check of seismic safety associated with the revision of the Seismic Design Guide (LS-D-I.02), and had put priority on its own review of the seismic safety assessment reports submitted by the nuclear operators, including its participation in the discussion at the secondary review conducted by the NSC. For this reason, when the IAEA established the Fundamental Safety Principles, both the NISA and the NSC could not afford to conduct a systematic review of the Regulatory Guides and other guidelines in Japan.

In order to examine the necessity for revising the structure of the Regulatory Guides, the Subcommittee for Reorganization of Regulatory Guides was established under the NSC, and the Subcommittee started discussion in July 2009, referring to the approaches in safety regulations abroad such as the adoption of IAEA Fundamental Safety Principles. In parallel, several special committees were working on the topic. However, the area of discussion was

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74 Specifically, it is stated, “Leadership in safety matters has to be demonstrated at the highest levels in an organization. Safety has to be achieved and maintained by means of an effective management system. ...The management system also has to ensure the promotion of a safety culture, the regular assessment of safety performance and the application of lessons learned from experience.”

75 As a specific content it is stated, “The main measure for the prevention and mitigation of accidents is “defense-in-depth.” Defense-in-depth is mainly realized by the combination of many sequential as well as independent protection levels, which may cause harmful effects on humans and the environment only when it failed to function.

narrowed down due to the difficulty in maintaining human resources necessary for the operation of these committees. The activity of the Subcommittee was aborted after the fourth meeting and the Subcommittee itself also ceased to exist in June 2011.

Nevertheless, in December 2010, the NSC formulated "The Basic Policies of the Near Term Initiative of the Nuclear Safety Commission," in which the NSC showed the principle that: "Whilst each of the Regulatory Guides established by the NSC so far is based on implicitly-agreed fundamental principles regarding nuclear safety, the fundamental principles have not been made explicit. The NSC recognizes the importance of this fact and is determined to formulate a document that clearly indicates the most fundamental principles." In February 2011, the NSC approved the "Approach towards the Promotion of the Basic Policies of the Near Term Initiatives," in which, opinion exchanges with external experts should be actively conducted regarding the fundamental principles for safety. On February 9, 2011, the first meeting was held and it offered an opportunity for an opinion exchange. The subsequent meetings have been reopened several months after the earthquake in 2011 in order to further develop the discussion.

At the first meeting, the NSC Chair Haruki Madarame explained the method of exchanging opinions – Instead of adopting the IAEA Fundamental Safety Principles as they were, the NSC aimed to reach a consensus among all the stakeholders by applying the basic concept of nuclear safety to SA measures for a re-examination of the concept and formulate a Fundamental Safety Principles document, involving regulators, licensees, and the entire the other Japanese citizens[76].

b. IAEA Safety Guide SSG-9 "Seismic Hazards in Site Evaluation for Nuclear Installations"

Based on the implementation of seismic PSA worldwide and the experience of the impact of

[76] In the "Harmonization to International Standards" described in the USNRC Management Directive 6.6 for Internal Management of the development and revision of regulatory guides, NRC states that the Safety Guide such as the standards published by IAEA should also be examined for the application to Regulatory Guides. Also in June 2009 when the European Council adopted the EU Directive to establish a common framework for nuclear safety at nuclear facilities, they placed priority on the opinions of the European Parliament, saying "The Member States, if appropriate, shall review relevant IAEA Fundamental Safety Principles that established the framework of actual practices, which the Member States must respect when implementing the EU Directive." In this way, both the U.S. and the EU respect the international nuclear safety standards such as IAEA Safety Standards, whilst at the same time attempting to harmonize it with national standards. In terms of the inclusion of the international nuclear safety standards into national standards, they were taking the lead in the response in comparison with Japan.

a large earthquake on nuclear power plants in Japan, the IAEA set to work on the revision of the existing Safety Guide NS-G-3.3 "Evaluation of Seismic Hazards for Nuclear Power Plants" since 2008. As the second experts meeting was held for the revision of NS-G-3.3 in Tokyo in 2009, Japan made a presentation on an assessment of ground motion using fault model. Ultimately, the revised document was published as the Safety Guide SSG-9 "Seismic Hazards in Site Evaluation for Nuclear Installations" in 2010 through the approval procedure within the IAEA.

One the features of the new Safety Guide is the first inclusion of an evaluation method by utilizing fault model (seismic source simulation) that has been widely used in Japan, because its effectiveness as an evaluation method of the ground motion had been demonstrated through the experience at the Kashiwazaki-kariwa NPS operated by TEPCO at the Niigata-Chuetsu-oki Earthquake in 2007. This is one of the examples of Japanese contributions to the formulation of international standards.

c. IAEA Safety Guide SSG-18 "Meteorological and Hydrological Hazards in Site Evaluation for Nuclear Installations"

Based on the flooding accident at the Madras Atomic Power Station Unit 2 (Kalepakkam Atomic Power Station, Unit 2) following the Major Earthquake off the Coast of Sumatra in 2004, the IAEA held a workshop in Kalepakkam, India, in 2005. The Japanese delegates initially consisted of the Director of Seismic Safety Office at NISA, JNES (Japan Nuclear Energy Safety Organization), Dr. Kenji Satake (currently professor of the Earthquake Research Institute, University of Tokyo, hereinafter, "Prof. Satake") who was then a member of the National Institute of Advanced Industrial Science and Technology (AIST), and a few representatives from electric power companies, while the NISA had to be absent at the meeting due to follow-up works related to the Earthquake off the coast of Miyagi Prefecture, which had affected the Onagawa Nuclear Power Station (hereinafter, "Onagawa NPS") operated by the Tohoku Electric Power Co., Inc. (hereafter referred to as "Tohoku Electric Power"). At the workshop, Prof, Satake talked with Mr. Antonio R. Godoy, who was a staff member of the IAEA, about the tsunami assessment method developed by the Japan Society of Civil Engineers. As Mr. Godoy requested a report on the tsunami assessment method in an English version, its

English translation was submitted at a conference in Italy in 2006.

Since the previously mentioned workshop, the IAEA worked on the development of the Safety Guide SSG-18 "Meteorological and Hydrological Hazards in Site Evaluation for Nuclear Installations." A draft of the Safety Guide DS417 was produced in 2010 and was finalized as SSG-18 and published in December 2011. Japan joined forces with the IAEA to establish SSG-18, and Japanese experts played a leading role in the development of SSG-18. Those who played an active role in the development included staff members of the JNES, Prof. Satake from the Earthquake Research Institute at the University of Tokyo and Prof. Fumihiko Imamura at the Tohoku University, both of whom were requested to participate in this task by the JNES. As the SSG-18 describes general principles as performance criteria, the IAEA is currently working on specification criteria that would contain detailed information about what should be implemented in applying the criteria to an actual assessment. This program is being implemented as the EBP (Extra Budgetary Program) funded by the JNES.

SSG-18 was developed for the following purposes to: revise the existing Safety Guides NS-G-3.4 "Meteorological Events in Site Evaluation for Nuclear Power Plants" and NS-G-3.5 "Flood Hazard for Nuclear Power Plants on Coastal and River Sites"; introduce the latest knowledge about floods; combine these two Safety Guides as part of the plan to restructure various IAEA Safety Standards. Particularly emphasized in terms of the contents was to flesh out the description of the tsunami hazard assessment. A unique component in the SSG-18 was that it includes a parameter study, which was proposed in the tsunami assessment method by the Japan Society of Civil Engineers and was used widely in Japan, without receiving an endorsement from NISA. It is rare that a concept or a method developed in Japan is adopted in the IAEA Safety Standards. Apart from this tsunami hazard assessment, there is only one other example, which is the fault model previously mentioned in section b.

Nevertheless, the Investigation Committee failed to find evidence and statements that proved the NISA's will to be the reason why the JNES had begun to contribute to the development of IAEA Safety Standards.

In addition, the development of the measures to protect facilities was not the central theme of the development of SSG-18. The draft of SSG-18, that is DS417, described various ideas, which could have been used as the countermeasures against the accident in Fukushima. In the

Chapter on protection measures, without going into specifics, it is pointed out that: design criteria for barriers like embankment would be different and more conservative in comparison with those for power stations; protection measures should be reinforced by adopting a water-proof system as diverse measures; reference to debris and water pressure. However, at the Investigation Committee hearing, a staff member of the JNES said that there was no particular discussion about above-mentioned descriptions in the revision of the DS417 at the IAEA, while the persons in charge at the JNES and that the NISA also did not pay any attention to those descriptions.

(2) Review of regulatory bodies and nuclear operators by the IAEA and other organizations

a. Integrated Regulatory Review Service by IAEA (IRRS)

The IAEA establishes the Safety Standards and provides safety review services, based on the request from its Member States in order to ensure safety in using nuclear energy in the Member States. The Integrated Regulatory Review Service (IRRS), which is one of the review services, aims to perform a comprehensive review of the legislative system related to nuclear safety regulation and the organizations involved in nuclear safety regulation in a nation. The IRRS is implemented through peer reviews by a review team that consists of experts from different countries.

The IRRS is an advanced review service that has been created by integrating the International Regulatory Review Team (IRRT) and the Radiation Safety and Security Infrastructure Appraisal (RaSSIA), intending to perform comprehensive reviews on the legislative system and organizations in a nation involved in nuclear safety regulation. The IRRS made its debut when Romania invited IRRS mission as the IRRT follow-up mission in January 2006, which was followed by an invitation from the U.K., France, Australia, and Mexico. At the 50th IAEA General Conference in September 2006, Japan announced that it would invite the IRRS mission during 2007. After a preparatory meeting in February 2007, the IRRS was carried out between June 25 and June 30 in 2007. Main IRRS implementation is listed in Table V-2.

After review areas are confirmed, the IRRS is conducted through peer reviews by a review team, which consists of experts from different countries, based on: 1. “Self-assessment report” prepared by member states; 2. “IAEA questionnaire.”

Table V-2 Main IRRS implementation list

Year	Country	Review scope	Safety requirements employed as review standards (※1)
2006	Romania	※IRRT follow-up mission	
2006	U.K.	Nuclear Power Reactor only	GS-R-1, GS-R-3
2006	France	Nuclear Power Reactor, etc.	GS-R-1, GS-R-3
2007	Australia	Research Reactor, etc. (※2)	GS-R-1, GS-R-3, GS-R-2, etc.
2007	Japan	Nuclear Power Reactor only	GS-R-1, GS-R-3
2008	Spain	Nuclear Power Reactor, etc.	GS-R-1, GS-R-3, GS-R-2, etc.
2008	Germany	Nuclear Power Reactor only	GS-R-1, GS-R-3, GS-R-2, etc.
2009	France	Nuclear Power Reactor, etc.	GS-R-1, GS-R-3, GS-R-2, etc.
2009	Canada	Nuclear Power Reactor, etc.	GS-R-1, GS-R-3, GS-R-2, etc.
2009	U.K.	Nuclear Power Reactor, etc.	GS-R-1, GS-R-3, GS-R-2, etc.
2009	Russia	Nuclear Power Reactor, etc.	GS-R-1, GS-R-3, GS-R-2, etc.
2010	U.S.	Nuclear Power Reactor only	GSR Part 1, GS-R-3, GS-R-2, etc.
2011 （※3）	Spain	Nuclear Power Reactor, etc.	GS-R-1, GS-R-3, GS-R-2, etc.

※1 Reference Safety Requirements : "Legal and Governmental. Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety" (GS-R-1), Safety Requirements (2000); "Governmental, Legal and Regulatory Framework for Safety" (GSR Part.1), General Safety Requirements (2010); "The Management System for Facilities and Activities" (GSR-3), Safety Requirements (2006); "Preparedness and Response for Nuclear or Radiological Emergency" (GS-R-2), Safety Requirements (2002) (see Table V-1).

※2 There is no nuclear power reactor in Australia.

※3 The IRRS follow-up mission in Spain was scheduled to take place from 24th January to 1st February 2011.

(a) Results of IRRS in Japan

For Japan, the IRRS was implemented in June 2007 and the Mission Report was published in December in 2007[77].

The following three points are emphasized as good practices in the report:

1. Japan has a comprehensive national legal and governmental framework for nuclear safety in place; the current regulatory framework was recently amended and is continuing to evolve.

2. NISA as the regulatory body plays a major role for directing and coordinating the

[77] For the IRRS Report and its draft translation, refer to the following links:

- http://www.nisa.meti.go.jp/genshiryoku/files/report.pdf
- http://www.nisa.meti.go.jp/genshiryoku/files/report2.pdf

evolution of the regulatory framework.

3. Challenges have already been addressed to improve the relations among NISA, the nuclear industry and stakeholders in order to come with a better understanding and cooperation. Further work is also in progress.

In addition, the points below are mentioned in the report as recommendations and suggestions.

R1 The role of NISA as the regulatory body and that of NSC, especially in producing safety guides, should be clarified[78].

S1 NISA is effectively independent from ANRE, in correspondence with the GS-R-1. This situation could be reflected in the legislation more clearly in future[79].

S4 NISA should consider different staff/job rotation frequencies and patterns (particularly for its senior management) to further enhance its knowledge management and effectiveness of nuclear safety regulation of strategic and operational issues[80].

S6 Before approval of operational safety program and start of routine operation, NISA should add an additional hold point for an integrated review of all factors essential for safety.

(b) Japanese effort towards IRRS

As shown in Table V-2, U.K, France, Australia, Spain, Germany, Canada, Russia and the U.S. used the Safety Requirements GS-R-2 as a reference, but Japan did not. The Safety Requirements GS-R-2 was published on November 6, 2002, with the aim to minimize harmful effects to humans, resources and environment in any nuclear or radiological emergencies, and

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78 According to the IAEA review, the relation between NSC Regulatory Guides and the ministerial ordinance by the Ministry of Economy, Trade and Industry (METI), "Ministerial Ordinance for Establishing Technical Standards for Nuclear Power Generating Facilities" as well as the interpretations and structures of these guides and ordinance is unclear.

79 According to IAEA review, in case of conflict between safety and promotion, the Minister of Economy, Trade and Industry is set to put priority on safety, as required by law, and therefore NISA is effectively independent from ANRE. The law referred to was the Article 2 of the Atomic Basic Law, which states that the research, development and utilization of nuclear energy shall be limited to peaceful purposes, on the basis of the highest priority of ensuring safety, and performed on an independent basis under the democratic operation. Its outcome shall be made public and be used to actively contribute to international cooperation. The legislative independence of NISA should be stipulated in the Atomic Basic Law, Act for Establishment of the Japan Atomic Energy Commission and the NSC, and in the Nuclear Reactor Regulation.

80 The IAEA mission report says that a job rotation with short intervals of such as two to three years is not likely to provide the officials with enough time to gain a step-by-step improvement of regulatory and technical abilities required to exercise the regulatory function such as regulatory reviews continuously.

established the requirements for preparedness and response at a sufficient level for such emergencies.

Spain invited the IRRS mission in 2008, a year later than Japan did in 2007. Nevertheless, as of March 11, 2011, Spain had invited a follow-up mission, whilst Japan did not.

The IRRS Guideline, which is a bylaw of the IAEA, states that IRRS follow-up mission should be conducted approximately two years after the main mission. The process of preparation for the follow-up mission begins when a host country of the review sends off an invitation letter to the IAEA. On August 7, 2009, the NISA posted a letter to the IAEA to invite a follow-up mission to be conducted in February 2010, and a preparatory meeting was held from September 3 to 4 in the same year.

On November 25, 2009, however, NISA sent a letter to the IAEA requesting it to put off the follow-up mission, and with the agreement from the IAEA it was postponed. NISA asserted that it would take time to devise a plan for dealing with the issues and to be well-prepared for the follow-up mission, citing the following reasons:

1. On April 3, 2009, a discussion on cross-sectional regulatory issues regarding ensuring safety started at the Basic Safety Policy Subcommittee of Nuclear and Industrial Safety Subcommittee, with the aim to devise a plan for the future as regulatory authority and appropriate future tasks related to safety regulation, taking into account the performance of NISA's past policies and the rapidly changing social environment in recent years. In December 2009, based on the discussion, a draft report "Summary of Tasks Concerning Nuclear Safety Regulations (draft)" was published[81]. Since the IRRS pointed out in its draft report that it identified the issues and suggestions/recommendations for further improvement in terms of the existing system, NISA began tackling these issues. However, the relevant tasks in progress would not have been completed until the follow-up mission scheduled for February.

2. Since 2010, the work load relating to seismic back-check and the restart of the Kashiwazaki-kariwa NPS would increase more than expected.

With regard to this topic, at the Investigation Committee hearing, the then Director of

[81] Later, this draft report was finalized after having been amended based on the public comments and the discussion at the Fundamental Policies Subcommittee of the Nuclear and Industrial Safety Subcommittee, and published in February 2010 as "Summary of tasks concerning nuclear safety regulations."

Nuclear Emergency Preparedness Division at NISA and Director of International Affairs Office at NISA, who was in charge of the issue inside NISA, provided the following statements: "The IRRS mission report was published in June 2007 and I think the NISA harbored a thought of dealing with the issues pointed out in the report. However, the Niigata-Chuetsu-oki Earthquake occurred in July 2007, which was immediately after the report had been published. Although it was just a year later than I was appointed as the Director of the Nuclear Emergency Preparedness Division, it seemed that NISA as a whole had been occupied with responding to the Niigata Prefecture Chuetsu-oki Earthquake (and verifications of seismic safety based on the earthquake) throughout the year. After my arrival at the new post, I became fully occupied with the work related to the seismic back-check"; "As it is stated in the bylaw of the IAEA that the IRRS follow-up mission should be conducted after two years of the main mission, we sent off the invitation letter and also had a preparatory meeting. Things went on according to the plan up to that point. But at the preparatory meeting, we were obsessed with responding to the Niigata Prefecture Chuetsu-oki Earthquake. For this reason, we had not been well-prepared for the matters pointed out in the report, and no progress had been made on other matters;" "As it has been 13 years since the establishment of NISA in 2001, we had a number of complicated issues to deal with. We were instructed to reorganize the whole system and were going to discuss this matter in the subcommittee. In such a situation, there was an attempt to discuss the whole issue including those pointed out in the IRRS review, from scratch. However, the duration of half a year until the follow-up mission was not long enough for digging up the whole issues and dealing with them. Given that the follow-up mission was invited as planned, a large amount of logistics would be needed during the period in which we should tackle the whole issue. Realizing that it would not bring a fruitful outcome, we came to agree to the idea, among the NISA, the NSC and relevant foreign regulatory agencies, that we should invite the follow-up mission after we finished comprehensive discussions. These were the reasons behind the postponement."

Until the earthquake on March 11, 2011, the invitation for the follow-up mission was not sent to the IAEA. The then Director of Nuclear Emergency Preparedness Division at NISA and Director of International Affairs Office at NISA, who were in charge of the issue inside the NISA, stated: "The follow-up mission had been postponed, because we would not be able to respond fully to the matters pointed out in the IRRS. As a condition for inviting the mission, there was a general agreement that we should send an invitation only after we became confident in ourselves that we would be able to respond to the issues pointed out in the previous mission to some extent;" "We thought that we would be able to sort out most of the issues within 2-3 years."

b. IAEA's International Expert Mission on the accident at the Fukushima Dai-ichi NPS

Based on the agreement with the government of Japan, the IAEA conducted an investigation by sending an international expert mission to clarify the immediate lessons learned from the Fukushima Dai-ichi NPS accident and to share the information with the global nuclear community. The result of the investigation was reported and published at the IAEA Ministerial Conference in June 2011[82]. The main conclusion of this report is that, given the extreme circumstances of the accident, the management of the accident site was conducted in the best way possible and following the IAEA Fundamental Principle 3. However, it is pointed out that there were insufficient defense-in-depth provisions for tsunami. As lessons learned, the following points are indicated: for severe situations, such as total loss of offsite power or loss of all heat sinks or the engineering safety systems, simple alternative sources for these functions including any necessary equipment (such as mobile power, compressed air, and water supplies) should be provided for severe accident management; severe accident management guidelines and associated procedures should take account of potential unavailability of instruments, lighting, and power, and abnormal conditions, including plant state and high radiation fields.

In the 3, 4, 5 "Follow-up IRRS Mission," it is stated that the respective roles of the NSC and the NISA are formally defined; however, some clarification seems necessary in their actual fields of intervention and respective contribution. According to the IAEA, whilst the NSC directly provided advice to the Prime Minister, the NISA, the regulatory authority, neither formed part of the decision-making process by providing a situation assessment nor composed part of the disaster response, apart from conveying orders and instructions to the nuclear

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[82] For the IAEA report and its provisional translation, please see the links below.

- http://www-pub.iaea.org/mtcd/meetings/pdfplus/2011/cn200/documentation/cn200_final-fukushima-mission_report.pdf
- http://www.nisa.meti.go.jp/oshirase/2011/08/230805-5-1.pdf (provisional translation)

operators. Thus, the IAEA felt that the regulatory authority should play a more distinctive role in disaster response, as stated in the IAEA Fundamental Safety Principles.

c. IAEA's response to the International Emergency Response Exercise (ConvEx-3)

IAEA's International Emergency Response Exercise (ConvEx-3) is implemented by the IAEA based on two conventions of nuclear accidents: Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency; Convention on Early Notification of a Nuclear Accident. The exercise aims at testing/evaluating exchange of information between the Incident and Emergency Centre (IEC) of the IAEA and Member States, and is conducted on the occasion of the Integrated Nuclear Emergency Response Drill in "Accident State." ConvEx, the IAEA's International Emergency Response Exercise, is composed of three types of exercises at different levels. Each exercise level is further divided into 2-4 levels of exercise modes. The ConvEx-3 is the exercise at the highest level and corresponds to so-called a comprehensive exercise.

The exercise has been conducted three times so far in 2001 (France), 2005 (Rumania) and 2008 (Mexico). At the ConvEx-3 in Mexico, 67 countries participated in the exercise, among which 41 countries including Japan were classified as level A participants (reception of messages/information only), whereas the remaining 26 countries were classified as level B participants (exchange notification/information and assistance). Level A participation starts when a participant receives early notification of the accident from the IEC and ends when the early notification is verified. Level B participation, in addition to the activities of Level A, includes exercises in receiving notification of emergency situation, organizing necessary activities in response to the notification and providing assistance if assistance is requested according to the above-mentioned international convention. Regarding Japan's participation as a Level A participant, a NISA official concerned said that, taking into consideration the location of the "Accident State" Mexico far away from Japan, it was difficult to suppose that the accident would affect Japan and that level A participation would be adequate. He also added that it did not seem logical to take part in level-B exercise, which would require a domestic response.

d. Review of nuclear operators

International and domestic organizations provide review services for nuclear operators: the Operational Safety Review Team (OSART) program by the IAEA; peer review run by the World Association of Nuclear Operators (WANO); peer review run by the Japan Nuclear Technology Institute (JANTI).

(a) Acceptance of the Operational Safety Review Team (OSART) by IAEA

The IAEA provides review services called OSART, which aims to review the operational safety of a nuclear power station for nuclear operators. The OSART employs the previously mentioned IAEA Safety Standards as the basis of assessment. According to the OSART Guideline, the OSART implements an assessment not only on the following nine fields but also on safety culture by analyzing the review results of each field: 1. Management, organization and administration; 2. Training and qualification; 3. Operations; 4. Maintenance; 5. Technical support; 6. Operational experience feedback; 7. Radiation protection; 8. Chemistry; 9. Emergency planning and preparedness. The procedure with the OSART is that nuclear operators send an invitation to the IAEA through the NISA, which is part of the government of Japan, and then the operators will be informed of the IAEA's decision on its acceptance through the NISA. The OSART Mission list in Japan is shown in Table V-3[83].

[83] Please refer to the IAEA "OSART Mission List" for details of situation in other countries (http://www-ns.iaea.org/downloads/ni/s-reviews/osart/osart%20mission%20list%20jan%202012.pdf)

Table V-3 OSART Mission List in Japan

Year	Nuclear facility
1988	Kansai Electric Power Co. Inc., (※) Takahama Nuclear Power Station, Unit 3 and Unit 4
1992	Tokyo Electric Power Company, Fukushima Dai-ni Nuclear Power Station, Unit 3 and Unit 4
1995	Chubu Electric Power Co. Inc., Hamaoka Nuclear Power Station, Unit 3 and Unit 4
2004	Tokyo Electric Power Company, Kashiwazaki-kariwa Nuclear Power Station, Unit 3 and Unit 6
2009	Kansai Electric Power Co, Inc., Mihanma Nuclear Power Station, Unit 3

(b) Peer reviews among nuclear operators

There are two peer review programs among nuclear operators, that is, the one implemented by the WANO and the other by the JANTI.

1) Peer reviews by the WANO

With the Chernobyl Accident in 1986 as a turning point, the WANO was established in 1989 by nuclear operators including those in Japan and has been conducting various support activities for power stations to improve the safety and reliability of nuclear power stations to their best condition, such as review services for nuclear power stations in the world and exchange of information on failures and troubles.

WANO peer review uses the “WANO Performance Objectives and Criteria: PO&Cs” as criteria and is designed to find out items to be improved and extract good practices through opinion exchange with the staff at power stations while conducting site observations.

From September 22 to October 3, 2008, TEPCO received the CPR (Corporate Peer Review), which is a review to evaluate the organization and management system. The WANO team, which consisted of nuclear experts from six countries, reviewed the organization and management system of the Headquarters of TEPCO. CPR report was submitted to TEPCO in

October 2008.

TEPCO created a digest version of the CPR report in order to communicate its content in the office. In the report, it is stated that there are several items to be improved in five areas, which are “safety culture,” “leadership to be taken by the headquarters regarding process improvement,” “monitoring of life management,” “use of OE (operating experience),” and “human resources and educational/training.” For example, the following points are reported in relation to “safety culture”: the headquarters do not have a policy document that clearly prescribes safety culture; the interview with employees revealed that understanding of safety culture was not consistent among the them; staff at the headquarters were not clear about the whole idea of safety culture and the concept was not permeated throughout the organization; with the aim to foster safety culture, transparency should be recognized and, in parallel, a broader approach should be taken beyond compliance with laws and regulations. In terms of “human resources and educational/training,” the report stated that: avoidable human errors were made due to flaws in the process expected to systematically extract training needs from non-compliance practices; a standard procedures common to all the plants were not shared among TEPCO and contractors’ workers; due to weak ownership (sense of ownership) towards educational/training in the line organization, TEPCO were missing opportunities to draw the maximum benefit from educational/training for improving performance.

TEPCO carried out a range of activities to make improvements responding to these suggestions and, in November 2009, decided to invite the CPR follow-up mission in October 2010. Specifically, in order to improve “safety culture” area, TEPCO clarified the whole aspect of safety culture by establishing “Seven basic principles of safety culture;” distributed a booklet about the principles to the headquarters and each site to share the principles throughout the organization; conducted educational activities such as a case study based on the principles. In addition, with regard to “human resources and educational training” area, the observation of training was carried out on regular basis and mainly by the operation management manager and the operation management officer, and unsatisfactory performance, if identified, was directly pointed out during the training or recorded on a training observation check sheet.

From October 4 to October 8, 2010, TEPCO invited the CPR follow-up mission that consisted of nuclear experts from three countries, and an evaluation report based on the review by the follow-up mission was submitted to TEPCO. A digest in-house version of this follow-up evaluation report was created to communicate its content to the employees. The evaluation was carried out based on three level criteria: Condition A - Problems have been solved or are expected to be solved shortly; Condition B - Good progress is being made. Objectives will likely to be achieved within a reasonable time period; Condition C - Objectives are unlikely to be resolved quickly. Some of the important measures are not employed. Among the five areas that were reported to require improvement, the "safety culture" area received "A," while the other four areas received "B." As for the evaluation on the "safety culture" area, the report cited as good examples the following activities: the "Seven fundamental principles for the basic idea of safety culture" were prescribed and actually conveyed to the employees; safety culture fostering activities were integrated into daily work; employees were awarded for such activities. For the "human resources and educational training" area, the report referred as a good practice to the observation of educational training by the managers, while it pointed out a need to clarify their expectations for the training observation and grasp the status of the training observation by the manager. At the end of this follow-up mission, the representative of the review team commented that various efforts were being made and that this was more than anticipated. In addition, he added that they the review team had an impression that the progress of activities was slow and that it would be important to prioritize important activities between these activities. Replying to this comment, TEPCO President Shimizu commented that it was one of the tendencies in the company to carry out various efforts in parallel but they would try to promote these activities putting priority among them.

2) Peer reviews by the JANTI

Following the JCO Criticality Accident in September 1999, Nuclear Safety Network (NS Net) was established by 35 companies and research institutes within the nuclear industry in December 1999, aiming to enhance safety awareness and thereby share/enhance safety culture across the entire nuclear industry. In April 2005, Japan Nuclear Technology Institute (JANTI)[84] was established by nuclear operators, nuclear manufacturers and research institutes with the aim

[84] At the time of establishment, it was a limited liability intermediary corporation, while as of March 2011 it is a general incorporated association.

to further improve nuclear safety by reinforcing technological foundations and promoting self-motivated activities for safety.

The JANTI carries out peer reviews to contribute to the promotion of the self-motivated activities for safety. The review team employs as criteria the "Performance Objectives and Criteria: PO&Cs" developed by the WANO and uses the review method adopted by the WANO and the Institute of Nuclear Power Operation (INPO[85]). The review team implements a review by conducting activities, with emphasis on site observations, as well as exchanging opinions with employees at power stations, whilst finding out items to be improved and extracting good practices in the review.

Table V-4 shows completed and planned peer reviews of TEPCO by the WANO and JANTI. The plans were made before the Tohoku Region Pacific Coast Earthquake[86]. Reviews by the IAEA and the OSART described in the previous section (a) are also included in the Table V-4.

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[85] This is an agency founded by nuclear operators in the U.S., following the TMI accident in 1979. Periodic reviews conducted on nuclear power stations all over the U.S. are one of the main activities of the INPO in which the major process involves field observations during a two weeks staying at a power station. In the summary of the results of the peer review on the Fukushima Dai-ni Nuclear Power Station carried out by the JANTI in 2008, it is stated that, "Among the nuclear stakeholders, it is recognized that the improvement in safety and reliability of the nuclear power stations in the U.S. since the 1990s owes a large part to the INPO."

[86] For the situations related to other nuclear operators in relation to the JANTI, please refer to "List of Peer Review" available at the link below: http://www.gengikyo.jp/db/fm/peerreview.php

Table V-4 Completed and planned reviews by the WANO and the JANTI on TEPCO (※1)

Year of implementation	Review target			
	Head Office	Fukushima Dai-ichi Nuclear Power Station	Fukushima Dai-ni Nuclear Power Station	Kashiwazaki-kariwa Nuclear Power Station
1992			IAEA-OSART Review	
1993			IAEA-OSART Follow-up	
1999				WANO Peer Review
2000		JANTI（NS Net） Review		
2003		WANO Peer Review	JANTI（NS Net） Review	
2004				IAEA-OSART Review
2005			WANO Peer Review	
2006		JANTI Review		IAEA-OSART Follow-up
2007		JANTI Follow-up		（※2）
2008	WANO-CPR		JANTI Review	
2009		WANO Peer Review		
2010	WANO-CPR Follow-up			WANO Peer Review
Future Plan（※1）		FY 2012 JANTI Review	FY 2011 WANO Peer Review	FY2013 JANTI Review

※1 "Future Plan" shows plans made prior to the Tohoku Region Pacific Coast Earthquake.

※2 WANO Peer Review was planned to take place in September 2007. However, it was postponed due to the Niigata-Chuetsu-oki Earthquake in July 2007.

6. Organizational Structure as Regulatory Bodies for Nuclear Safety

(1) NISA as a regulatory authority

a. Background of the foundation of the NISA

As a result of the reorganization of the central government in January 2001, the Ministry of Economy, Trade and Industry took charge of all safety regulations on nuclear power as an energy source. In this process, the NISA was established as a "special agency" inside the Agency for Natural Resources and Energy, an extra-ministerial bureau, to take charge of ensuring energy safety and industrial safety alone.

The NISA was made up of: the main agency; the Regional Mine Safety and Inspection Bureau, which was set up nationwide as a mine safety administration organization; the Nuclear Safety Inspector, which was established near nuclear power facilities throughout the country; and the Nuclear Safety Inspector Office where Senior Specialists in Nuclear Emergency reside.

The initial number of the staff at the NISA was 625 (as of April 2001) among which the staff in charge of nuclear safety increased from about 140 to about 260 since the foundation of the agency. Of the latter, the number of Nuclear Safety Inspectors and Senior Specialists for Nuclear Emergency, who were resident inspectors, increased from about 50 to about 100. The most common career background of the staff members who were employed at that time through the mid-career hiring is said to have been in engineering at nuclear vendors and in the Self-Defense Force with knowledge about disaster prevention.

b. Progress in the administration during the first 10 years of the NISA's establishment

On January 11, 2001, which was immediately after the central government reorganization, the Minister of Economy, Trade and Industry made an inquiry to the Advisory Committee for Natural Resources and Energy[87] about the way of ensuring nuclear safety in the future based on recent changes in the environment[88], and its review was relegated to the Nuclear and Industrial Safety Subcommittee[87]. As a result of this review, in July 2001 the direction that nuclear safety regulations should aim at was indicated in the Nuclear and Industrial Safety Subcommittee report entitled, "Report on Ensuring Nuclear Safety Infrastructure". In addition, the report emphasized the necessity to reinforce nuclear safety infrastructure and became the guide to the NISA's nuclear safety regulations.

However, various accidents and other events relating to nuclear safety occurred, overwhelmed the NISA with work required in response to each accident/event. These

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[87] The Nuclear and Industrial Safety Subcommittee was set up under the former Advisory Committee for Energy in December 2000 to discuss intensively about nuclear safety regulations due to the issues raised (on July 21, 2000) by the General Subcommittee of the former Advisory Committee for Energy inside the former Ministry of International Trade and Industry. Through the central government reorganization on January 6, 2001, as a succeeding advisory committee, the Advisory Committee for Natural Resources and Energy was established inside the Agency for Natural Resources and Energy, while the Nuclear and Industrial Safety Subcommittee was set up on January 10, 2001.

[88] January 11, 2001, Inquiry 2 "What should it be done to ensure nuclear safety and secure power in the future based on recent changes in the environment?"

accidents/events included a falsification of voluntary inspection reports at a nuclear power station run by the Tokyo Electric Power Company (TEPCO), which was made public in 2002, the secondary system pipe rupture at Unit 3 of the Mihama NPS operated by the Kansai Electric Power Co., Inc. (2004), the reactor trip at the Onagawa NPS following the Earthquake off the coast of Miyagi Prefecture (2005), seismic back check (2006), and the fire at the Kashiwazaki-kariwa NPS operated by the TEPCO caused by the Niigata-Chuetsu-oki Earthquake (2007). Every time an accident/event occurs, the NISA must instruct the operator concerned to conduct an investigation and produces a report to investigate the cause of the accident/event and has to evaluate the validity of the report. As required, the NISA reports its evaluation results to the NSC, if need be, whilst the NISA amends relevant laws if necessary and instruct nuclear operators to respond to the amended laws. Moreover, based on the evaluation results, NISA has to provide an explanation about the safety of the nuclear facility at the local areas where the facility is located. As having been occupied with responding to these accidents/events, the NISA was not able to assign enough organizational and human resources to address long-term tasks sufficiently. It was in 2010 that the Nuclear and Industrial Safety Subcommittee had discussion based on the changes in the environment surrounding the nuclear safety regulation, and produced the report entitled “Basic Policy Subcommittee Report: Report of the Issues on Nuclear Safety Regulation.”

c. Organizational Problems with the NISA and problems with the environment surrounding the NISA

(a) The NISA is not an agency dedicated to nuclear regulations

NISA is in charge of not only nuclear safety regulations but also industrial safety. Therefore, if such accidents occur as petrochemical complex accident or gas water heater accident in the field of industrial safety, NISA is forced to respond to the accident by investigating into the causes of the accidents and formulating measures to prevent them from happening again. Whether the division that handles the accident is in charge of nuclear safety regulations or industrial safety, NISA executive officials such as the Director-General and the Deputy Director-General of the NISA are forced to handle these accidents. This means that the NISA does not have an organizational structure, which allows the leaders of the organization to focus on nuclear safety regulations.

(b) The NISA is not independent in terms of personnel management

Whilst the specialists with technical expertise are independently employed through mid-career recruitment by the NISA, other staff members such as administrative and engineering officials are employed as staff members for the entire Ministry of Economy, Trade and Industry. The personnel transfers for these staff members are implemented following the personnel rules applied to the whole Ministry and are arranged for the entire Ministry to give each official an opportunity to have work experience within various posts and units, with the aim to identify the aptitude of each official. Since personnel transfers with a normal interval, which is 2-3 years, are also applied to the posts and units that require expertise and experience of nuclear regulation such as the NISA, that makes it difficult to develop specialized technical ability. Although staff members who are identified to have an aptitude for the NISA through the personnel operation are given a higher position step-by-step in a systematic manner, the necessity to develop staff member's expert technical abilities still remains a problem.

Nevertheless, when reviewing the personnel operation of the NISA, it is necessary to take into account the statement mentioned in the Basic Policy of Employment and Promotion (approved by the Cabinet on March 3, 2009[89]), which is based on the Article 54 of the National Public Service Act. The statement says, "With regard to a personnel transfer, efforts must be made to give the staff a variety of job opportunities, whilst it shall be implemented in consideration of the following points: development of administrative processing system which is able to respond appropriately to various administrative issues and changing work load; prevention of negative effects resulting from the situation in which a specific staff member is assigned to the same official post for a long period of time."

(c) The NISA does not have an organizational and personnel arrangement that is capable of addressing mid- to long-term challenges

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89 Based on Article 54, Section 1 of the National Public Service Act, which was revised by the Law of Partial Revision on the National Public Service Act (Law No. 108, 2007), the basic policy of employment and promotion was formulated as a basic guideline to secure appropriate and effective operation concerning the employment, promotion, demotion and transfer of officials.

As described in previous paragraphs and in Chapter VI of the Interim Report, during approximately 10 years since its establishment in January 2001, NISA has been occupied with the handling of various accidents, which have occurred at nuclear facilities, and therefore NISA had no choice but to prioritize the handling of such short-term administrative issues. Depending on the type of accident, a certain section has to take charge of a response to the accident, but due to the priority placed on these pressing issues, it was not feasible to maintain a sufficient amount of human resources for mid- and long-term tasks within each section. Although NISA recognized the necessity of reviewing mid- and long-term issues, it had no room for dealing with those issues in terms of its organizational and personnel capacities.

For example, the Study Group on the Use of Risk Information under the Nuclear and Industrial Safety Subcommittee was discussing more comprehensive use of risk information to realize more effective and efficient regulations through further enhancement of scientific rationality in safety regulations. Whilst the Study Group began its discussion in 2005, it was forced to have an interruption for four years between November 2006 and September 2010 due to the comprehensive checks of the falsification of inspection records and other misconduct at nuclear power facilities (NISA instruction in November 2006[90]).

(d) The NISA cannot afford to have a sufficient personnel interaction with international agencies and foreign regulatory authorities

Whilst Japan is the second largest financial contributor[91] after the U.S. to the IAEA, which promotes the peaceful use of atomic energy and aims to prevent the use of atomic energy to be diverted from a peaceful purpose to a military purpose, the number of Japanese staff members account for only five percent of the entire IAEA senior staff. It is not the problem specific to the IAEA that Japanese personnel contribution is low in comparison with the share of Japanese financial contribution. The same can be said of most international agencies. Although

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[90] On October 31, 2006, the falsification of data at the Matanogawa Power Station operated by the Chugoku Electric Power Co., Inc. was disclosed. Since other accidents and problems were uncovered one after another, the NISA instructed all the power companies to conduct comprehensive checks as to whether falsified records, lack of necessary procedures and other similar problems at hydroelectric, thermal and nuclear power generating facilities by the end of March 2007.

[91] Simple international comparison is not feasible because financial contributions are made in various forms; however, in 2011, the shares of contribution by the U.S. and Japan for the regular budget of IAEA were 25.7% and 12.4% respectively.

government officials with work experience at the IAEA are useful to grasp the trends of the international safety standards as well as coordinate with the IAEA for various matters, the current staffing situation at the NISA does not allow an increase in the number of staff working for the IAEA. The same can be said of the personnel interaction with the NRC.

In addition, due to the time constraints coming from daily tasks, NISA officials did not often participate in IAEA meetings such as CSS and NUSSC. In these cases staff members from the JNES sometimes took part in the meetings on behalf of NISA staff. This is a good example to show that the direct opinion and information exchanges with officials from foreign regulatory authorities are not conducted sufficiently.

(e) NISA's organizational and personnel arrangements are suitable only for response to individual accidents

As reported previously and in Chapter VI of the Interim Report, NISA is an agency that conducts an investigation to identify accident causes and takes measures to prevent recurrence when an accident has occurred at a nuclear facility. However, NISA's review is limited to an individual accident caused by a specific event and does not include a comprehensive review such as an investigation into the possibility of an accident caused by related events combined and its preventative measures.

For example, in implementing the seismic back check, a priority was placed on checking the seismic safety of the safety-related buildings and structures at the nuclear facility, based on the experience at TEPCO's Kashiwazaki-kariwa NPS at the time of the Niigata-Chuetsu-oki Earthquake. As a result, the interim report of the seismic back check covered only the evaluation of design basis earthquake ground motion and seismic safety check of the safety-related buildings and structures. On the other hand, although the instruction of the seismic back check included the evaluation of the residual risk by the use of seismic PSA, the safety assessment of accompanying events such as tsunami had been postponed for the final report. And then, the Fukushima Nuclear Accident occurred.

Moreover, a comprehensive risk assessment on the nuclear facility has not been conducted, factoring in potential external events leading to a nuclear accident such as fire, volcano and landslide.

(f) Problem with the efficiency of administrative work in relation to the Nuclear Safety Commission (NSC)

The NISA was set up as a special agency within the Agency for Natural Resources and Energy, which takes a position to promote the use of nuclear energy. However, it can be said that its independence as a nuclear regulatory agency is practically ensured, as its regulatory activities are being checked by the NSC. On the other hand, NISA does not formulate regulatory guides separately from the NSC Regulatory Guides, which is NSC's bylaws, for fear of impairing efficiency in administrative work. Instead, NISA waits for the NSC to formulate and revise the NSC Regulatory Guides. Once the NSC Regulatory Guides have been established, the NISA takes actions.

(2) The NSC as an organization involved in regulation

a. Background of the foundation of the NSC

In 1978, with the aim to strengthen the system of securing nuclear safety, the NSC was established to take charge of safety regulations separated from among the functions associated with the former Japan Atomic Energy Commission. The Government regulation on the safe use of nuclear energy is implemented directly by the administrative bodies such as the Ministry of Economy, Trade and Industry and the Ministry of Education, Culture, Sports, Science and Technology[92], whereas the NSC plays a role in making decisions on the fundamental policies regarding the safety regulations used by the Government and in leading not only the administrative bodies but also nuclear operators from a neutral and independent position from the administrative bodies. For this reason, the NSC possesses a strong authority including recommendations to the relevant administrative bodies through the Prime Minister.

From the standpoint of neutrality, the NSC belongs to the Cabinet Office. The NSC consists of: five commissioners appointed by the Prime Minister with consent from the Diet; examination committee members that are composed of experts in various fields; special committee members; approximately 100 staff members of the Secretariat.

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[92] These ministries were the former Science and Technology Agency and the Ministry of International Trade and Industry, etc. prior to the central government reorganization on January 6, 2001.

b. Organizational Problems with the NSC and the problems with environment surrounding the NSC

(a) Term of special committee members and open-ended work plan

In general, the term of the members of the NSC special committees had not been prescribed until recently, while that was determined on the occasion of reviewing the regulation related to the term and concurrent holding of positions, which was applied to all the council members in the government[93]. For this reason, it turned out that some special committee member served as the chairperson of a special committee for a long period and that some special committee member served as a commissioner at the Atomic Energy Commission or the NSC after having served as a special committee member.

For the formulation and revision of the guidance, a deadline is not particularly set. For example, it took more than five years to revise the Seismic Design Regulatory Guide from 2001 to 2006. As for the Regulatory Guide for Reviewing Nuclear Reactor Site Evaluation, the revision process began in 1979, immediately after the NSC was separated from the Japan Atomic Energy Commission and was established[94]. After the first and second reviews were conducted from 1979 to 1985 and from 1992 to 1997, respectively[95], the revision activity was ultimately discontinued.

The term of office for Special Committee members is not prescribed, and no end date is set for the formulation and revision of the Regulatory Guides, This means that the Regulatory Guides concerning nuclear safety were formulated and revised upon only after experts discussed the issue through and through to reach agreement. As the proceedings of the meeting have been made public, it can be said that the transparency of the discussion is ensured;

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[93] The Secretariat for the NSC established “Rules regarding the bylaw of the announcement of the examination committee members, expert members and special committee members” on April 1, 2005 and placed limitation on an assignment for a long period of time in relation to the special members. According to the NSC, there was no rule for reappointment and term of office period before the rule was established.

[94] In October 1978, for the purpose of establishing the system to ensure nuclear safety, the function related to safety (e.g. policy planning, review and decision on items concerning safety among those related to the development and utilization of nuclear energy) was separated from the other functions held by the Atomic Energy Commission. Following this, the NSC was established to have jurisdiction over the above-mentioned separated function, while at the same time it was also decided that the NSC would take a role to double check the safety inspection conducted by the competent authorities.

[95] The third review started in 2009; however, it was discontinued following the Tohoku Region Pacific Coast Earthquake in March 2011.

however, there is also a criticism that the formulation and revision of the Regulatory Guides are not carried out as quickly as required.

(b) The NSC has no organizational capacities to deal with mid- and long-term issues properly

As described previously and in Chapter VI of the Interim Report, whereas NISA was forced to respond to various accidents at nuclear facilities, the NSC was also forced to check the NISA's regulatory activities in such a situation. For example, the NSC was occupied with checking NISA's response to the falsification of the voluntary inspection report by operators at nuclear power stations and NISA's report on seismic back check assessment. Although the NSC recognized the necessity of reviewing mid- and long-term challenges, it did not have the organizational and personnel capacities to deal with those issues.

Hence, it was not until in December 2010 that the NSC clarified the mid- and long-term tasks, such as the documentation of the fundamental principles for nuclear safety and improvement of the SA measures, in "The basic policies of the near term initiative of the NSC". NSC's resources were preferentially allocated to the urgent task, which was the seismic back check assessment. Thus, until 2011, the NSC had not been able to tackle the most fundamental task, which was to lead nation-wide discussion about the fundamental principles of nuclear safety, in response to the establishment of the IAEA Fundamental Safety Principles in 2006 and to enshrine the principles in an appropriate document after deepening the discussion on the topic.

Also, as illustrated previously in 3.(2).b, in reviewing the AM implementation policy for the Tomari NPS Unit 3, external experts suggested the following points: a review of the AM concerning external event such as a large earthquake is necessary as a future issue; the implementation of the PSA for fires and floods, in addition to earthquakes, is the world trend; these PSAs should be implemented and, based on PSA results, it is encouraged to implement additional measures, if need be. The NSC was aware of the necessity to tackle such mid- and long-term issues, but it could not afford to start the review, being occupied with dealing with short-term issues.