

## **VI. Wrap-up and Recommendations**

### **Introduction**

On March 11, 2011, the Fukushima Dai-ichi Nuclear Power Station (hereafter, “Fukushima Dai-ichi NPS”) and Fukushima Dai-ni Nuclear Power Station (hereafter, “Fukushima Dai-ni NPS”) of Tokyo Electric Power Company (hereafter, “TEPCO”) were damaged in the Tohoku District - off the Pacific Ocean Earthquake and the ensuing tsunami. In particular, an extremely severe accident measuring Level 7 on the International Nuclear and Radiological Event Scale (“INES”) occurred at the Fukushima Dai-ichi NPS. This accident drew strong awareness of people what enormous damage could have brought up in terms of time and space by a large-scale nuclear disaster.

The Investigation Committee was established on May 24, 2011 by a Cabinet decision. Its mission is to make policy recommendations, by investigating and verifying the causes of the accident and ensuing damage, on measures to prevent the further spread of damage caused by the accident and a recurrence of similar accidents in the future.

The outline of the basic direction of the Investigation Committee was determined on the first meeting held on June 7, 2011, and thereafter the Investigation Committee proceeded with investigation activities of the cause of the accident at the Fukushima Dai-ichi and Fukushima Dai-ni NPSs, cause of damages incurred by the accidents, and their background elements. Those outcomes were released on the Investigation Committee’s Interim Report on December 26, 2011. The Investigation Committee has continued multifaceted follow-up investigations referred to in the Interim Report together with the added new studies.

The investigations and verifications of the Investigation Committee were constrained by factors such as extremely high level of radiation dose rates inside and outside of the nuclear reactor building, causing difficulties of direct survey of the reactor and related piping, equipment and systems. There are still less well understood matters, and possibilities of cause and mechanisms merely just pointed out due to time constraints and other reasons still exist, but we believe the Investigation Committee has conducted investigations and diagnosis to the extent possible at the present stage.

The facts revealed by the investigation after the Interim Report are described up until the previous chapter.

The major direct causes of the accident were attributed to natural phenomenon of earthquake and tsunami, but the Investigation Committee's investigation revealed that combination of factors including various problems of accident preventive measures and emergency preparedness, on-site response in the wake of the accident, and off-site damage-expansion preventive measures had been existing as factors of the latest accident becoming that desperately serious and large-scale. For example, referring to the accident preventive measures and emergency preparedness, such as those of TEPCO and Nuclear and Industrial Safety Agency (hereinafter referred to as "NISA"), their emergency preparedness against tsunami or severe accidents was insufficient, preparation for large-scale complex disaster had flaws, and no emergency preparedness existed to cope with possible containment vessel damage and resulting release of large amounts of radioactive materials to off-sites of the power stations. TEPCO's mismanaged on-site responses at the power station at the accident were also observed, and in the government and local governments' off-site damage-expansion preventive measures as well, various problematic cases were identified in which the circumstances of the victims were not sufficiently considered, including radiation monitoring, application of the System for Prediction of Environmental Emergency Dose Information ("SPEEDI"), evacuation orders to local residents, treatment of the radiation-exposed, and the provision of information at home and abroad. Crisis management by the government also surfaced as problematic.

The investigations and verifications conducted up until now have revealed that the drastic strengthening of measures is required in order to prevent further occurrence of accidents at nuclear power stations, and to prevent and mitigate the damage. From this perspective, this chapter discusses and examines the problematic issues considered to be of high importance, and presents the recommendations of the Investigation Committee. To present things clearly, the recommendations concluded in this chapter are printed in bold letters.

## **1. Analysis of Major Problems**

### **(1) TEPCO responses to the accident and the damage to the plant**

#### **a. Problems with the on-site response at the Fukushima Dai-ichi NPS in comparison with that of the Fukushima Dai-ni NPS**

Problems regarding the response at the Fukushima Dai-ichi NPS to the accident were described in Chapter IV of the Interim Report. The following problems with the response at the Fukushima Dai-ichi NPS have also become clear since the compiling of the Interim Report, as a result of comparative review against the newly-investigated response at the Fukushima Dai-ni NPS.

#### **(a) Alternative means of water injection at Unit 3**

At Unit 3 of the Fukushima Dai-ichi NPS, an alternative means of water injection was not prepared before the manual shutdown of the High Pressure Coolant Injection system (“HPCI”). Consequently, the injection of water to the nuclear reactor was cut off for more than six hours, as already pointed out in the Interim Report. At the Fukushima Dai-ni NPS, which had been hit by the tsunami as at the Fukushima Dai-ichi, basically, an alternative means of water injection to take was first verified to actually function before switching to the alternative means, although there were differences in the detailed procedures.

On this point, a TEPCO staff stated at a hearing of the Investigation Committee to the people concerned of the Fukushima Dai-ni NPS that “Such preparatory actions are the very natural thing to do.” It is considered that basic procedures to take on the occasion of a serious accident were shared among staff at the whole site. Of course, the working environment there was better in comparison with the environment at the Fukushima Dai-ichi NPS, as the off-site power was available at the Fukushima Dai-ni NPS. As such, the staff in charge of responding to the situation at the Fukushima Dai-ni NPS were deemed to be in better psychological conditions. Nevertheless, even upon consideration of these points, the response made at the Fukushima Dai-ichi NPS was not appropriate

#### **(b) Monitoring of S/C pressure and temperature at Unit 2**

At Unit 2 of the Fukushima Dai-ichi NPS, the Reactor Core Isolation Cooling System

("RCIC") continued to operate after the complete loss of power on March 11, but as a result of the power loss it could not be controlled and its operation could be interrupted at any moment. Under such conditions, the water source for the RCIC was switched from the condensate storage tank to the Suppression Chamber (S/C) after approximately 04:00 on March 12. However, in the situation that the Residual Heat Removal system could not achieve the expected cooling due to the power loss, maintaining this operational method for a long period of time would cause temperature rise of the steam circulating between the reactor pressure vessel and S/C, and consequently the S/C pressure and temperature to rise, and accordingly the RCIC cooling capability and water injection capability to weaken. Furthermore, the integrity of S/C could have been jeopardized, as it would become difficult to depressurize the reactor by the operation of the main steam Safety Relief Valve (SRV) for an alternative water injection method using the fire protection system lines by fire engines, should the RCIC fail to function. As such, it is considered necessary to have continually monitored the S/C pressure and temperature, prepared the fire engine water injection lines, and conducted reactor depressurization without waiting for the RCIC to stop functioning, without completely relying on the RCIC in operation. However, in reality, as noted in Chapter IV. 5. (1) f. of the Interim Report, these measurements were not done till around 04:30 on March 14, despite the feasibility of measuring pressure and temperature by connecting batteries. In addition, the alternative water injection was not implemented at around 05:00 of the same day, despite the fact that the alternative water injection lines were ready by that time point.

At the Fukushima Dai-ni NPS, on the other hand, the SRVs were opened in phases and water was injected through the Make-up Water Condensate System by monitoring the S/C pressure and temperature, while the RCIC was still in operation, in consideration of preparing an uninterrupted water injection process (See Chapter II. 5. above). Thereafter, too, the S/C temperature and pressure continued to be monitored, being prepared for a situation requiring reactor depressurization when the reactor pressure increased. In parallel, the data was communicated to the Fukushima Dai-ni ERC every hour so that the S/C conditions could be understood at the whole station.

As mentioned above, the situation at the Fukushima Dai-ichi NPS was that the RCIC was just merely functional with the S/C as its water source, but the RCIC was in an unstable and

uncontrollable condition and expecting every moment to stop functioning. In addition, therefore, depressurization and alternative water injection should have been conducted before the S/C pressure suppression function was lost. With this taken into consideration, it is to be noted that the necessity of monitoring S/C pressure and water temperature at the Fukushima Dai-ichi NPS had been higher than that of the Fukushima Dai-ni NPS.

In summary, the staff involved in the responses to the accident at the Fukushima Dai-ni NPS could have less psychological stress thanks to the availability of external power, while those at the Fukushima Dai-ichi NPS were forced to respond simultaneously to multiple units under station blackout conditions. Even under such different conditions, it should be pointed out that the response measures taken at the Fukushima Dai-ichi NPS were inappropriate in comparison with the measures taken at the Fukushima Dai-ni NPS.

**b. The need to continue thorough clarification of the damage**

Although the Investigation Committee has put its utmost effort into the investigation and verification of the truth under the difficulties of conducting on-site investigations as well as time limitations, there are still points that it has been unable to clarify as of this point in time. These include details of the overall damage incurred, including the damaged areas in the main facility of the Fukushima Dai-ichi NPS, the degree of damage, and the development of events over time. The background to the leakage of radioactive substances and the causes of the explosions in the reactor buildings are also included therein. It is also difficult to answer a question whether the explosions could have been avoided, if reactor depressurization and alternative water injection could have been conducted earlier at Units 1 and 3. The Investigation Committee ends its mission by the submission of this Final Report, but nevertheless, almost all stakeholders (relevant organizations) in the field of nuclear power generation, including the national government, nuclear power operators, nuclear power plant manufacturers, research institutes and related academic societies, are in position to shoulder the responsibility of undertaking thorough investigation and fact analyses on the accident till the end. They should take an organizational stance and continue, in their respective capacities, comprehensive and thorough investigation and verification of the unresolved issues.

Some of them have already released their investigation results, but there are not a few cases

of their conclusions being based on apparent misrepresentation of facts, as pointed out in this Final Report Chapter II (Attachment II-1-1). For example, series of incomplete investigations became apparent during the process of investigations of the Investigation Committee, including: Evaluation of plant parameters, which are considered important for fact-finding (such as the results of gamma-ray dosimetry by the containment atmosphere monitoring system (CAMS)) had been lacking until the Investigation Committee required TEPCO; insufficient investigation of causes of reactor water level indicator malfunctions; and, in addition, a few cases of contradictions between statements by employees during its in-house investigations and physical evidence and data were left untouched. Given these circumstances, it should be considered that the investigation conducted by TEPCO and other stakeholders up to now is still insufficient in terms of fact-finding of the accident, and that there are still further remaining points to verify and materials and data to be released. TEPCO and other stakeholders should realize, as the primary party of the accident and their expertise on nuclear power generation, their responsibilities and obligation to provide and continue process of thorough investigation of fact-finding. Relevant agencies of the government should also provide proper guidance to those stakeholders for appropriate investigation of causes and fact-finding, while they should perform their own fact-findings within their own authorities and responsibilities.

Debating on the need of nuclear power generation in Japan is not under the scope of the Investigation Committee, but as long as it exists, building innovative accident-preventing measures should be considered indispensable, in order to prevent any further severe accidents. It is also straightforward that such measures be based on full awareness of fact situations of the latest accident. However, it is considered that the whole clear picture of the accident has not been established yet at this moment, thus the accident preventing measures have no other alternative but to be formulated with knowledge available at this stage. Stakeholders such as TEPCO and nuclear safety regulation authorities should continue efforts to expose the full picture of the cause of the accident, and when new insights become available, continuous review of the accident-preventing measures is necessary based on the new knowledge.

Investigation of the cause of the accident at the Fukushima NPS is brought to international attention. It is the responsibility of Japan to continue further detailed fact-finding and disclose the information to the international community.

## **(2) Responses to the accident by the government and other bodies**

An emergency response facility, the Off-site Center, where the Nuclear Emergency Response Local Headquarters (hereinafter referred to as “Local NERHQ”) was set up, did not function adequately at the initial stage of the accident, and so the government had to assume the key role at the Prime Minister’s Office to respond to the accident. The Prime Minister’s Office was pressed to make circumstantial judgments one after another without any personnel or material scheme such as that of the Off-site Center for aggregating relevant information, while they were pressed to respond to the earthquake and tsunami that had hit a wide-area. Since March 15, when the Integrated Headquarters for Response to the Incident at the Fukushima Nuclear Power Stations (hereinafter referred to as “Integrated Headquarters”) was set up at the TEPCO Head Office, information sharing situation was improved, but concerns were left referring to the function as the government emergency response headquarters.

The followings are descriptions focused on the problems referring to the responses to the accident by the government and other bodies, which were identified further after the Interim Report had been issued.

### **a. Nuclear Emergency Response Local Headquarters**

Referring to the Nuclear Emergency Response Headquarters (hereinafter referred to as the “NERHQ”), the first problem revealed is that, although the Nuclear Emergency Response Manual of the government is drawn up based on the ground that the Off-site Center actually functions, where the Local NERHQ is established, that ground actually failed to stand in the event of this accident, and consequently, the response measures stipulated in the Nuclear Emergency Response Manual could not be taken (See the Interim Report Chapter VII. 3. (1) a.).

The most serious problem to note here is: To begin with, the measures to ensure the continued functionality of the Off-site Center even at a severe accident should have been in place<sup>1</sup>, and further, the measures should also have been taken to facilitate response to such an accident in case of the functional failure of the Off-site Center<sup>2</sup>.

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<sup>1</sup> These will include a better location of off-site centers (as indicated in a MITI notice) and their building equipped with better radiation protection.

<sup>2</sup> Specific measures include designation of an appropriate alternative facility, or redistribution of its roles among the

Secondly, the Investigation Committee must point out the problem of failure to delegate the authority of the Director-General of the NERHQ to the Director-General of the Local NERHQ.

The Act on Special Measures Concerning Nuclear Emergency Preparedness (hereinafter referred to as the “Nuclear Emergency Preparedness Act”) stipulates in its Paragraph 8, Article 20, that part of the authority of the Director-General of NERHQ may be delegated to the Director-General of Local NERHQ in order to issue necessary instructions to implement emergency responses accurately and promptly. Pursuant to this clause, the existing Nuclear Emergency Response Manual rules that on the occurrence of an accident at a commercial nuclear power reactor, NISA, which is the competent government agency for nuclear safety regulation, is to get the decision of the Director-General of NERHQ (Prime Minister) concerning the delegation of authority and to give the notice of delegation. In the scenario for the annual Integrated Nuclear Emergency Response Drill implemented by the government, the process for delegating part of the authority of the Director-General of NERHQ to the Director-General of Local NERHQ is also provided.

In response to the occurrence, at approximately 15:36 on March 11, of a nuclear emergency as defined by Paragraph 1, Article 15 of the Nuclear Emergency Preparedness Act (“Article 15 Emergency”), NISA generated a draft document of announcement concerning declaration of a nuclear emergency and a draft document of notice concerning delegation of authority from the Director-General of the NERHQ to the Director-General of the Local NERHQ. When Minister Banri Kaieda of the Ministry of Economy, Trade and Industry (“METI Minister Kaieda”) requested Prime Minister Naoto Kan for approval of the declaration of a nuclear emergency at approximately 17:42 of the same day, the staff of NISA, who accompanied METI Minister Kaieda and had carried the draft document concerning the delegation of authority from the Director-General of the NERHQ to the Director-General of the Local NERHQ, missed a chance to seek its approval from Prime Minister Kan and left the matter unprocessed. They also failed to act proactively thereafter to get the approval and complete the delegation procedures

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relevant ministries and agencies concerned, when an off-site center loses its functionality. The designation of an alternative facility is stipulated in Paragraph 12, Article 16 of the Enforcement Regulation Act on Special Measures Concerning Nuclear Emergency Preparedness, and is designated in the Off-site Center operation guidelines. In reality the City Hall Minamisoma was designated as an alternative site but was not usable as the alternative facility because it was fully used for the earthquake disaster response.

despite repeated requests from the Local NERHQ to check on the progress<sup>3</sup>. Furthermore, the staff of the Cabinet Secretariat and Cabinet Office, who had received the draft document from NISA, also failed to drive the NISA staff to carry forward the delegation procedures. Under such circumstances, the Local NERHQ consulted the Secretariat for the NERHQ within the Emergency Response Center (ERC) of METI, made various decisions on the implementation of evacuation measures and other items, and implemented them, so that all necessary steps could be taken promptly and without fail, assuming that the delegation of authority had been already complete.

The fact that NISA left the delegation procedure unattended without confirming the progress despite the repeated inquiries from the Local NERHQ was an important problem as posing possible difficulties for on-site local responses. It seems that Cabinet Secretary and Cabinet Office should have driven NISA to complete the delegation procedures, as long as they had been aware of the progress situation of the procedure, even if the matter was not under their own scope of responsibilities.

## **b. Nuclear Emergency Response Headquarters (NERHQ)**

### **(a) Response within the Prime Minister's office**

In the event of a nuclear disaster, the core body of the government response to the emergency is the NERHQ with Prime Minister at its Director-General. According to the Nuclear Emergency Response Manual, the NERHQ is to be set up at the Prime Minister's Office, and the Emergency Response Office of the Prime Minister's Office is to be set up within the Crisis Management Center located in the basement of the Prime Minister's Office, with the role of collecting information, reporting to the Prime Minister, and centralizing coordination of overall government activities. Director-general level personnel from each Ministry and Agency concerned are to gather at this Crisis Management Center and to make up an "Emergency Operations Team." In order to facilitate prompt and accurate decision-makings during an

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<sup>3</sup> The reason why the procedure (of authorizing delegation of authority) was not completed still remains partly unknown, but if the ERC's situation back then is considered, the causes could have been that the Center was in a chaotic situation, and the sense of the importance of the procedure and the understanding that NISA itself was required to have Prime Minister's approval were lacking.

emergency, this Team is expected to consolidate quickly the information brought to the Center from each Ministry and Agency, and coordinate the opinions in a flexible manner.

Upon receiving notification pursuant to the provisions of Article 10 of the Nuclear Emergency Preparedness Act from TEPCO at around 15:42 on March 11, the government Emergency Response Office regarding nuclear energy disaster response was set up at the Crisis Management Center at around 16:36 on the same day. Most of the critical decisions regarding accident response including the emergency evacuation steps, however, became drawn apart from the Crisis Management Center (Emergency Operations Team) at a room on the mezzanine floor below ground or on the fifth floor of the Prime Minister's Office, being attended by competent ministers, the Chairman of the Nuclear Safety Commission (hereinafter referred to as "NSC"), NISA key officials, senior TEPCO officials, etc. Deputy Chief Cabinet Secretary for Crisis Management Tetsuro Itoh (hereinafter referred to as "Crisis Management Deputy Chief Itoh") who heads the Emergency Operations Team often attended the discussion meeting, but his constant attendance to the discussion meeting on a steady basis was actually difficult as the Emergency Operations Team became pressed in responding to the situation including the earthquake and tsunami. As a result, it was difficult for the Emergency Operations Team to completely comprehend the discussion results in the mezzanine floor below ground or on the fifth floor of the Prime Minister's Office<sup>4</sup>. Leading officials of the Ministry of Education, Culture, Sports, Science and Technology ("MEXT") that holds jurisdiction over the SPEEDI system etc. that provide references to formulate evacuation steps, were not requested to attend the discussion meetings, and therefore no mentioning was made about SPEEDI in the subsequent discussions regarding evacuation steps. Moreover, as the members' discussions were made apart from the Crisis Management Center, discussions were occasionally not based on the most recent status of the Fukushima Dai-ichi NPS, as previously reviewed in detail in Chapter III. 4. (2) a., referring to the dispute about TEPCO's evacuation from the accident site<sup>5</sup>.

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<sup>4</sup> At the Prime Minister's Office, the Crisis Management Center was assumed to have the main role of aggregating information. But the members on the mezzanine of the basement floor or the 5th floor of the Prime Minister's Office, who were engaged with the accident response, used the information, for their decisions, obtained from the TEPCO key members in the room as well, who had contacted the TEPCO Head Office or Site Superintendent Yoshida of the Fukushima Dai-ichi NPS for information.

<sup>5</sup> This particular debate was done from before dawn of March 15 till about 04:00 on the day when TEPCO

**The emergency responses should, in general, be based at a location close to the accident site where the relevant information is easy to obtain in a nuclear emergency, and the activities at the accident site are easy to grasp.** From this perspective the following are the problems to note: This time the decision-making was made in the Prime Minister's Office (fifth floor of the Prime Minister's Office, for instance), at a distance from the ERC which served as the government's base for the collection of information on the Fukushima Dai-ichi NPS; even in the Prime Minister's Office the decisions were made in places separated from the Crisis Management Center which served as the base for the gathering of information; and this resulted in a lack and bias in information, creating a situation where a decision had to be made without sufficient information. This is a major lesson that should be drawn from the responses to this accident.

In order to eliminate the situation of insufficient and biased information at the Prime Minister's Office, the Integrated Headquarters was established on March 15, 2011, in TEPCO's Head Office. While this may be evaluated positively as an attempt to improve the accessibility of information pertaining to the Fukushima Dai-ichi NPS, the information required for the government's response was not necessarily information related to TEPCO. In addition, as there is a possibility that similar accidents may occur in nuclear power stations under other power companies that do not have head offices in Tokyo, the Fukushima incident should not be regarded as a universal precedent. **To promptly collect accurate information is, needless to say, the fundamental element in responding to a nuclear emergency. The government emergency response headquarters should be set up in a way which enables the government people access to the necessary information while staying in government facilities like the Prime Minister's Office, without moving to the nuclear operator's head office.**

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President Shimizu visited the Prime Minister's Office and under an assumption that the pressure in the Unit 2 RPV had been dangerously high since the night of March 14. In reality, however, the Unit 2 RPV pressure was on the level of 0.6 MPa gage since about 01:00 of March 15, which enabled continuous water injection. Although it was still in a dangerous situation, water injection was not impossible and in addition the SRV was being attempted to open for reducing the RPV pressure below 0.6 MPa gage, which was believed to enable stable continuous water injection. Members on the fifth floor of the Prime Minister's Office continued their debate without full knowledge of such situation of Unit 2 or actions being taken at the site.

**(b) Problems with collection of information**

The information collection by the government showed great improvement after the Integrated Headquarters was set up at the TEPCO Head Office on March 15, 2011. In an accident such as the one in Fukushima, the Nuclear Emergency Response Manual rules that the nuclear operators are first to report the accident information to the ERC, and then to the Prime Minister's Office from the ERC. At the ERC, actually four or five TEPCO staff dispatched from the Head Office were stationed on a full-time basis since soon after the earthquake on March 11, 2011. Information referring to the Fukushima Dai-ichi NPS was being reported through these TEPCO staff to the ERC.

Members of METI or NISA who had gathered at the ERC had strong dissatisfaction, at the beginning, with TEPCO's provision of information lacking in promptness, as reviewed in detail in the Interim Report Chapter III. 2. (2). The members at the fifth floor of the Prime Minister's Office who were involved in decision-making of evacuation steps etc. also had similar strong complaints that information regarding the Fukushima Dai-ichi NPS, which had not been made available without delay. But, there was hardly anyone at the ERC, who had known that the TEPCO Head Office and the Off-site Center were obtaining on-site information via the TEPCO's television-conference system, and no thought was given to setting up a TEPCO's television-conference system terminal in the ERC, and there were not any such proactive steps taken as to dispatch NISA staff to the TEPCO Head Office to get relevant information<sup>6</sup>.

**c. Fukushima Prefecture Nuclear Emergency Response Center**

Fukushima Prefecture established the Fukushima Prefecture Nuclear Emergency Response Center (hereafter, the "Prefectural Emergency Response Center") on March 11, 2011, with the Governor of Fukushima heading the Center (See Chapter III. 3. of the Interim Report). It was located on the third floor of the Fukushima Prefecture Jichi Kaikan ("Local Government Hall")

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<sup>6</sup> None of the fifth floor of the Prime Minister's Office was aware of the existence of the TV conference system connecting the TEPCO Head Office and the Fukushima Dai-ichi NPS. The Government-TEPCO Integrated Headquarters was not proposed with the intention of utilizing this TV conference system. Those members learned its existence for the first time when they visited the TEPCO Head Office early in the morning of March 15. The launching of the Integrated Headquarters seems to have brought dramatic improvement in dissolving information gap.

adjacent to the government building. While the purpose of the Center had been to take response measures to the accident, insufficiencies in internal and external coordination by the Fukushima Prefecture Nuclear Emergency Response Center gave rise to a couple of problems. One was the response to the evacuation and rescue of patients in the Futaba Hospital, who had been left behind in the evacuation area.

As described in Chapter III. 3. (2) b. above, issues arose referring to the evacuation and rescue of the Futaba Hospital patients etc., who had been left behind evacuation from the Evacuation Zone, such as;

- Firstly, according to the Fukushima Prefecture regional disaster prevention plan, the teams responsible for evacuation measures number in more than one such as the residents' evacuation and safety team (responsible for logistics concerning evacuation vehicles etc.), and the rescue team (responsible for locating remaining patients and arranging evacuation hospitals etc.) within the Prefectural Emergency Response Center, and no team assumed overall control of the teams. So until March 13, the teams did not have problem-consciousness of considering that it was their duties to locate all the hospitalized patients in the evacuation areas and neither did they confirm so with one another.
- Secondly, the Prefectural Emergency Response Center did have the information that most of the hospital patients in the Futaba Hospital were bed-ridden, but did not share the information within the Center, and consequently for their transportation on March 14, resulted in arranging vehicles that required changing vehicles to the destination, situations not suitable for evacuating bed-ridden patients.
- Thirdly, besides the Prefectural Emergency Response Center, staff of the Division of Persons with Disabilities Welfare, Social Health and Welfare Department of Fukushima Prefecture, arranged evacuation hospitals themselves but did not report that to the Prefectural Emergency Response Center, thus resulted in evacuating the patients to a distant high school gymnasium as the transportation destination.
- Fourthly, Director of the Futaba Hospital was at the mountain path of Wariyama-toge with a police officer to meet the Japan Self-Defense Force's rescue team at night on the same day, but the information from the Fukushima Prefecture Police Headquarters was not shared within the Prefectural Emergency Response Center, and consequently the hospital

director etc. were not able to converge with the Japan Self Defense Force and failed to witness the rescue operation on March 15. That further resulted in other 35 patients in the hospital annex building being left unnoticed when the Japan Self Defense Force implemented its second rescue operation on the day.

- Fifthly, the rescue team of the Prefectural Emergency Response Center was not responsible for the entire operation for evacuation of the hospital patients. Even though the team did not have the overall information correctly, the team put out an improper bulletin based on only limited information they had, which gave impression that the Futaba Hospital people had fled from the site without waiting the rescue operation of the Japan Ground Self-Defense Forces.

In order to prevent the recurrence of such situations in the evacuation and rescue of victims from disaster areas, it is necessary: To make firstly the team organization in the emergency response center, that is set up by a prefectural government, cross-sectional and functional depending on the measures that should be taken, rather than to simply bring together the personnel in a vertical manner from the existing relevant organizations. On top of that, there is a need to establish a framework that is able to oversee and coordinate the overall situation, as well as a need to strengthen mutual communication between each team; and secondly, to prepare, in the disaster prevention plan, a system to respond to a disaster by not only the staff who will be based in the emergency response center in the prefecture but also, whenever necessary, the entire government personnel.

Furthermore, **in a nuclear emergency, the prefectural government should take a responsible role in front, because the damage can extend to a regional size. The nuclear emergency preparedness should take this point into account.**

#### **d. Analyses of other specific responses**

##### **(a) Declaration of a nuclear emergency**

As noted in Chapter III. 2. (1) previously, at about 17:42 on March 11, 2011, METI Minister Kaieda, together with Director-General of NISA, Nobuaki Terasaka (“NISA Director-General Terasaka”), who had been at the Prime Minister’s Office as a member of the Emergency Operations Team, being accompanied by other officials, reported to Prime Minister Kan, in his

executive office on the fifth floor of the Prime Minister's Office, on the occurrence of an Article 15 Emergency and requested approval for the declaration of a nuclear emergency. However, NISA Director-General Terasaka and the accompanying officials were unable to provide sufficient explanations to the questions by Prime Minister Kan, when questioned on the situation of the nuclear reactors at the Fukushima Dai-ichi NPS as well as on related legislation. As time passed, the petition proceedings were temporarily suspended because Prime Minister Kan had to leave them about five minutes after around 18:12 on the same day, in order to attend a meeting among party leaders that had been scheduled. After returning from the meeting, Prime Minister Kan soon gave his approval for the declaration of a nuclear emergency, and the declaration was issued at 19:03 on the same day.

Generally, the situation may develop suddenly and rapidly during a nuclear disaster. In this latest case, it was the time when Unit 1 was not being cooled, and the situation was rapidly worsening. It appears that in receiving a report of the Article 15 Emergency, and if the occurrence itself of such emergency is obvious, the process of releasing the declaration first and then grasping the detailed situation etc. should fit the philosophy of the Nuclear Emergency Preparedness Act. Therefore, it is believed that priority should have been given to the declaration of a nuclear emergency, rather than a search for details on the development of the situation and on relevant laws.

**(b) Inspection visit to the Fukushima Dai-ichi NPS**

In the predawn on March 12, 2011, Prime Minister Kan gave instructions to Prime Minister's secretary and others to prepare for an inspection visit to the Fukushima Dai-ichi NPS, for reasons including the lack of adequate information pertaining to the accident at the Fukushima Dai-ichi NPS. Prime Minister Kan was advised from the Chief Cabinet Secretary, Yukio Edano (hereinafter referred to as "Chief Cabinet Secretary Edano") referring to the inspection visit plan that "future political critique is possible." But since the available information referring to the Fukushima Dai-ichi NPS was insufficient, Prime Minister Kan who claimed pride in "being familiar with" nuclear powers (a remark according to the Investigation Committee's interview to former Prime Minister Kan) than any other ministers decided that he needed to talk directly with (Fukushima Dai-ichi) Site Superintendent Yoshida (hereinafter referred to as "Site

Superintendent Yoshida”), and implemented the inspection visit.

This inspection visit ended without any accident and apparently did not affect venting procedures at the Fukushima Dai-ichi NPS after all. Prime Minister Kan addresses his meeting with Site Superintendent Yoshida as having been productive to himself. However, a question still remains as to whether a less problematic step should have been taken by, for instance, dispatching another person to check the situation, instead of having the Prime Minister, who is the supreme commander, staying absent from the Prime Minister’s Office for long time in the event of such a large-scale disaster and accident, taking a risky inspection tour to, and visiting, the accident site where the site staff were being pre-occupied with emergency responses.

**(c) Involvement of the Prime Minister’s Office in specific response to the accident**

At slightly past 18:00 on March 12, 2011, Prime Minister Kan received a report from METI Minister Kaieda about his order to inject seawater into Unit 1 of the Fukushima Dai-ichi NPS, issued at 17:55 immediately before the report. Prime Minister raised a question of whether or not there would be a possibility of recriticality if seawater were injected into the nuclear reactor. As the Chairman of the Nuclear Safety Commission, Haruki Madarame (hereafter referred to as “NSC Chairman Madarame”), who was present on the scene, did not deny the possibility in response, Prime Minister Kan instructed to further review the pros and cons of injecting seawater (See for details Chapter IV. 3. (1) a. above and also Chapter IV. 4. (1) c. of the Interim Report for the discussion process). TEPCO Fellow, Ichiro Takekuro, who was also present there, made a telephone call to Fukushima Dai-ichi Site Superintendent Yoshida slightly after 19:00 on the same day, and made a strong request to “suspend the injection of seawater as the issue was being reviewed in the Prime Minister’s Office.” The development thereafter is as described in details in Chapter IV. 4. (1) c. of the Interim Report.

When Prime Minister Kan raised a question about the possibility of recriticality, there were several individuals present with expertise about nuclear reactors, such as NISA Vice Director-General Eiji Hiraoka and TEPCO Fellow Takekuro as well as NSC Chairman Madarame, but none of them immediately answered and denied the possibility of recriticality in response to the question. Also there were no suggestions such that immediate seawater injection should be implemented immediately because the risk of not injecting the seawater was

apparently higher than the risk of recriticality by seawater injection, by weighing the pros and cons of the two options. None of them assumed the job of an expert. There was also a problem of the attitude of TEPCO management personnel, who jumped to a request to suspend the injection of seawater without giving much consideration, simply because Prime Minister had raised the question.

It should be examined, to begin with, to what extent the Prime Minister's Office should intervene in those actions that would be extremely relevant to on-site response, such as whether seawater or freshwater to be injected. Such matters should first be taken based on the judgment of nuclear operators in their responsibility, which are in the best position to grasp the on-site situation, and possess special and technical knowledge. The government and the Prime Minister's Office, while gaining a good understanding of the response measures being taken and reviewing the measures carefully to assess if they have been appropriate, should leave the response action to the operator, if the operator is taking the appropriate response, and only if the response is assessed to have been inappropriate or inadequate, they should issue an order for the appropriate actions. It should be considered inappropriate for the government and the Prime Minister's Office to spearhead the response and intervene in the on-site response from the onset of the incident.

### **(3) Measures to prevent the expansion of damage**

#### **a. Unique characteristics of a nuclear accident**

A large-scale accident that occurs at a nuclear power station is not regarded simply as a serious accident in the sense of devastating damage to power generating facilities and equipment. Rather, a nuclear accident is extremely extraordinary in the sense of having a level of impact that is not seen in other types of accidents, because, for instance, it: causes, by the dispersion of, and contamination by, leaked radioactive substances, an impact on the health and lives of not only plant personnel but also residents over a wide area; contaminates urban areas, farms, forests, and seawater; brings economic activities to a standstill; and eventually jeopardizes the local community. In the investigation and verification of such nuclear accidents, there is a need to clarify the causes of the accident and the background to the event, as well as to assess if measures taken to prevent the occurrence and spread of damage have been appropriate.

If the measures taken have not been sufficient, there is then a need to assess the reasons behind that. These problems must be investigated and analyzed from many perspectives in order to uncover policies that should be in place to prevent damage.

The following problems will be examined concerning spread of radioactive materials and its monitoring, utilization of SPEEDI information, responses for the residents' evacuation, radiation exposure prevention of on-site workers and residents, and provision of information to the residents and international communities, and other related problems, based on the facts discovered by the investigations after the Interim Report.

#### **b. Monitoring readiness**

Problems pertaining to monitoring systems and utilization of the monitoring data were already reviewed in the Interim Report (Chapter VII. 5. (2) b. and c.), and further the measures to take therefor were also reviewed in the Interim Report (Chapter VII. 5. (2) d.). The division of monitoring roles in the event that the Off-site Center fails to function is examined below, in addition.

In this accident, the monitoring activities based in the Local NERHQ within the Off-site Center were insufficient. Therefore, as reviewed in Chapter IV. 1. (2) a., the government took an initiative in the morning of March 16, 2011 to strengthen the monitoring system and coordinated the division of roles of MEXT, the NSC and the NERHQ. It was decided then that the consolidation and release of monitoring data from the respective organizations would be undertaken by MEXT, the assessment of data would be undertaken by the NSC, and response measures based on the assessment conducted by the NSC would be undertaken by the NERHQ. However, it is difficult to assess that a decision was made with adequate coordination beforehand, amidst a situation that requires an urgent response, among the related organizations, with regard to the scope of data assessment.

The need to decide on the division of roles under such emergency situations is believed to be a result of having not assumed functional failure on the part of the Local NERHQ (the Off-site Center), which was to be responsible for the series of work processes, from the consolidation of monitoring data, assessment and release of information, to the implementation of responses based on the assessment. A lesson drawn from this incident is the need to review monitoring

readiness development.

### **c. SPEEDI utilization policy**

#### **(a) Problems with the systems and the entities that make use of them**

SPEEDI is a system that can predict radiation dose rates in the surrounding environment when a nuclear accident occurs, based on the emissions source information that is transmitted from the Emergency Response Support System (ERSS). However, the ERSS may fail to function in collecting and transmitting the reactor information when a nuclear accident occurs, and in such a situation SPEEDI itself, too, might fail to function. Therefore, the policies of utilizing SPEEDI when the ERSS cannot function should have been reviewed beforehand, and the results of the review should have been shared among the personnel concerned to respond to the accident.

Nevertheless, many of the individuals who were responsible for taking response measures in the event of an accident had a belief that there would be no room to allow for the utilization of SPEEDI in evacuation activities once the ERSS failed to function. The Guideline for Environmental Radiation Monitoring (NSCRG T-EN-II.01) has a clause on the methods of utilizing SPEEDI in the event that emissions source information cannot be obtained (i.e., when the ERSS does not function). However, no consensus had been reached on whether this could be applied to evacuation activities. Furthermore, no clarification had been made as to the entities that would make use of SPEEDI (operation and public announcement) in the event that an off-site center failed to function.

#### **(b) SPEEDI and evacuation orders**

One of the major reasons as to why SPEEDI was not effectively utilized, as described in (a) above, is considered to lie in the fact that any of the relevant organizations did not have an idea of its potential role in the implementation of evacuation activities, being in preconception about the impossibility of utilizing SPEEDI in evacuation activities when emissions source information could not be obtained from the ERSS. However, prediction was possible through SPEEDI by assuming the unit emissions, even when the emission sources information could not be obtained, and actually the prediction results had been obtained; it may be concluded that,

if the prediction results by assuming the unit emissions had been distributed, there was room of allowance for the respective local governments and residents to be able to select a more appropriate timing or direction to evacuate.

The relationship between the actually released evacuation orders (those for the Fukushima Dai-ichi NPS were released since March 12) and the SPEEDI information (predictions assuming unit release) is discussed earlier in Chapter IV. 2. (3) above. Table VI-1 below sorts out the relationship between the specific orders and SPEEDI data, and possible specific evacuation procedures etc. (timing of evacuation, direction of evacuation, etc.) provided the SPEEDI information had been used.

For a simple practical discussion, the third order from among the three evacuation orders since March 12 is examined here: the case of stay-indoor order within 20-30 km from the accident site at 11:00 a.m. on March 15. In this case, a little before the order (at 08:30 a.m. to 10:15), a high radiation dose rate of around 10,000  $\mu\text{Sv/h}$  had been measured, at a point near the main gate of the Fukushima Dai-ichi NPS, and late at night on the same day (23:15 to 23:55), about 7,000 to 8,000  $\mu\text{Sv/h}$  high level dose rate had been still recorded (see Fig. IV-6 in Chapter IV. 2. (3) d. above), indicating a larger amount of release of radioactive materials than before.

Specifically, SPEEDI predicted dispersion mostly towards the land (to south-west to north-west) from March 15 to March 16. Therefore, even if implementing evacuation, it appears that it was possible to minimize the out-door exposure to radiation by keeping the initial order to stay indoors first for the meantime and waiting the time periods, while staying alert to SPEEDI information, when the SPEEDI's prediction of dispersion constantly avoids overlapping with the evacuation route (for example, after 07:00 on March 16, when the prediction of dispersion was coast bound and did not overlap with whichever evacuation route was taken). Actually, as reviewed in detail earlier in Chapter IV. 2. (3) d., there is a possibility that the evacuees from the Minamisoma City and Namie Town who had begun evacuation on March 15, particularly in the evening or later (after around 15:00), might have taken their evacuation route overlapping with the predicted direction of dispersion of radioactive materials. A detailed release of advice on the evacuation route and timing based on the SPEEDI information could have avoided these situations to happen.

As seen above, even in cases that the information of the source of emissions was not available from ERSS, there seems to have been room for effective use of SPEEDI.

Table VI-1

Evacuation Orders	The predictions by SPEEDI and possible evacuation policy based on it
<p>05:44 on March 12</p> <ul style="list-style-type: none"> <li>• Evacuation from 10km zone from the accident site</li> </ul>	<ul style="list-style-type: none"> <li>○ Constantly coast bound (towards southeast) from 05:00 am to noon</li> <li>○ Southbound from 13:00 to 15:00</li> <li>○ Westbound from 15:00 to 16:00, northwest to north from 16:00 to 18:00</li> </ul> <p>[Possible evacuation policies]</p> <p>The predicted dispersion was constantly coast bound in the morning after the evacuation order. Even if radioactive materials were being released, evacuation was possible well in order. As dispersion was predicted south bound into the afternoon, the residents from the south of power station had to be careful in evacuation.</p>
<p>18:25 on March 12</p> <ul style="list-style-type: none"> <li>• Evacuation from 20km zone from the accident site</li> </ul>	<ul style="list-style-type: none"> <li>○ North bound from 18:00 to 19:00</li> <li>○ Almost constantly coast bound (towards northeast) from 20:00 to 10:00 on the next day, March 13.</li> </ul> <p>[Possible evacuation policies]</p> <p>The predicted dispersion was true north bound from the time of evacuation order until 20:00. Later on until about noon on the next day, March 13, predicted dispersion was mostly coast bound. Therefore, even if radioactive materials were being released, evacuation well in order was possible later in the evening.</p>
<p>11:00 on March 15</p> <ul style="list-style-type: none"> <li>• Stay-indoors in the 20 to 30km zone from the accident site</li> </ul>	<ul style="list-style-type: none"> <li>○ South west bound from 11:00 to noon</li> <li>○ North west bound from 13:00 to 02:00 on the next day, March 16</li> <li>○ South to south east bound after 03:00 on the next day, March 16</li> </ul> <p>[Possible evacuation policies]</p> <p>Many residents actually evacuated despite the stay-indoor order. The predicted dispersion after the order, however, was constantly land bound:</p>

	<p>west to north west bound after the order and only changed to west to south bound over the night until early morning of the next day, March 16.</p> <p>Incidentally, a large amount of radioactive materials were released from March 15 to March 16. The dispersion was being predicted to change to coast bound for the first time after 06:00 on March 16. Therefore, there appears to be a possibility of limiting exposure risks to radiation, by an advice on the evacuation timing based on this prediction.</p>
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**d. Evacuation orders for residents**

The problems pertaining to the decision-making and the contents of evacuation orders to residents are discussed in Chapter VII. 5. (4) of the Interim Report. The following points are raised in light in addition based on the investigations and verification conducted after the Interim Report.

**(a) Evacuation orders to areas beyond 10km radius from the Fukushima Dai-ni NPS**

At 17:39 on March 12, 2011, an evacuation order was issued for the evacuation to areas beyond 10km radius from the Fukushima Dai-ni NPS. The justification of this evacuation order needs some examination, that is, this evacuation order was issued on the fifth floor of the Prime Minister’s Office, based on a judgment that preparations in readiness would be necessary for the possibility of an incident occurring at the Fukushima Dai-ni NPS, similar to the explosion at Unit 1 of the Fukushima Dai-ichi NPS at 15:36 the same day. Actually however, the conditions of each Units of the Fukushima Dai-ni NPS (referring to Units 1, 2 and 4, whereas Unit 3 was already in the cold shutdown condition) at this time (approximately 18:00 of March 12) were such that the water injection was being continued by the Make-up Water Condensate System or High Pressure Core Spray System, and even though the S/C water temperature indicator exceeded 100°C, the water temperature increase was at a slower pace (106 to 118°C) and the conditions changed only little from when the Declaration of Nuclear Emergency had been released early in the morning on the same day.

Each nuclear unit had sufficient quantity of water (more than 5 m over the top of the fuel, higher than in normal operation), with the reactor pressure indicating 0.2 to 0.24 MPa abs, and

the drywell (D/W) pressure about 0.18 to 0.2 MPa (in the case of Unit 3, which had reached cold shutdown at noon on the day, the reactor pressure was 0.22 MPa and the D/W pressure was about 0.14 MPa abs at 18:00, respectively ((by the way, one atmospheric pressure is about 0.1 MPa abs)), and indicated that the conditions continued to be relatively stable without any abrupt changes. The afore-mentioned evacuation order was not based on the discussion about the information of specific conditions at the Fukushima Dai-ichi NPS units.

At 18:25 of the same day, approximately one hour after this evacuation measure was taken, an evacuation order was issued for evacuation to areas beyond 20 km of the Fukushima Dai-ichi NPS. Most areas in the 10 km radius from the Fukushima Dai-ichi NPS are covered by the 20 km radius area from the Fukushima Dai-ichi NPS, and therefore the residents in the area covered by both orders had to evacuate anyway, but a very limited part of the northern area of

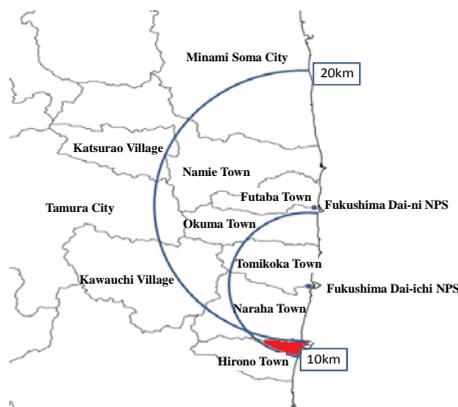


Fig. VI-1 Correlation between the evacuation areas within 10km radius from the Fukushima Dai-ni NPS and a 20km radius from the Fukushima Dai-ichi NPS

Hirono Town (“northern edge of Hirono Town”) was not within the 20km radius zone from the Fukushima Dai-ichi NPS (See Figure VI-1), and it would not have been included in the evacuation area if the evacuation order for evacuation to areas beyond 10km from the Fukushima Dai-ni NPS had not been issued<sup>7</sup>. However, upon this order (evacuating from the 10 km zone from the Fukushima Dai-ni NPS), Hirono Town administration suggested all its residents, not only

its northern edge, to evacuate over the time from the night of the same day to the following March 13, and started to evacuate<sup>8</sup>. The evacuation order for evacuation to areas beyond 10 km

<sup>7</sup> When the area of 20-30 km from the Fukushima Dai-ichi NPS was designated as the stay-indoor order area on March 15, it covered the entire area of Hirono Town. This designation was temporarily lifted on April 22, and on the same day the Hirono Town was newly designated as the Area Prepared for Emergency Evacuation. This new designation requests the people to prepare for evacuation if an emergency arises. It does not require an immediate evacuation (See Interim Report V. 3. (2) d.).

<sup>8</sup> On April 21 the government reduced the evacuation area around the Fukushima Dai-ni NPS from the 10 km radius to 8 km radius, as it judged that it was no more necessary. This excluded the northern edge of Hirono Town from the evacuation area. But as mentioned in the previous footnote, the area was included in the newly designated Area Prepared for Emergency Evacuation, in connection with the evacuation zones for the Fukushima Dai-ichi NPS. This new designation was lifted on September 30, but the Town’s suggestion of evacuation

from the Fukushima Dai-ni NPS was issued, based on a judgment that had been made amidst confusion due to insufficient information and based on the explosion in the nuclear reactor building of Unit 1 of the Fukushima Dai-ichi NPS. The plant conditions at the Fukushima Dai-ni NPS were then, in fact, comparatively stable. As such, problems remained with the decision-making process of the subject evacuation order.

**(b) Evacuation of hospital patients etc.**

With regard to the Futaba Hospital, where many bedridden patients had been accommodated, the evacuation response could only be assessed as having been inappropriate for instance, as noted in Chapter IV. 3. (2) b. above: the rescue of warded patients had been greatly delayed; and the transportation destination for those who had been rescued was a gymnasium of a high school in remote location.

Besides those reasons mentioned in (2) c. above, the reasons that such problems arose can be sorted out as, including: (i) The Japan Self-Defense Force, who headed for rescuing the still-not-evacuated residents on March 12, could not locate the Off-site Center, and were not able to communicate with the Headquarters etc. over radio. Consequently after all, they turned back without initiating the rescuing operation; (ii) In the midst while the Self-Defense Force was evacuating inpatients over five hours from the screening spot at Minamisoma City to the evacuation destination of Iwaki-Koyo High School on March 14, couple of hospitals were authorizing accepting inpatients, but the Self-Defense Force on transporting mission with inpatients could not receive this information because it had not been equipped with radios; and (iii) the Resident Safety Squad of the Local-NERHQ (Off-site Center) did attend the first rescue operation by the Self-Defense Force (Northeast District Army) in the morning on March 15, but they had left the Futaba Hospital with leaving only the inpatients alone, just before the second rescue team of the Self-Defense Force (12th Brigade) arrived. This was along with the relocation of the Local-NERHQ. There was nobody left who could tell the rescue team where

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remained in effect till March 31, 2012 (the number of evacuees of Hirono Town was 5,200 as of September 30, 2011. See Interim Report Chapter V. 3. (3) k.).

MEXT published an estimation map of the accumulated radiation dose till March 11, 2012. It shows the contamination level of Hirono Town is relatively low as compared with other locations in the Area Prepared for Emergency Evacuation. Except for the mountain corridors, the level is about 5 mSv or lower.

and how many inpatients had been still remaining. Consequently, therefore, the inpatients in the hospital annex were left alone unnoticed even in the second rescue operation.

In order to prevent the recurrence of such situations, there is a need for the Self-Defense Forces, which is responsible for evacuation, to make sure to secure a communication system with external parties<sup>9</sup>, for instance, by seeking the cooperation of the prefectural police which owns a police radio system<sup>10</sup>. Needless to say, those who are responsible for the rescue of human lives should gain a renewed awareness of the weight of that responsibility, and undertake their duties with a strong sense of that responsibility.

#### **e. Response to radiation exposure**

##### **(a) Problems of not using APDs**

To workers on duty at the Fukushima Dai-ichi NPS (radiation workers) after the accident, it was vital for each worker to wear an alarm pocket dosimeter (APD) in order to measure the radiation dose they received and avoid excessive exposure above the exposure limits. However, as pointed out in Chapter IV. 4. (3) b. (c) above, an extraordinary arrangement continued until March 11 at the Fukushima Dai-ichi NPS: the APDs that had originally been stocked were damaged with water and became useless, and as a consequence, the workers commenced work since March 15, 2011, whereby only the group representatives wore an APD, because of shortage of usable APDs.

Investigations into this problem by the Investigation Committee found that a large number of APDs actually had been delivered from other power plants immediately after the accident, but that these APDs had remained unused. Specifically, first point to note is that 300 APDs on March 12, and another 200 APDs on the next day, March 13, were delivered from the Kashiwazaki-kariwa Nuclear Power Station (hereinafter referred to as “Kashiwazaki-Kariwa NPS”) of TEPCO, but the Health Physics Team members of the Fukushima Dai-ichi NPS ERC left the APDs unused because they recognized they did not have corresponding battery chargers,

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<sup>9</sup> In the case (See Chapter IV. 1. (1) b. (b) above) of rendezvous at a park in Aomori Prefecture, the SDF helicopter for the aircraft monitoring mission and the monitoring staff could have started monitoring earlier if the SDF radio communication system had been functional.

<sup>10</sup> The SDF wireless system needs new relay points for wide area communication, but the police wireless system is ready for wide area communication using the existing relay points.

and furthermore, did not report to the Team leader this fact, and eventually left 500 APDs unused until the end of the month. The second point to note is, the Health Physics Team leader of the Fukushima Dai-ichi NPS sent back to J-Village the 450 APDs which had been delivered on around March 21 from the Shikoku Electric Power Co., Inc. (hereinafter "Shikoku Electric Power) via J-Village, because of the unavailability of corresponding alarm-setting devices. The alarm-setting devices had been received actually from the Shikoku Electric Power at the J-Village, but a TEPCO staff at the J-Village did not get aware of this fact.

As seen above the problems here are: (i) A large number of APDs were received from the Kashiwazaki-Kariwa NPS, but the team member left them unused for the reason that they had not come with battery chargers and he did no effort to get the chargers delivered nor did he report the problem to the team leader; (ii) Referring to the APDs received from Shikoku Electric Power, the Health Physics Team leader merely delivered back the APDs for the reason that they had not come with alarm-setting devices, despite the fact that they could be used for radiation dose rate measurement itself even without any alarm-setting devices. He did not even try to get the alarm-setting devices delivered; and (iii) The said Health Physics Team leader answered, when asked why, as "the number of APDs were already sufficient in following the operation procedures that only the leaders were supposed to wear an APD," suggesting that he interpreted the exceptionally applicable procedure due to legally inevitable reasons in his own favor and applied it as generally acceptable standard procedure and was not willing to overcome the problem. Based on these observations, it should be pointed out that the level of awareness among TEPCO staff was low concerning the prevention of radiation exposure of on-site workers. This suggests an insufficient understanding of the widely accepted stance of the International Commission on Radiological Protection (ICRP), which stipulates that radiation exposure should be kept as low as possible (See Chapter V. 4. (1) b. of the Interim Report). Therefore, it is determined that there were problems with TEPCO's radiation education in the area of avoiding radiation exposure.

**(b) Orders from the government concerning the intake of iodine tablets**

On March 13, 2011, the Medical Squad of the Local NERHQ commenced preparations in the morning to issue an order from the Director-General of the Local NERHQ, as mentioned in

Chapter IV. 4. (5) b. above, concerning the screening level corresponding to the anticipated radiation exposure limit. During that process, the NSC delivered a FAX transmission at approximately 10:40 of the same day to the ERC with the comment that stable iodine tablets should be administered to those whose radiation contamination exceeded the screening level. A liaison officer dispatched from the NSC to the ERC received this transmission. However, this comment was not shared within the ERC Medical Treatment Squad, and nor was it reviewed in the ERC, and therefore it was not transmitted to the Local-NERHQ, either. This is considered to be the result of a lack of awareness, on the part of the NSC liaison officer, of the importance and necessity of incorporating the NSC comments into the orders to be issued by the Director-General of the NERHQ. It can be so understood from the grounds that the said liaison responded to the NSC Secretariat over the phone soon after he had received the above fax message from the NSC as “it is too late to alter the existing plan because it is already moving on with the original level,” suggesting a difficulty in incorporating the comment in the order, and that the comment was never shared or reviewed in the ERC thereafter.

On the other hand, the staff of the NSC Secretariat who learned from the liaison “it is too late to alter the existing plan because it is already moving on with the original level,” conveyed the message to each NSC committee member. The NSC, however, did not give any further advice for the reason, “The NSC is by nature an advisory body. What should be advised is already advised.” The NSC indeed is an advisory body but it cannot be denied that the fact that they took no further action but merely stating “what should be advised is already advised” about their own comments which seriously concerned the people’s safety reflects the lack of responsibility as an administrative body concerning people’s safety.

**(c) Orders from the local governments concerning the intake of iodine tablets**

As reported in detail in Chapter V. 4. (5) e. of the Interim Report, the Miharu Town administration decided at midnight on March 14, 2011, to distribute and issue orders for the intake of stable iodine tablets, based on an anticipation of residents’ exposure to radiation. At approximately 13:00 on March 15, this was announced to the residents of the town over the community radio system or other means, and under the supervision of pharmacists, stable iodine tablets were distributed to 95% of the residents. A staff of the Local Medical Care

Division, Health & Hygiene Promotion Office of Fukushima Prefecture who came to know of this fact issued an order in the evening of the day to suspend the distribution and recall the tablets, based on the reason that no instructions had been received from the national government. However, the Miharu Town administration did not comply. Considering the fact that the NSC's opinion about the administration of stable iodine tablets was dismissed as outlined in (b) above, it cannot be concluded that the decision by the Miharu Town administration was inappropriate simply because it had not been backed by an instruction from the national government. **In the existing emergency preparedness, administration of stable iodine tablets is, in principle, subject to the judgment of the government nuclear emergency response headquarters (according to the Nuclear Emergency of Response Manual). However, in view of the aforementioned incident, a system which allows local municipalities to independently administer the tablets should be reconsidered, and so is the appropriateness to distribute them in advance to the residents as a precaution.**

**(d) Raising the screening level**

To respond to the residents' concern regarding the fears of contamination by radioactive materials, appropriate screening and subsequent decontamination is absolutely necessary. Fukushima Prefecture initially established the screening level at 40 Bq/cm<sup>2</sup> (equivalent to 13,000 cpm), when it had started the screening process and subsequent decontamination on March 12, 2011. However, it raised on March 13, 2011 the screening level for whole-body decontamination to 100,000 cpm, effective from March 14, 2011, based on suggestions of radiological experts. But at this moment Fukushima Prefecture was not aware that the raised screening level was against the order from the Director-General of the Local NERHQ released in the afternoon of March 13, 2011 (the screening level to set at 40 Bq/cm<sup>2</sup> etc.), because it had not been transmitted to the Prefectural Emergency Response Center.

One of the staff members of the ERC Medical Treatment Squad learned from a Fukushima Prefecture's report in the evening on March 13, 2011 that Fukushima Prefecture was intending to raise the screening level to 100,000 cpm<sup>11</sup>. The staff member, however, did not know of the

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<sup>11</sup> This member of the ERC Medical Treatment Squad did not know the Fukushima Prefecture's decision to conduct

aforementioned order itself, and was not able to point out that raising the screening level to 100,000 cpm was against the said order. Knowing about the intentions of the Fukushima Prefecture government to raise the screening level before dawn of March 14 from an ERC report, the NSC reviewed the plan immediately and advised the ERC at 04:30 on the same day that the screening level should be kept at 13,000 cpm<sup>12</sup>. This advice was conveyed to Fukushima Prefecture, but the prefecture kept its own policy and continued its own screening and decontamination procedures, based on the understanding that the new screening level and decontamination procedure did not necessarily contradict with the NSC's suggestion, because they decontaminated the people by partial sampling, instead of doing nothing to the persons counting not less than 13,000 cpm but below 100,000cpm.

Later at 14:40 on March 19, the NSC renewed its advice to the ERC and endorsed raising the level to 100,000 cpm, and on March 20, the Director-General of the Local NERHQ issued the order at 23:00 to set the screening level at 100,000 cpm. This new order, however, did not stipulate to implement decontamination of the people counting not less than 13,000 cpm but below 100,000 cpm, leaving room to interpret as no requirement of decontamination of such people, and thus the new order became less strict than that of Fukushima Prefecture back then.

Observing the above development, problems arise such as:

- (i) Was it really necessary to raise the screening level? and
- (ii) Why was the communication lacking between the national government and prefectural government, as noticed in the case of no transmittal of the order of the Director-General of the Local-NERHQ to the relevant teams of the Prefectural Emergency Response Center?

Regarding Problem (i) the need of raising the screening level, the Prefecture decided to raise the screening level upon the radiological experts' deliberations, but the deliberations were based on the condition that every individual above the screening level was to receive full-body decontamination (shower). "Radiation Emergency Medical Care Operations Manual

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sampling wipe-off decontamination of the people of not less than 13,000 cpm but below 100,000 cpm.  
<sup>12</sup> The NSC suggestion to maintain the screening level at 13,000 cpm was made on the ground that, if the 13,000 cpm came entirely from internal exposure due to iodine, the equivalent thyroid exposure dose of children would reach 100 mSv, which was the guidance value of administering stable iodine tablets.

(Fukushima Prefecture),” in the meantime, stipulated as its decontamination policy that not only full-body decontamination (shower) but also decontamination by undressing, wipe-offs, hair washing, etc., be implemented depending on the specific body sites indicating high dose rates. Therefore, deliberations to raise the screening level had been based on a wrong understanding. However, at the time, it was more important to formulate policies for detailed decontamination methods (removal of clothes, wiping off, etc.) corresponding to doses (examination of the background of the Manual provisions stipulating the policy), rather than raising the screening level for whole-body decontamination (shower). Furthermore, it is conceivable that the NSC advice, which allowed for the 100,000 cpm screening level, as well as the order issued by the Director-General of the Local NERHQ based on that advice, might have been unnecessary. Rather, to the contrary, the advice and order posed problems. By simply raising the screening level to 100,000 cpm, no decontamination procedures were specified for those detected to have radiation levels of 13,000 cpm or higher but below 100,000 cpm, and left room for an interpretation that decontamination was not required for such people.

Regarding Problem (ii) the lack of communication, the cause of the incident is considered to be as; the low consciousness to the importance of relevant persons involved in communicating information (the person sending the order to the prefecture and the recipient), and lack of communication within the Local-NERHQ, or ERC Medical Treatment Squad, or among each other. This problem happened when the Local-NERHQ and the prefecture experienced a first-time large scale nuclear disaster that made them fall into disorder. In emergency situations such as this, it is vital to acknowledge the importance of sharing important information among the personnel in charge, to nominate a person, who is adept in coordinating the relevant administrative organizations, at the top of the emergency response department (team), and to take response measures in a unified manner among the related national and local administrative organizations. From this aspect, another problem was that a staff of the Ministry of Health, Labour and Welfare, who had been expected to take main roles as a person in charge at the Local NERHQ and coordinate discussions/arrangements between the ERC and prefectural staff, did not gather until March 21, 2011, at the Local-NERHQ.

**(e) Standards for the use of school buildings and schoolyards**

In the Interim Report three problems concerning use criteria of school buildings and schoolyards were pointed out as remaining (Interim Report Chapter VII. 5. (6) b.). Investigation results of these problems are as follows:

The first problem was a question: “In setting a criterion for the use of schoolyards as the children’s activity base, was it adequate to refer to the same value (20 mSv every year) in the criteria for designating the Deliberate Evacuation Area?”

As noted earlier in Chapter IV. 5. (2) a., MEXT announced its stance on April 19, 2011, with respect to criteria for the use of school buildings and schoolyards (“Provisional criteria for the judgment of the use of schoolyards and educational facilities (“Provisional Criteria”)): restricting activities on schoolyards to about one hour per day at schools that have an air dose rate measuring 3.8  $\mu\text{Sv/h}$  (annually, this corresponds to the 20 mSv<sup>13</sup> that ICRP has established as the upper limit of the reference level for “existing exposure situations”<sup>14</sup>) or above; and permissible to continue using school buildings and schoolyards as usual at schools that have an air dose rate measuring below 3.8  $\mu\text{Sv/h}$ . This announcement raised criticisms and concerns about the lack of consideration for children by obviously allowing radiation exposure up to 20 mSv/year, or about the lack of sufficient prior explanations and publicity to the people in Fukushima Prefecture.

The Provisional Criteria were indeed problematic as: (i) the assumption of eight hours a day for schoolyard activities should be practically much shorter; (ii) the assumption of wood buildings (assumes the radiation dose rates are estimated as 0.4 times that of outdoors) for indoor activities but actually the school building structures are of concrete constructed with radiation dose rates inside estimated as 0.1 time that of outdoors; and (iii) radiation exposure on weekends should be lower unless one stays in high level radiation dose rate areas like schoolyards. Even if the air dose rate was 3.8  $\mu\text{Sv/h}$  in schoolyards, the actual exposure dose would be significantly lower. The problem was that there was no sufficient explanation for such background.

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<sup>13</sup> This value is based on an assumption that children spend eight hours of a day outdoors and 16 hours indoors (See Interim Report Chapter V. 5. (2) a.).

<sup>14</sup> See Interim Report Chapter V. 4 (1) b.

This 20 mSv/year was really a guidance value for formulating specific criteria of school buildings and schoolyards. But, certainly the MEXT explanations at the time might have been comprehended as if establishing the 20 mSv/year as a reference value for the use of school buildings and schoolyards. It is difficult to say that such an explanation could allay the strong sense of anxiety and unease toward radiation, and it was not appropriate from the point of view of risk communication, either. Furthermore, there is still room for debate as to whether it was appropriate to apply the upper limit of the value, that is used under “existing exposure situations,” to school buildings and schoolyards that were used by children, who are generally considered to be more susceptible to the influence of radiation than adults (ICRP Pub60). Later on May 12, 2011, MEXT re-estimated an exposure dose that corresponded more closely to realistic living conditions, and set a figure of 10 mSv/year<sup>15</sup> or lower. This was set based on a condition, with safety margin, that children spent in outdoors six hours (including two hours in the schoolyards) on school days, and eight hours on weekends.

The second problem was a question: “There were areas where schools measuring 3.8  $\mu$ Sv/h (or 20 mSv a year) or more were concentrated. From the very beginning, should not those areas have been designated as a Deliberate Evacuation Area?”

According to the monitoring survey conducted in the beginning of April, there was a tendency that schools measuring 3.8  $\mu$ Sv/h or higher were concentrated in specific areas of Fukushima City, Nihonmatsu City and Koriyama City, etc.. MEXT conducted another monitoring survey to all the relevant schools on April 14. The result showed that still 16 schools had dose rate of 3.8  $\mu$ Sv/h or higher (dose rate at 50 cm above ground) in their schoolyards but in those schools’ premises all the part covered by concrete showed the dose rates lower than 3.8  $\mu$  Sv/h. According to the monitoring survey conducted outside the school premises at about the same time, there were only a few spots measuring the dose rates over 3.8  $\mu$ Sv/h, indicating that even schoolyard spots measuring high dose rates were localized without area-wise

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<sup>15</sup> The calculation is based on the following assumptions: On each of 200 school days of a year, children spend one (1) hour to/from school, two (2) hours in the schoolyards, five (5) hours in the school building, three (3) hours outdoors after school and thirteen (13) hours; on each of the off-school days (131 days), they spend eight (8) hours outdoors, and sixteen (16) hours at home; the accumulated dose for 34 days from the day of accident to April 14 was 2.56 mSv; and the radioactive materials gradually deplete after April 14 onward (See Chapter IV. 5. (2) a.).

contamination, thus did not have the element (area-wise high dose rate contamination) to be designated as a Deliberate Evacuation Area.

The third problem was a question: “Schools measuring the dose rates lower than 3.8  $\mu\text{Sv/h}$  were allowed to use without any restrictions, but the level of 20 mSv a year is the maximum dose rate of ‘existing exposure situations’ recommended by the International Commission on Radiological Protection (ICRP), which leaves a question whether the new criteria were appropriate from a perspective of minimizing the radiation exposure to the extent possible.”

In this country, the radiation exposure due to just natural radiation alone reaches around 2.1 mSv a year<sup>16</sup>. In a “planned exposure situations” without an accident like the latest one at the nuclear power station, the additional planned exposure to be acceptable is another 1 mSv a year (the public exposure dose limit during in the planned exposure situations, see the Interim Report Chapter V. 4. (1) b.). This means the 10 mSv a year is not a small number. It is said that the correlation between radiation dose rates and the probability of developing cancer is unknown under a low dose rate environment (Interim Report Chapter V. 4. (1) b.), and that, even if they have correlation, it is too small to observe significant increases. However, even so, the government should not feel satisfied in a figure of 10 mSv/year, but should have put in place policies to reduce the exposure dose to the extent possible<sup>17</sup>, in consideration of the fact that a greater impact of radiation is anticipated on children than on adults (ICRP Pub60)<sup>18</sup>, and the ICRP recommendation seeks a reduction, as much as possible (optimization of protection, See Chapter V. 4. (1) b. in the Interim Report), of the exposure dose under reference level of 1 to 20 mSv/year set out in the “existing exposure situations.” Even for schools that have an air dose rate measuring below 3.8  $\mu\text{Sv/h}$ , it would have been appropriate to make further attempts to reduce exposure dose by, for instance, setting criteria for activities within the schoolyards.

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<sup>16</sup> Nuclear Safety Research Association, Radiation in human life environment (calculation of the national dose, new version), December 2011

<sup>17</sup> As a matter of fact, many schools in Fukushima Prefecture took measures to keep the exposure dose as low as possible by independently setting the restriction guidelines for children to use schoolyards, regardless of the aforementioned MEXT Provisional Criteria.

<sup>18</sup> Some data show a significant difference in the high dose range of 1,000 to 4,000 mSv.

**(f) Radiation emergency medical care institutions**

Six hospitals had been designated as initial radiation emergency medical care institutions for response to accidents such as that which occurred at the Fukushima Dai-ichi NPS, as described earlier in Chapter IV. 4. (6). But four of these six hospitals were unable to fulfill their function as radiation emergency medical institutions because they were included in the evacuation area. Such a situation would have been brought up by the fact that this kind of severe accident had not been postulated in which initial radiation emergency medical care institutions could be covered by the evacuation areas. Therefore, **a considerable number of medical facilities for radiation emergency medical treatment should be located in the area which is not likely to be included in an evacuation designated area, so that radiation emergency medical care could be provided even in a severe accident like the accident at the Fukushima Dai-ichi NPS. Those medical facilities should not be concentrated in the area close to the nuclear power station. At the same time, such medical care systems in a nuclear emergency would need to be coordinated for collaborating over a wide area across the prefectural borders.**

**(g) Public understanding of radiation effects**

Radiation effect to human body was reviewed in the Interim Report Chapter V. 4. (1), but cannot be regarded easy to understand since it requires knowledge to understand the concept of such as stochastic effect. Furthermore, it is also hard to accept that the general public had sufficient opportunities to learn about scientific characteristics of radiation or its effect to human body at schools or in a community<sup>19</sup>. It is reported that a considerable number of the public get fears against radiation effect regarding the accident at the Fukushima Dai-ichi NPS, and there are victims of fraudulent businesses taking advantage of such people's fears. The facts stated

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<sup>19</sup> The Investigation Committee investigated the status of how the topic of radiation had been taken up in the school curricula in the compulsory school education history in Japan. The topic was deleted in the Curriculum Guidelines for Junior High Schools announced in 1977 (enforced since JFY1981). The topic was recovered back in its 2008 version (to be enforced since JFY2012. But the education of that topic started in JFY2011 pursuant to the special arrangement effectuated in 2008). The new Curriculum Guidelines announced in 2008 stipulates that the radiation properties and their utilization should be referred to in the subject of "Energy." In the meantime at Senior High Schools the topic of radiation was educated in the subject of "Science I" to every pupil from JFY1982 to JFY1993. But before and after that period, the topic was educated to limited pupils who took the selected subject of physics, for instance (same as now).

above are likely the cause of these happenings.

This accident has served as a reminder of the need not only to take all possible precautions in order to protect ourselves against radiation, but also to “fear radiation properly.” Knowledge such as the following will be useful in order to “fear radiation properly” (Interim Report Chapter V. 4. (1) b.):

- (i) Radioactive materials are not contagious like a virus;
- (ii) The average annual radiation exposure from natural radiation (including internal radiation exposure from foods etc.) without accidents at nuclear power stations etc. is about 2.1 mSv a year in the county<sup>20</sup> (international average is about 2.4 mSv a year<sup>21</sup>);<sup>22</sup>
- (iii) Iodine-131 absorbed in human body accumulates in thyroid gland, but since its half-life is short, only about eight days, the residual iodine-131 originating from the accident at the Fukushima Dai-ichi NPS remains only little;
- (iv) The physical half-life of cesium-134 is two years and that of cesium-137 is 30 years. A large amount of them still remain in the environment, but unlike the iodine, they do not accumulate in particular parts of human body upon absorption. They are distributed uniformly to muscular tissues of the whole human body, and half of them will be removed from the adult’s body in 90 days<sup>23</sup>;

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<sup>20</sup> Nuclear Safety Research Association, Radiation in human life environment (calculation of the national dose, new version), p155 onward, December 2011: This national average used to be about 1.5 mSv till December 2011. The reason of this big increase of the value is explained (p157) as the underestimated exposure dose due to radioactive polonium 210 because of lack of sufficient data till then.

<sup>21</sup> Nuclear Safety Research Association, Radiation in human life environment (calculation of the national dose, new version), p159, December 2011, and UN Scientific Committee on the Effects of Atomic Radiation, SOURCES AND EFFECTS OF IONIZING RADIATION (UNSCEAR 2008 Report to the General Assembly with Scientific Annexes), p.4

<sup>22</sup> These figures are annual dose rate humans receive from natural world, regardless of nuclear accidents etc. (includes external exposures such as from ground and space, and from internal exposures such as inhalation and food ingestion. Average domestic external exposure alone is around 0.6 mSv a year and that of world average is around 0.9 mSv a year). Therefore, when radiation exposure (both external and internal exposures) up to 1 mSv a year that ICRP suggests as the individual dose limit (public exposure dose limit under “planned exposure situations”) is received in Japan, the average total individual exposure dose rate (external dose rate and internal dose rate) becomes around 3.1 mSv/year.

<sup>23</sup> The biological half-lives (the time needed for radiation in the body to deplete by 50% due to metabolism and other mechanisms) of cesium-134 and cesium-137 are said to be nine days for those up to one year old, 38 days for those up to nine years old, 70 days for those up to 30 years old, and 90 days for those up to 50 years old, respectively (Food Safety Commission, “Provisional Guidance Regarding Radiation,” March 29, 2011, and Ministry of Agriculture, Forestry and Fisheries, “Basic Knowledge of Radioactive Materials,” February 2012)

- (v) Human bodies originally contain about 120 Bq/kg of radiation materials including potassium-40 and carbon-14<sup>24</sup>;
- (vi) There are foods in our daily life consumption that contain 100 Bq/kg or more of radioactive potassium; and
- (vii) Correlation between exposure dose and cancer initiation is not apparent in an environment of less than 100 mSv, but the radiation protection principle assumes a direct proportion between them.

There is, of course, a need to put utmost effort into preventing unnecessary exposure in the future, and at the same time, **as many opportunities as possible should be institutionalized for the public to get knowledge and deepen their understanding of radiation. By doing so, the individuals would be able to judge the radiation risks based on correct information; in other words, they would be freed from unnecessary fears about, or from underestimating, the radiation risks because of the lack of information.**

#### **f. Analysis concerning the provision of information to the public**

##### **(a) Prior consent from the Prime Minister's Office**

On March 12, 2011, NISA Deputy Director-General, Koichiro Nakamura (hereafter, "NISA Deputy Director-General Nakamura"), announced the possibility of a "core meltdown" at Unit 1 of the Fukushima Dai-ichi. The relevant parties who had been gathered at the Prime Minister's Office had not received any prior report of a possible "core meltdown." Knowing the announcement of NISA, they saw as problem that NISA had announced a fact unknown to the Prime Minister's Office without informing the Prime Minister's Office of it in advance, and requested a prior report on the contents before the announcement. Consequently, based on a decision made by NISA Director-General Terasaka, NISA decided to obtain prior consent on the contents of press announcements from the Prime Minister's Office.

Starting on March 13, TEPCO also decided to obtain consent from the Prime Minister's Office prior to its press announcements, as noted in Chapter IV. 8. (4), thereby leading to delays

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<sup>24</sup> An average Japanese of 65.3 kg (an average man of 20 years old or higher in 2008) is said to have 7,856 Bq (Working Group for an assessment of the effect of radioactive nuclides in food or health, Food Safety Commission, Provisional Estimation of Radionuclides in the Human Body, July 13, 2011)

in these press announcements.

It is natural for the Prime Minister's Office, which should serve as the center of the government for decision-making and announcements, to seek prompt provision of information and certainly other administrative organizations and nuclear operators including TEPCO should try to provide relevant information and materials as early as possible. But, as noted above, requiring a prior consent of administrative organizations or higher government bodies before making press announcements could create a situation where public announcements can be delayed and urgent information cannot be released immediately. In other words, strict accuracy and centralization of announcements occasionally sacrifices promptness of announcements. For example, TEPCO attempted to obtain consent to an announcement from the Prime Minister's Office regarding the condition of the pressure increase of the Unit 3 primary containment vessel in the early morning of March 14, but lost timing of the announcement in time while the nuclear reactor building exploded at 11:00 on the same day.

It is not necessarily appropriate to seek prior consent from the Prime Minister's Office for the release of all information, as there are cases where each public relations organization needs to make announcements by its own decision, regarding urgent information.

**(b) NISA publicity that actively negated a core meltdown**

NISA started seeking prior approval from the Prime Minister's Office for the content of its press announcements as noted in (a) above, after the occasion of an announcement on "core meltdown" by NISA Deputy Director-General Nakamura. Evidences show that some of the spokespersons of NISA began to make awkward statements thereafter in efforts to avoid a reference to a core meltdown, as described in detail earlier in Chapter IV. (2). For instance, at a press conference by NISA on March 14, 2011, when Assistant to NISA Hidehiko Nishiyama ("NISA Spokesperson Nishiyama") affirmed the possibility of a core meltdown or made comments to the effect of not denying the possibility of a core meltdown, another NISA staff who was also at the press conference stated immediately after the announcement "I think the situation has not reached the stage of such as a meltdown" – as if to dismiss the statement by NISA Spokesperson Nishiyama and negate actively the possibility of a core meltdown. However within NISA back then, core melt had been acknowledged as quite affirmative or at

least a fact difficult to negate. Therefore it is hard to understand the remark of this NISA staff.

It might be acceptable to refer to an uncertain matter as uncertain. But it is definitely wrong to make an announcement negating an undeniable fact. Regardless of the subjective knowledge underlying the remarks made by the abovementioned NISA staff, the remarks actively denied the possibility of a core meltdown, which was a fact hard to deny. As such, these remarks were extremely inappropriate in the sense that they had misguided local residents and emergency response staff at the central government and on site, who were desperately in need of information.

**(c) Publicity about the impact of radiation**

When conducting publicity activities concerning radiation exposure or concerns for radiation exposure to residents during the accident at the Fukushima Dai-ichi NPS, the government often used the expression “immediate (no immediate effect on the human body)” (See Chapter IV. 8. (8) above). Chief Cabinet Secretary Edano, taking a responsible role of government announcements, used often this kind of wording. He mentioned at the beginning as, regarding low level radiation dose exposure of residents, for example, “it does not harm human health much” (at around 08:30 on March 13), “the situation will not develop to harm health in our view” (at around 15:30 on the same day), or “ a quantity not to worry about” (at around 21:00 on March 14). At the subsequent press conferences he began to use the expression as “immediate (no immediate effect on the human body);” for example: “in broad strokes, no immediate effect on human body,” at around 18:00 on March 16, regarding monitoring figures of the same day at around 20 km from the Fukushima Dai-ichi NPS; or “Your thorough understanding and response with coolness are cordially requested, since the figures are not at a level that immediately affects your health (even if you take tentatively the food which contained radioactive materials exceeding the provisional regulation values)” at the press conference at around 16:00 on March 19, regarding radioactive materials detected from milk etc. exceeding provisionally regulated values. Later in the hearing by the Investigation Committee, Chief Cabinet Secretary Edano explained as “(We) Used (the expression) for implying that the effect of accumulated low level radiation exposure was not obvious, but at least the value was in a level not to cause acute symptoms,” referring to the expression “immediate...”

Besides, the expression “immediate (no immediate effect on health)” was also used on the Consumer Affairs Agency’s home page and in the NSC bulletin as mentioned previously in Chapter IV. 8. (8).

In the background of such expression of “immediate,” there is scientific knowledge regarding low level radiation exposure that correlation between radiation exposure and development of cancer etc. is not obvious, and it will take considerably long time to become cancerous even if correlation exists (See Interim Report Chapter V. 4. (1) b.). Chief Cabinet Secretary Edano’s explanations mentioned above are likely to be based on this scientific knowledge. However, this expression “no immediate effect on the human body” could refer to “there is no need to worry about the effect on the human body” or conversely, “while there is no immediate effect on the human body, there are long-term effects to the human body.” It was not necessarily clear which meaning the expression had been used in reference to. Expressions such as this, which could be comprehended in more than one way, should be avoided in the use of publicity in times of emergency, and is an important issue to be reviewed in the future from the perspective of risk communication.

**(d) Problem with non-publicity of the “sketch of a contingency scenario”**

On March 22, 2011, Prime Minister Kan made a request to the Chairman of the Japan Atomic Energy Commission, Shunsuke Kondo (“Dr. Kondo”), as noted earlier in Chapter IV. 8. (9), to provide a hypothesis of the worst-case scenario for the accident at the Fukushima Dai-ichi NPS, and the measures to be taken in the event of such a scenario. The request was made with an intention to predict what situation would result from the accident if the accident further developed, and to be prepared therefor. In response to this request, Dr. Kondo drew up a “Sketch of a Contingency Scenario for the Fukushima Dai-ichi Nuclear Power Station” (hereafter, the “Sketch”). On March 25, Dr. Kondo submitted his personal Sketch to the Special Advisor to the Prime Minister, Goshi Hosono (“Special Advisor Hosono”). Special Advisor Hosono reviewed the measures laid out in the Sketch, but did not release the Sketch publicly.

Announcing the occurred fact in prompt and accurate manner is one of the important roles of the government. Simulating the worst case scenario also is one of the important roles of the government. The Sketch was based only on the virtual facts, not on the real facts, and therefore,

there was concern of being misperceived that the entire picture in the Sketch was happening in the real world, if released without sufficient explanation. Simulation results based on the virtual facts are not necessarily required always to be announced promptly, because they are based simply only on the virtual facts. Sufficient explanation is required for a report of this nature to avoid misunderstandings when to disclose, if it is to be disclosed as a matter of importance. As the Sketch had been a simulation based on a hypothetical scenario very because they are based only on the virtual facts with a low probability of taking place in real life, it cannot be flatly said that the action of Special Advisor Hosono not releasing the text of the document publicly was inappropriate. However, generally speaking, there can be also an option of releasing it, even for a simulation based on a hypothetical scenario. This can be carried out with a thorough explanation of the preconditions behind the simulation, and with consideration given to factors such as the need for publication, the presence or absence of measures in response to the simulated results of the scenario, and the timing of the publication.

**g. Distribution of information overseas and coordination with international community**

**(a) Sharing of information with international community**

The problem of releasing contaminated water to the ocean without prior explanation to neighboring countries was reviewed in the Interim Report Chapter VII. 5. (5). Followings are the problems that became clear in details after the Interim Report, concerning the relationship with international community.

After the onset of the accident, Japan did not necessarily provide information pertaining to the accident to other countries in a satisfactory manner, as mentioned in Chapter IV. 9. (2) above. Following causes can be pointed out in this regard: (i) The government itself did not have sufficient information regarding the conditions at the Fukushima Dai-ichi NPS until the Integrated Headquarters was established early in the morning on March 15; (ii) The experts that were capable of elaborating on the reactor conditions were deeply occupied with accident responses, thus did not have available time to sufficiently explain to the international community; or (iii) Being not notified that the United States of America (hereinafter referred to as “USA”) had been collecting information for its own evacuation advices, the government did not set up active information provision measures at the beginning.

**Provision of information to overseas countries is equally important as to the Japanese public, especially to neighboring countries or those countries which have many of their nationals residing in Japan. Active and careful responses should be in place for prompt and accurate provision of relevant information with due consideration to language barriers.**

**(b) Receiving support from other countries**

Japan was initially not able to receive provisions of relief supplies immediately, as noted earlier in Chapter IV. 10. (2) b., because there were flaws in the system to receive relief supplies from other countries, and in addition there were no storage space for the supplies that were received.

Neither METI's Nuclear Disaster Management Operation Manual nor TEPCO's Nuclear Operator Emergency Management Operation Plan had descriptions on the response procedures to receive relief supplies from overseas in the occurrence of a nuclear disaster. NISA, the competent agency, had even no full-time staff to administer receiving tasks of relief supplies. There was only one person who was engaged in handling this task for receiving while he was covering another post in parallel. Therefore, a big confusion resulted in receiving the relief supplies until the beginning of April.

NISA could not receive the relief supplies at the beginning, since NISA could not reserve a space for storing the supplies offered from overseas. NISA first took a process to identify the bodies that needed these supplies, and then to inform the will of acceptance to the countries offering the supplies and asked for shipment. As a result complaints arose from the international community about the late reply to accept supplies. Later NISA rented a warehouse near the Narita International Airport, which improved the situation by replying earlier for receiving the supplies from the aid-providing countries.

**International support in a nuclear emergency should be accepted and received as early as possible, when offered, for international comity and for urgently meeting national needs. To avoid confusion and inappropriateness experienced in the early stages at the time of the accident, operation manuals of competent ministries, nuclear operator emergency management operation plans and other relevant materials should prescribe**

**how to respond to such international support.**

**(4) Accident preventive measures and emergency preparedness**

**a. Need for comprehensive risk analysis and severe accident measures**

**(a) The background of why accident management, targeting external events, not introduced**

In Japan, too, deliberations started since 1992 on the accident management (“AM”) as a measure for a severe accident, and nuclear operators completed their development by around 2002 as part of their voluntary safety initiatives. The evaluation of their effectiveness was conducted in 2004 by the relevant regulatory bodies. The regulatory authorities had an intention to expand the AM scope from internal events such as mechanical failure and human errors to external events such as earthquakes/tsunamis, but only measures for incidents arising as a result of internal events have been drawn up as accident management programs. External events such as earthquakes and tsunamis were not viewed as targets for specific consideration.

A couple of reasons can be provided as a background to the abovementioned situation, including:

- (i) The Probabilistic Safety Assessment (“PSA”) that is regarded as a useful means of reviewing severe accident measures by assessing the safety of nuclear facilities in a comprehensive and quantitative manner was gradually being established but still limited as a means, because the PSA for external events established prior to the Fukushima nuclear accident was only the seismic PSA;
- (ii) The regulators checked the PSA results for internal events and severe accident measures thereupon on the occasion of nuclear safety inspections related to the Periodic Safety Review (“PSR”), but did not go as far as to offer opportunities for improving severe accident measures, in consideration of technological advancements of PSA for external events;
- (iii) When the NSC reviewed the implementation plan of AM measures at Unit 3 of Hokkaido Electric Power Company, too, the early introduction of the PSA was not deliberated due to factors such as work pressure on seismic back checks, despite the suggestions by some that the implementation of external event PSA and of reasonable additional measures, if there had been any, should be encouraged; and

(iv) Verification of safety at nuclear reactor facilities concerning natural phenomena was gradually in progress starting from earthquakes. The experience at the Kashiwazaki-Kariwa NPS when the Niigata-Chuetsu-oki Earthquake occurred, the seismic back check results upon revision of the Regulatory Guide for Reviewing Seismic Design of Nuclear Power Reactor Facilities (NSC RG L-DS-I.02) (hereinafter referred to as “Seismic Design Regulatory Guide), etc. contributed to this progress, but at the point of the Fukushima NPS accident, only a partial deterministic seismic assessment had been completed; and in addition

(v) At TEPCO, the AM for internal events reported to the government for review received its evaluation as “acceptable,” but it did not go further to specific consideration of AM that involved external events such as earthquakes beyond design basis events.

Consequently, comprehensive risk analysis for external events was not conducted, encompassing analysis through seismic PSA and safety analysis for tsunami, and fires, volcanoes, and slope collapses, etc. which could cause a disaster.

#### **(b) Need for comprehensive risk analysis**

In the verification of safety at nuclear power reactor facilities concerning natural phenomena, it would be unavoidable to place priorities on safety verification of relatively frequent earthquakes and their accompanying tsunamis or slope collapsing, due to budgetary and personnel constraints of nuclear operators and regulating authorities. However, **nuclear facilities are installed in a natural environment, which is really diversified. Nuclear operators should conduct comprehensive risk analysis encompassing the characteristics of the natural environment including the external events, not only earthquakes and their accompanying events but also other events such as flooding, volcanic activities or fires, even if their probabilities of occurrence are not high, as well as the internal events having been considered in the existing analysis. Nuclear regulators should check the operators’ analysis.**

**In doing so, nuclear operators should actively utilize currently available methods in their analyses of such external events, even if the PSA approach is not firmly established for them. The government should consider support to promote relevant research**

**programs for such initiatives.**

It is needless to say that measures to minimize the damage should be ensured, even when an event occurs exceeding the measures determined by such risk assessment (the so-called “assumptions”).

**(c) Formulation of severe accident measures in consideration of comprehensive risk analysis**

As described in (a) above, the problem of measures for ensuring safety at nuclear reactor facilities in our country was that the measures actually implemented did not sufficiently reflect the suggestions of taking external event risk into consideration, such as those of earthquakes and tsunamis, even though the suggestions had been made as important. AM as severe accident measures was limited only to those for internal events which began to be developed in 1992 and completed in 2002. The regulatory authorities also did not review them with consideration of external events. Furthermore, there were no appropriate understandings at the regulatory authorities that the facilities and procedures developed by nuclear operators as an AM, including that in the TEPCO’s accident management development report, had not been necessarily effective in severe accidents initiated by an external event such as earthquakes and tsunamis.

**In order to ensure maintaining nuclear safety at nuclear power stations, vulnerability of individual facilities for a wide range of characteristics of various internal and external events should be identified by comprehensive safety analysis encompassing external events also, and appropriate measures (severe accident management) against such vulnerability should be examined and placed in shape, assuming a situation in which the core may have serious damage by an accident far exceeding the design basis. The effectiveness of such severe accident management should be evaluated through the PSA or other means.**

Under such circumstances, there can be no justification to dispense with examining and implementing severe accident measures on the ground of immaturity in PSA techniques. Even though there are restrictions in risk analysis methods, nuclear operators should review and assess severe accident measures in order to ensure the safety of their own facilities, in consideration of the characteristics and limitations of the risk analysis method employed. In

conducting this review, there is a need to take sufficient reference from other sources, too, such as situations in other countries. When implementing severe accident measures in urgent need, the regulating authorities should also verify and review, using risk analysis methods or other means, the effectiveness of those measures in the event of a natural disaster, even if they urge deliberating and implementing the legitimization of safety measures or request to nuclear operators.

#### **b. Revision of nuclear emergency preparedness**

With regard to the development of a nuclear emergency preparedness system, the NSC commenced work in 2006 on revising the “Regulatory Guide: Emergency Preparedness for Nuclear Facilities” (NSCRG: T-EP-II.01) (hereafter, “Emergency Preparedness Regulatory Guide”), in tandem with the establishment of safety standards for nuclear or radiation emergency situations under the International Atomic Energy Agency (“IAEA”). In the process the introduction of the Preventive Action Zone (“PAZ”) to Japan was discussed, but the concept and scope of PAZ were never directly included in this regulatory guide after all, as a result of coordination between NISA and the NSC. The reason was that prerequisites for effective PAZ operation had not been sufficiently developed, and the NSC and NISA had not been ready to review the prerequisite events for examining the setting of evacuation zones, etc.

In the meantime, NISA commenced its review on complex disasters, which saw the simultaneous occurrence of a nuclear accident and large-scale natural disaster. A review was requested, under the initiative of NISA, to the Central Disaster Prevention Council, which deliberated managing natural disasters and nuclear disasters. But it was only three days prior to the Tohoku District - off the Pacific Ocean Earthquake, when the request was made. It should be assessed as too late that relevant in-depth discussion had not been made at the Central Disaster Prevention Council and other bodies prior to the earthquake.

**The existing Emergency Planning Zone (“EPZ”) had been set before the accident on the basic assumption of 8 to 10 km from a nuclear power station, so that the situation could be well dealt with even in an incident far exceeding a hypothetical accident. However, the accident has shown the need to reconsider what accidents to assume and how to designate evacuation areas.**

**Furthermore, the roles of the government in a nuclear emergency are so large that the government responses should not be limited to those outside nuclear site boundaries such as the residents' evacuation. It should also be considered what the government should do to cooperate or support the nuclear operator in a nuclear emergency, in consultation with the operator.**

Moreover, natural disasters and nuclear disasters involve their respective characteristics in emergency responses and recovery actions suitable to respective incidents, and the priority should be put first to envision the responses to respective incidents, and examine and develop their emergency responses and recovery plans. As mentioned in the Interim Report VI. 6. (2), there is a possibility that a nuclear disaster and a natural disaster, or more than one natural disaster, occur simultaneously, or during the time of recovery operation, thus the emergency preparedness not only to the individual events but also to simultaneous events should be examined.

#### **(5) Nuclear safety regulatory bodies**

NISA is an organization to regulate safety of nuclear power reactor facilities, and is expected to take a responsible role of accident responses in front as the Secretariat for the NERHQ in a nuclear disaster at commercial reactors. However, in the latest accident responses, it is difficult to say that NISA has sufficiently fulfilled its role as the organization responsible for taking preventive measures against accidents as well as for responses to the accident. Examples are: (i) it could not collect information from the nuclear operator etc. regarding the nuclear disaster and failed to sufficiently function to provide relevant information as required from the Prime Minister's Office and relevant ministries in a timely and sufficient manner; (ii) It could not dispatch experts with sufficient expertise at the beginning who could explain to the Prime Minister's Office how the nuclear disaster situation would develop and what responses by the government would be needed; (iii) It could not make effective use of SPEEDI information despite its acquiring the information, in an understanding that without emission source information, it could not be utilized for evacuation programs; and (iv) It failed to request the operators to implement appropriate severe accident measures, regarding preventive measures of nuclear accidents, since it was busy responding to specific issues and could not sufficiently

respond to mid-to-long term issues including domestic regulation issues such as severe accident measures.

In consideration of problems such as those posed by NISA, the Investigation Committee raised following five points in Chapter VII. 8. (2) of the Interim Report with respect to the operations of nuclear safety regulatory bodies: (i) The need for independence and transparency; (ii) Organizational preparedness for swift and effective emergency response; (iii) Recognition of its own role as a provider of disaster-related information to Japan and the world; (iv) Development of competent human resources and specialized expertise; and (v) Efforts to collect information and acquire scientific knowledge. The Investigation Committee also recommended taking consideration to these points in the planning to establish the new nuclear safety regulatory body. The following two points have been added in the Final Report in consideration of investigations and verifications conducted after the Interim Report. The two points included here are items that are also applicable to the NSC.

**(i) Active relationship with international organizations and regulatory bodies of other countries**

Dispatching staff to international organizations or international conferences with constant attendance should build up human network with staff of international organizations and foreign regulatory authorities, and will enable to smoothly exchange information and knowledge such as regulatory trends, and furthermore will facilitate smooth office processing works such as a notification and other matters in cases like the latest nuclear disaster. However, under existing staff capacity conditions at NISA, relationships with international community are limited to a small number of personnel exchanges with the IAEA and the Nuclear Regulatory Commission (“NRC”) of the United States. Furthermore, as priority must be given to the processing of domestic administrative affairs, there are limitation to the presence that can be sufficiently shown at international conferences and other such events. These efforts do not contribute sufficiently to the enhancement of organizational competence of the regulatory authorities and to coordination with the international community with respect to nuclear safety.

**The limited number of personnel at a government administrative organization is a collective issue of the all administrative organizations, and not limited to an issue of NISA**

**etc. But that of the new regulatory body should be duly considered, because of the importance of nuclear safety. The new regulatory body should secure its personnel, should establish an organizational system competent for international contribution, and develop human resources who can take a role in personnel interaction with international organizations or regulatory bodies of other countries.**

**(ii) Strengthening of the regulatory body**

Organizational structure of NISA and the NSC originates from the reorganization of central government ministries in 2001. Both organizations, however, are difficult to evaluate that they deserved the position they administered, regarding their activities to prevent the nuclear accidents and the latest accident responses. They were not able to sufficiently administer the mid-to-long term challenges, although recognizing the importance of issues such as the conforming of domestic regulations to the international standards at IAEA. They were caught up in the specific problems on a case-by-case basis such as the so-called TEPCO's record falsification case (2002) and the concerns at the Kashiwazaki-Kariwa NPS resulting from the Niigata-Chuetsu-oki Earthquake (2007); occasionally they were not able either to provide sufficient advice and guidance, based on specialized expertise to operators and relevant agencies for responding to an emergency.

**In order to ensure nuclear power safety, responses to individual problems encountered are not sufficient. Continuous efforts are needed to keep national regulatory guides updated at their newest and best qualities, with consideration to international trends of safety regulations and nuclear security, not only to the latest scientific knowledge in the country and overseas.** Nuclear operators bear the prime responsibility on nuclear power generation and necessary responses should be of course voluntarily implemented on their own responsibility. Regulatory authorities also should carry out swift and appropriate planning concerning nuclear safety regulation in response to the mid-to-long term issues. While monitoring the latest trend of relevant research on comprehensive risk assessment and severe accident measures covering external events such as those mentioned previously in (4) a. above, the regulatory authorities should urge operators to implement measures, and pursue effective nuclear safety regulation by verifying those measures. It is, of course, important to take

preventive measures against accidents such as the accident this time. But in addition, **considering that the impact of a nuclear disaster on society can be sizable, responses in an emergency should be fully established during normal times by formulating the emergency preparedness or by conducting nuclear emergency response drills so that effective and prompt responses could be taken in an emergency. The regulatory organization should foster the specialized skills to provide individuals and organizations responsible for emergency response with expert advice and guidance and should also foster the management potential to utilize organizational resources effectively and efficiently. Appropriate size of budget and human resources should be duly examined.**

## **(6) TEPCO competence**

### **a. Vulnerabilities in emergency response capability**

TEPCO has been conducting legally required education and drill to relevant personnel of nuclear power generation prior to the accident. As a matter of fact, in the hearings of the Investigation Committee to TEPCO personnel, every staff in the nuclear sector showed abundant knowledge in the isolation condenser (“IC”), fail-safe functions, reactor water level indicators, and the CAMS. They were on the level with that of the plant manufacturer personnel.

However, upon investigation of the response measures taken by TEPCO staff toward this severe accident, effective use of such knowledge was occasionally questionable. A typical example was the misunderstanding of the IC functioning conditions, the detail of which was discussed in the Interim Report Chapter IV. 3. (1), but the same observation is also applicable to the case of reactor water level indicators. Referring to the reactor water level indicating no movement for a long time, nobody at the TEPCO Head Office or Fukushima Dai-ichi NPS pointed out the possibility at the time of the accident that the reactor water level might have been below the reactor inlet nozzle (further below the bottom of active fuel (“BAF”)). According to the records including those from the in-house television-conference system, somebody mentioned the risk of improper reactor water level indicated higher than the actual level when the reference water head lowered, but there is no indication that further discussion with assessment and study was made with a concern of the possibility that the reactor water

level was below the reactor inlet nozzle.

Despite the abundant knowledge of the CAMS mechanism and the AM assessment referring to the indicated results of CAMS, no effort was taken at the time of the accident and even thereafter in order to grasp the plant conditions correctly by assessing the integrity of the pressure vessel or containment vessel using the indicated results of CAMS. They merely reported to NISA the calculated values of core damage fraction on a manual basis.

It is certain that in continued environment of extremely stressful accident responses, the thinking ability might have slowed, but when examining the response at the beginning of the accident (the misunderstanding of IC operating conditions, for example), or the response far later after the accident (the interpretation of the CAMS measurement records, for example), it cannot be denied that the ability to think about and confront the situation independently was poor, and that there was a lack in flexible and proactive thinking, which is necessary in responding to a crisis. These are not the problems of individuals, but rather should be addressed as TEPCO's corporate failure to provide staff education and training focused on the enhancement of such qualities and capabilities. Further probing into this issue reveals a fundamental problem of the inability to capture such crises as a reality that could happen in our lives; this, in turn, is the result of a myth of safety that existed among nuclear operators including TEPCO as well as the government, that serious severe accidents could never occur in nuclear power plants in Japan.

The Investigation Committee described in the Interim Report Chapter VII. 4. (1) that among TEPCO's nuclear power relevant personnel, fundamental understanding such as that of the IC had been lacking. The meaning intended was to point out that at TEPCO, fostering qualities and abilities to respond to a critical and serious accident had not been practiced. Of course, these qualities and abilities cannot be acquired overnight, and cannot be acquired from mere tabletop exercises. The qualities and abilities required for accident responses are the capabilities to sort relevant information collected by weighing all possibilities, then make decisions how to respond, and implement, beyond the knowledge from textbooks. The Investigation Committee strongly expects TEPCO, as a nuclear operator that bears the primary responsibility for nuclear safety, to sincerely revise its existing education and training contents, as well as to implement practical education and training programs aiming at the enhancement of qualities and

capabilities that are required in accident response, for each individual that deals with nuclear power.

**b. Problems of a vertical organization based on specialized official capacities**

TEPCO has structured its organization with an Emergency Response Center and other relevant departments in its Disaster Management Operation Plan and Accident Management Guide, under which functional teams are formed, including power generation teams, recovery teams, and engineering teams, etc. with the aim of providing an organizational, unified response in the event of a nuclear disaster. However, these functional teams certainly made efforts to fulfill their respective scopes given, but did not perform sufficiently well in capturing the situation from a comprehensive point of view, positioning the roles of their own teams within the overall picture, and carrying out the necessary support operations based on such perspectives.

TEPCO personnel, just like as those of other nuclear operators, categorize themselves by their specialty areas from normal times such as an “operating guy,” a “safety guy,” an “electric guy” or a “machine guy,” and their roles are segmentalized. While some personnel take an official career path by experiencing various fields widely and shallowly, some remain in one specialty for long periods. Such personnel might have abundant knowledge of his/her own specialty, but in contrast it is hard to say that he/she has sufficient knowledge of other areas, even closely related matters. If an organization is structured with these kinds of personnel, the individuals might have a narrow view of things, and, even if the organization seems to function without any problems under normal conditions, it results in exposing weaknesses of the organization in an emergency like the latest accident. Superintendent Yoshida was instructing from the early stage on March 11 to examine the water injection by fire engines, which had not been the scheme formulated beforehand in the manual. As a result, none of the functional teams or groups realized it was a task under its jurisdiction, thus no substantial review was done until early morning of March 12. This should be a typical case in which the aforementioned weakness became exposed.

When opening the SRV, it can be done on the control panel in the main control room by the shift team on duty, if electric power is available. But during the station black out, the recovery

team had to connect a total of 120V batteries to the connecting terminal on the back of the control panel. As a result, an issue arose when implementing the opening operation of Unit 2 SRV in the evening of March 14 onward, it was not clear who should implement the operation: the shift team or the recovery team. This should be another case in which the weaknesses of a vertical division of administration became exposed.

**c. Lack of education and training with a view to extreme situations**

The ability of each individual in functional teams in the Emergency Response Centers established at the Fukushima Dai-ichi NPS (“Fukushima Dai-ichi NPS ERC”) and at the TEPCO Head Office (“TEPCO ERC”) was insufficient, as mentioned in b. above, to make decisions and judgments in a timely manner, and to fulfill his or her function as a member of the functional team. This can be considered to stem from a consequence of inadequate education and training that gives a view to an extreme situation such as the complete and simultaneous loss of AC power at multiple nuclear reactor units. According to the abnormal operating procedures (event-base) and emergency operating procedures (symptom-base) of TEPCO, neither of the procedures assumes loss of all AC power at multiple units that lasts for days after scram. These procedures assume the AC powers will recover in couple of hours or one day. But the procedure does not stipulate the process how the AC power recovers. It appears that the procedures are written in detail, but there is always a way out somewhere, and the ground why there is a way out is unsourced.

The accident management development report which TEPCO compiled in 2002 specifically stipulates that “at events that all AC powers are lost, the events progress slowly, with sufficient time margin,” but the reason why the events progress slowly is left unsourced. Preparing these kinds of insufficient procedures, even if being informed to all relevant personnel, will just enable the response to the cases of very localized power outages.

Referring to drills, at the Fukushima Dai-ichi NPS for example, a drill was carried out around the end of February in 2011, simulating a series of events of an external power loss at one of the units due to an earthquake, with a transformer broken, followed by emergency diesel generators (DG) failing to start, thus losing the AC powers, leading to a notification pursuant to Article 10 of the Nuclear Emergency Preparedness Act. But the drill assumed the recovery of DGs after a

certain amount of time, which meant the drill just simulated the situation on how to manage until the DG power was recovered. It was not designed to assume an extremely serious situation like this accident.

TEPCO insists that it was an event beyond assumptions that the Fukushima Dai-ichi NPS lost almost all power sources due to the earthquakes and tsunami. However, it should be regarded as having been beyond assumptions simply because such events had been excluded from assumptions based on the myth of safety as a prerequisite without any basis, and the scope of assumptions was very limited. It should be concluded that, whatever education or drills are conducted based on this kind of limited assumptions, it will not contribute to the improvement of emergency management capabilities.

#### **d. Lack of enthusiasm in uncovering the causes behind the accident**

Even as of the present point in time more than one year after the accident, TEPCO has not demonstrated sufficient enthusiasm in thoroughly clarifying the causes behind the accident and thereby contributing to the prevention of the recurrence of a similar accident. For Example, in the MAAP analysis reported by TEPCO in March 2012, the conditions assumed therein were apparently wrong, if judged from the measured results by CAMS and the indicated values of reactor water level indicators. Nevertheless, TEPCO, without correcting these assumptions, has drawn the analysis results, by simply correcting the calculated values closer to the actually measured facts only for the first half of the event progress, and by ignoring part of the unfavorable data that was actually measured, but insisted that there were limitations at this moment in the existing analysis code and input data of assumed conditions. Even though there are limitations regarding the analysis model or radiation dose rate measurements, a further realistic analysis should be possible by using data that are already available or can be gained easily. Actually when the Investigation Committee raised a range of questions in its hearing, concerning the analysis, TEPCO defended by replying as: (i) no consideration was made to CAMS results; (ii) the false indications derived from the reactor water level indicator's mechanism were not adjusted in the analysis; or (iii) among the data from the shift operators' logbook of Unit 3, the reason was unknown why the reactor water level indicator's reading one hour after the HPCI had stopped had not been considered in the analysis. Thus, TEPCO

admitted the insufficiency of their analysis, but shows no intention to conduct a further analysis.

TEPCO bears the prime responsibility to actively contribute with its utmost effort to the prevention of similar accidents. TEPCO should have the enthusiasm in obtaining new knowledge from a range of event progress and use of the knowledge to prevent similar accidents and improve the safety of nuclear power generation, but their attitude towards clarifying the causes does not show such enthusiasm. The Investigation Committee calls strongly for a proactive stance from TEPCO in proceeding with clarification of the causes behind the accident.

**e. Need for the creation of a safety culture of an even higher level**

**TEPCO bears critical responsibilities to society as a nuclear operator primarily responsible for nuclear power plant safety. Nevertheless, TEPCO was not sufficiently prepared for such an accident, that natural disasters including tsunami may lead to large-scale core damage. Furthermore, TEPCO had not taken adequate preparedness for tsunami risks beyond design basis at the Fukushima Dai-ichi NPS. The accident showed quite a number of problems with TEPCO such as insufficient capability in organizational crisis management; hierarchical organization structure being problematic in emergency responses; insufficient education and training assuming severe accident situations; and apparently no great enthusiasm for identifying accident causes. TEPCO should receive with sincerity the problems which the Investigation Committee raised and should make further efforts for solving these problems and building higher level safety culture on a corporate-wide basis.**

At the eighth meeting of the Investigation Committee (February 24 and 25, 2012) with participation of overseas experts, Dr. Richard A. Meserve, Former Chairman of the US NRC pointed out that “the responsibility of individuals is also important in safety management. It is important that every individual involved in this area should have awareness of his/her own responsibility and always keeps a questioning attitude.” This mindset is also one of the important elements of a safety culture to be built.

**(7) Harmonization with international practices such as the IAEA safety standards**

Looking back about the 10 years since NISA was established in 2001, regulatory authorities including NISA could not actively contribute to the activities of developing international safety standards, while being occupied with other projects including the seismic back checks. The NSC also did not pursue, despite its awareness of the necessity, the updating of the domestic standards conforming to the IAEA safety standards, particularly in the issues of the defense in depth and severe accident responses. Consequently, Japan's involvement in the international safety standard development activities has been limited only to checking the negatives. Thus the criticism is reasonable that Japan was inactive in the human contribution to such international activities or in harmonizing the domestic standards with the international standards. On the other hand, Japan has made a certain level contribution concerning the development of IAEA safety standards in the earthquake and tsunami area.

As mentioned previously, regulatory authorities such as NISA had been aware of the need to review and formulate national guides and standards with reference to IAEA safety standards. But, they mostly failed to implement these measures. **It is necessary to keep the national regulation qualities constantly updated in line with the nuclear knowledge accumulation and technological development in the international and national community. To this end, continuous efforts are needed to keep the national regulatory guides newest and best while monitoring international standards, such as those at the IAEA.**

Japan has contributed to activities related to the formulation of IAEA standards in the area of earthquakes and tsunami. Further on, **lessons on nuclear safety should be extracted from the accident, and those lessons and relevant knowledge should be provided to the international community so that they could contribute to the prevention of similar accidents, not only in our country but also in other countries. In the process of revising national regulatory guides, international contribution should be pursued by making efforts to propose them to incorporate into the IAEA standards etc., if they turn out to be effective and useful as international standards.**

## **2. Recapitulation of Major Issues**

### **(1) Building of fundamental and effective disaster preventive measures**

The Investigation Committee conducted investigations and verifications into the damage due to, and actual responses to, the accident at the Fukushima Dai-ichi NPS, as well as prior measures having been taken by the government and TEPCO toward the prevention of nuclear accidents. In the Interim Report and the Final Report, the Investigation Committee pointed out that there had been many problems in these areas. These problems are listed below once more. Firstly, the following problems were pointed out regarding the accident responses at the Fukushima Dai-ichi NPS:

(i) Functions and operation procedures of the IC set of Unit 1 were not comprehended well enough not only by the shift teams but also by the NPS ERC and TEPCO- ERC. As the result, the IC condition was not properly grasped from the information intermittently obtained;

(ii) The risk of battery depletion at Unit 3 was underestimated. As the result, the shift team manually stopped the HPCI, before confirming the preparedness for sufficient depressurization and availability of alternative means of water injection. The inappropriate procedure caused failure to depressurize the reactor for the alternative means of water injection. Moreover, these operations were implemented by the decision of limited staff in the shift team etc. without asking for the manager's instruction, that revealed the inadequate information sharing procedures at the NPS;

(iii) At Unit 3, alternative means of water injection using fire engines should have been examined and prepared before the batteries for the RCIC and HPCI were likely to deplete. But the NPS ERC started examining and preparing the means only after learning that the HPCI had stopped; and

(iv) At Unit 2, the RCIC water source was switched over to the S/C, while the RCIC was out of control and unable to cool the S/C by RHR. In this circumstance, the RCIC could stop functioning in any minute, causing the S/C pressure and temperature to rise, and a difficulty in depressurizing the reactor by SRV, and there was a possibility that the alternative means of water injection became impossible. Therefore, the S/C pressure and temperature should have been continuously monitored while completing the preparation of the alternative means of water injection by fire engines and, without waiting for the RCIC to stop, the alternative means

of water injection should have been implemented by SRV depressurization before the S/C lost its pressure suppression capability. In actuality, however, the S/C pressure and temperature remained unmonitored until around 04:30 on March 14.

On the other hand, the following points were pointed out referring to the prior measures by the government and TEPCO toward the prevention of nuclear accidents:

(i) Nuclear operators requested, as its voluntary efforts, the Tsunami Evaluation Subcommittee, the Nuclear Civil Engineering Committee of the Japan Society of Civil Engineers, Inc. (now Public Interest Incorporated Association) (hereafter referred to as “JSCE”) to compile the “Tsunami Assessment Method for Nuclear Power Plants in Japan” (hereafter, “Tsunami Assessment Method”), based on which the nuclear operators estimated the anticipated tsunami height. This Tsunami Assessment Method had a limitation of using only the “tsunamis with recorded trace heights, which were judged to be fairly reliable” as its base reference, and having a high possibility to exclude the tsunamis with insufficient literature or reference materials from the assessment;

(ii) Concerning the tsunami to anticipate in the design phase, the Seismic Design Regulatory Guide was revised in September of 2006, in which tsunami response measures were stipulated. But during the deliberation of the revision process of the Guide at the NSC, sufficient discussion regarding tsunami was not made. No criteria for the effectiveness of the tsunami assessment method or tsunami response measures were presented from NISA etc., either;

(iii) At TEPCO, a tsunami wave height exceeding the design basis height was calculated at the Fukushima Dai-ichi NPS, by referring to the point mentioned in the report (\*), indicating a possibility of inter plate earthquake (tsunami earthquake) anywhere in the area from north-off shore Sanriku to off-shore Boso towards the trench, and by test calculations based on the research paper “Wave Source Model” of Jogan tsunami. However, no affirmative tsunami response measures were taken;

(\*) “Long-term evaluation of seismic activities in the region from Sanriku-Oki to Boso-Oki” (“Long-term Assessment”) compiled by the Headquarters for Earthquake Research Promotion (“Promotion Center”) of MEXT

(iv) Also in Japan, severe accident response measures were being developed by the regulatory authorities and nuclear operators, but the events reviewed were limited to internal

events such as mechanical failure and human errors. The scope of events for review was not actively expanded and promoted to external events including earthquakes and tsunami etc.;

(v) TEPCO was not examining and preparing AM measures for tsunami. TEPCO understood that they could respond to natural disasters including tsunamis within design, thus was extremely insufficient in developing measures to respond to natural disasters beyond design basis that caused serious damage to reactor cores;

(vi) TEPCO did not assume a simultaneous breakdown and damage at multiple units, concerning power sources. No measures had been ever taken for ensuring independence of Emergency DGs and power distribution panels by multiplexing and diversification of their locations. There was no preparedness to a situation of the loss of DC power as well. Moreover, the operating procedures were not developed and staff education was not conducted for responding to such a situation. No equipment or materials were sufficiently stocked for responding to such situations;

(vii) Water injection using fire engines had been recognized as effective by some TEPCO personnel, but was not authorized as part of AM measures, and seawater injection was not examined as part of AM measures. It was not clear which function team should implement water injection by fire engines;

(viii) At TEPCO, a smooth communication method within the power station had not been developed, assuming the loss of all power sources for a long time. The routinely used PHS ran out of battery power. Radio communication which was used after the PHS power depletion had constraints in locations able to communicate; and

(ix) No specific rules were in order concerning operational personnel of equipment and materials in case of emergencies. As a result, the operational personnel in need failed to deploy, giving an impact on the prompt development of the initial response activities to the accident.

The Investigation Committee strongly seeks the sincere acceptance of these criticisms by practically all stakeholders in nuclear power generation, including the government, nuclear power operators, nuclear power plant manufacturers, research institutes, and nuclear academic societies, as well as the implementation of specific initiatives to eliminate and improve upon these problem areas.

As it is described previously, **quite a number of problems exist, which need highly**

**specialized nuclear knowledge over a wide range for solving technical and nuclear engineering problems. These problems should be reviewed and resolved, results being shaped into concrete actions, through competent knowledge by stakeholders in nuclear power generation. In doing so, they should sincerely take into consideration the recommendations the Investigation Committee has made and they should do so with accountability to society for its process and results.**

Referring to the items that should be reflected to the future safety measures based on the latest accident, the government has presented directions of measures of as many as 30 items, including, external power, on-site electrical facilities, cooling/water injecting systems, containment vessel damage and hydrogen explosion, and accident response system/instrumentation facilities. Some of these measures would be further specified closer to reality. The Investigation Committee strongly urges that relevant individuals and organizations make continued and integrated efforts to develop the truly effective measures including these.

## **(2) Lack of complex disaster point of view**

The accident at the Fukushima Dai-ichi NPS resulted from the Tohoku District - off the Pacific Ocean Earthquake accompanied by a major tsunami. The earthquake and tsunami, of course, not only hit the Fukushima Dai-ichi NPS but also caused serious human and physical damage to the Pacific Coast area in Tohoku district.

The Tohoku District - off the Pacific Ocean Earthquake caused a large-scale, wide-area, and complex disaster that included the elements of an earthquake, tsunami, and nuclear accident. When such a complex disaster occurs, a lot of difficulties different from individual accidents or disasters are resulted simultaneously. The national government and local municipal governments encountered had to respond to more than one unprecedented disaster simultaneously. Amidst a situation in which the earthquake and loss of power cut off communication lines, they fell into a state of confusion at various stages and consequently failed to respond to problems timely or adequately. As reviewed in the Interim Report and this Final Report, the Off-site Center, which should have taken a primary role in accident responses, could not function fully due to failure of communication means and other reasons. The monitoring equipment was also damaged, resulting in difficulty in monitoring radiation dose

rates. The essential infrastructures to respond to an accident at the nuclear power station were seriously damaged to function.

In particular, the incapability of the Off-site Center to function demonstrated the lack of complex disaster point of view in emergency preparedness at the government and local municipalities. In other words, the Off-site Center was a facility located and developed without sufficient consideration of the risks of access road damage or communication system breakdown due to an earthquake. Consequently, the complex disaster revealed its limitations, and it immediately lost its functionality.

In this accident, the accident occurred simultaneously at multiple reactor units, and the accident progress at one unit affected the emergency response at the adjacent unit. In the existing severe accident measures in our country, a simultaneous occurrence of serious accidents at multiple units was not considered possible.

Until the accident at the Fukushima Dai-ichi NPS, the national government and the majority of local governments did not imagine the occurrence of a nuclear accident in the form of a complex disaster highlighting the inadequacies in Japan's crisis management attitude, in both aspects of the safety of nuclear power plants as well as safety of the surrounding local communities. **When reviewing the existing safety measures at nuclear power stations, risks of a large scale complex disaster should be sufficiently considered in emergency preparedness.**

### **(3) Change needed in an attitude to face risks**

In establishing safety measures for accidents or disasters, whether the causes are internal (flaws/failure, human errors, etc.), or external (earthquakes, tsunami, volcanoes, tornadoes, destructive storms, landslides, mudslides, power outages, aircraft crashes, terrorist attacks, etc.), it is naturally necessary to predict the probability of occurrence and mode of damage in each event. In particular in Japan, earthquakes, tsunami and volcanoes are important risk elements in the safety of nuclear power stations as well as in regional disaster prevention.

As elaborated in the Interim and Final Reports, attention in recent seismological research based on the plate tectonics theory has been shifting to the regional characteristics of seismic source areas, the characteristics of submarine faults concerning tsunami earthquakes causing

major tsunamis, and probabilistic assessment on the frequency and probability of occurrence of such earthquakes. The application of such new forms of knowledge in identifying specific priority regions for emergency preparedness could be deemed reasonable to a certain extent.

However, despite advances in academic knowledge, a gap was also growing between such advanced knowledge and emergency preparedness (Pitfalls in Safety Barriers by the Swiss cheese model of J. Reason), as seen in the following cases: (i) the probabilistic assessment of earthquakes and tsunami, which predicts a possibility of occurrence of earthquakes in terms of scale and frequency in each region divided by the characteristics of initiation, is based on limited case studies for which detailed records remain. They are mostly in Edo Period between 200 and 400 years ago even at the oldest, although depending on the region. On the other hand, earthquakes and tsunami occurring in long intervals of 500 to 1,000 years with insufficient records such as those mentioned in historical documentation, which are difficult to estimate their source model and scale, are left out from the database; (ii) research institutes and the relevant administrative agencies have attempted to improve precision in computing the probability of occurrence of natural disasters such as earthquakes and tsunami, in order to provide clear justification for the establishment of certain emergency preparedness. On the other hand, however, there were growing tendencies to forget the traditional concept of emergency preparedness that mandated the consideration and preparation at the same time for those rare natural phenomena lying beyond the boundaries of existing academic knowledge; or (iii) in assuming earthquakes and tsunami for design, extremely rare cases have been raised as issues to be reviewed under the expressions “residual risk” and “remaining challenges,” but, in actual fact, they were simply so written down in documents and have continued to be left behind without further and deeper discussions.

In order to avoid such pitfalls, it is necessary to make the following significant changes in the perception of risks, based on the premises of safety measures and emergency preparedness.

**(i) It is necessary to humbly face the reality of natural threats, diastrophism and other natural disasters, which are sizable in scale and time, keeping in mind that Japan has often had them in its long history.**

**(ii) Risk reduction should be tackled in a drastically different approach.** In the past risk concept used as the basis for safety measures and emergency preparedness, the probability of

occurrence of an event has been placed at the center of judging criteria, and events with a low probability of occurrence have been removed from the scope of safety measures. There was a certain level of reasonableness in such an approach when designing general machinery or buildings. However, what the Tohoku District - off the Pacific Ocean Earthquake demonstrated was the importance of shifting awareness of risk so that “even if an event is predicted in a probabilistic approach to have a low probability of occurrence, appropriate measures need to be taken in cases where the consequence of damage is extremely large once an accident or disaster occurs.”

In that instance, when it deals with designing general machinery or buildings, the conventional approach of estimating the risk as “Risk = Probability of occurrence x Consequence of damage” will be applicable. However, **in the government as well as in private entities, a new approach to safety measures and emergency preparedness should be established for a disaster which potentially brings about serious damage in broad areas like a gigantic tsunami or the severe accident at the Fukushima Nuclear Power Station, regardless of its probability of occurrence.**

**(iii) An institutional framework is needed to ensure continued in-depth examination of “residual risks” or “remaining issues” without leaving them behind beyond the predetermined safety measures and emergency preparedness.**

After the Tohoku District - off the Pacific Ocean Earthquake, experts in safety theory or risk management came to emphasize, in a variety of occasions, the importance of focusing attention on the aforementioned way of considering risk and on “residual risk.” Among those, particularly important is the concluding remark in the “Report” (September 28, 2011) compiled by the “Committee for Technical Investigation on Countermeasures for Earthquakes and Tsunamis Based on the Lessons Learned from the ‘2011 off the Pacific Coast of Tohoku Earthquake’” (Chairman Yoshiaki Kawata; Professor, Kansai University) of the Central Disaster Management Council. In the Report, while reflecting on the fact that the Jogan tsunami (in 869) and similar events had been placed outside of considerations, the concluding remark says that “Despite the probability of their occurrence being low, historic earthquakes in which earthquake and tsunami damage is considered to have been on an overwhelming scale must be adequately examined.”

It is hoped that the way risks are perceived, which forms the premise for future emergency preparedness of Japan, will come to be thought of, based on this sort of approach in regards to various external causes, in addition to earthquakes and tsunami.

#### **(4) Importance of “Deficiency analysis from the disaster victims’ standpoint”**

Why was the evacuation of people from surrounding regions fraught with chaos on the occasion of the accident at the Fukushima Dai-ichi NPS ? This question is of equal importance to the question of why the severe accident had occurred at the Fukushima Dai-ichi NPS.

In designing and establishing a nuclear power station, which is a massive system, nuclear operators first formulate multiple safety measures for the various facilities that could be called the “system core domain,” such as those inside of the reactor building and turbine building. This involves reactor safety measures themselves as well as other measures such as establishing two emergency generators to respond to situations in which external power is lost, or preparing multiple emergency cooling water systems.

Taken into account next are the various facilities that could be called the “system support domain.” In other words, the preparation of truck-mounted emergency generators for use during accidents, fire engines, heavy machinery, support equipment and extension electrical cables, etc., equipment for measuring radiation dose rates at sources of radioactive material emissions and in neighboring regions (emissions detectors and monitoring posts), the development of communication infrastructures and transportation infrastructures, etc.

Additionally, the administrative institutions concerned – the government and regional municipalities – have to formulate nuclear disaster prevention plans to prepare for the unlikely event of an accident in which radioactive materials disperse over neighboring regions, in order to protect the people in those regions from radiation exposure. However, in addition to frameworks for evacuating people in the region and information systems planning, these disaster prevention plans should include measures for providing medical support, measures for schools and childcare centers accompanying environmental contamination, and measures for the agricultural and fisheries industries, etc. The domain where these kinds of measures are required will be provisionally referred to as the “regional safety domain.”

The purpose of dividing the domains relating to nuclear power stations into the three

categories of “system core domain,” “system support domain” and “regional safety domain” is not to impose strict divisions like those for determining the domains covered under design standards, but rather to make it easier to determine within what sort of overall framework the safety of the system itself and the safety of the people in the surrounding regions should be ensured. It should be noted that in some cases a facility will have a common role in two domains. For example, the monitoring post and communication infrastructure, etc. cited under the “system support domain” are also key facilities in the “regional safety domain.”

In verifying the safety of a nuclear power system, what is observed will differ greatly depending on the position of the person doing the verifying. When examining the safety of the system from the nuclear operator’s standpoint, naturally, the area where an all-out effort is initially made is in ensuring the safety of the “system core domain.” As a result of implementing multiple safety measures, nuclear power is recognized as being “safe.” If, however, that recognition ends up becoming certitude, then a certain laxity tends to develop in the stance of engaging in tasks and undertaking checks with a sense of vigilance when ensuring safety in the domains other than the core domain.

Whether talking about the “system core domain” or the “system support domain,” when safety is said to be ensured this only means the safety within the boundaries of the preconditions of the design: In a case where an event occurs that is outside of those preconditions, safety can no longer be assured. In fact, not only were nuclear operators and regulatory-related institutions overly confident that an event outside design conditions would not occur, until they were faced with an event that exceeded those conditions in the way this massive tsunami did. They did not notice that even in the “system core domain,” the measures for preventing a worst-case scenario were actually riddled with “holes,” to say nothing of the deficiencies in the safety measures that they had overlooked in the “system support domain” and the “regional safety domain.” This is representatively expressed by the fact that at the NSC and NISA also, when deciding nuclear disaster-prevention plans there was a false sense of confidence that a situation involving a large-volume dispersal of radioactive material as a result of damage to the containment vessel of the reactor would not occur. Consequently they did not prepare the system support for responding to such a predicament, or formulate measures for evacuating citizens.

The following two points should be cited as important lessons demonstrated by the above

facts:

(i) If nuclear operators and regulatory bodies overestimate the safety of the “system core domain” within only those assumptions, for which it was designed, safety measures will fail.

(ii) Safety measures in the “system support domain” and “regional safety domain” need to be able to function independently in the case of an emergency, regardless of the level of safety of the “system core domain.” Should this principle be neglected, it would increase risks to create many “pitfalls” (deficiencies) in the safety barrier, which should protect the lives of regional people.

So, what has to be done to detect those kinds of deficiencies, and to ensure that the barriers for preserving safety in each of the domains are sound?

As a means for achieving this, the Investigation Committee proposes an approach which can be called a “deficiency analysis from the disaster victims’ standpoint.” This is a method of analysis conducted from the standpoint of a person who has fallen victim to the disaster. Through this method, personnel in charge of emergency preparedness at regulatory bodies and local governments, working in collaboration with specialists in the field of disaster issues, put themselves and their families in the shoes of residents of the affected areas and analyze thoroughly the events that might befall themselves in the worst case.

Put more specifically, what scale of nuclear accident is to assume, as a premise for evacuation planning? Should the envisaged event occur, are communication routes in place for conveying information speedily and accurately? What area will radioactive materials disperse across, and how? In one’s own area, what radiation dose could there potentially be for it to actually be safe? How will the areas to evacuate be decided? Are the direction of evacuation, the means of travel and the evacuation destination completely reliable? Will it be possible to evacuate hospital patients, elderly people living at home and disabled people? How long with the evacuation take? As a result of environmental contamination from radioactive materials, what sort of impact will there be on residential conditions and lifestyles, the farming, livestock, fisheries, forestry and various commercial industries, and children’s childcare services and education, etc.? Are these measures in place, in advance? Thoroughly investigating a raft of issues such as this serves to highlight flaws and deficiencies in safety measures.

Between April and July 2006, the NSC set up a working group and explored revising the

Emergency Preparedness Regulatory Guide (NSCRG: T-EP-II.01) with the goal of strengthening the emergency preparedness framework, including the establishment of evacuation zones for residents living in the vicinity of nuclear power stations, in line with new IAEA policies. At that point, however, NISA voiced strong objections, arguing that an adequate response was possible under the then-existing emergency preparedness framework, and so the revision plan was frozen after all. When this issue too is examined from the perspective of “deficiency analysis from a victim’s standpoint,” it provides a vivid insight into the true nature of the problem. Japan’s nuclear emergency preparedness framework made no allowance whatsoever for the occurrence of a major event in which large quantities of radioactive materials would be dispersed as a result of damage to or venting of a reactor containment vessel; only a small-scale leak of volatile materials etc. had been assumed. By comparison, based on the lessons of the Chernobyl accident and other events, in the IAEA’s new policies severe accidents had come to be an assumption of emergency preparedness. More specifically, as areas that would be needed to evacuate quickly when an emergency event occurred, the area within a 3-5 km radius of a nuclear power station was designated as a PAZ. With an emphasis on preventing deterministic effects as a result of radiation exposure, residents living within the PAZ were to immediately evacuate from the zone from the point at which there was a danger of a release of radioactive materials. It was these new policies that the NSC had sought to introduce in Japan.

Meanwhile, however, NISA was convinced that a situation such as damage to a reactor containment vessel would not occur in Japan, and it argued that the existing emergency preparedness framework, which designates the area within an 8-10 km radius of a nuclear power station as an Emergency Preparedness Zone (“EPZ”), was enough. NISA also asserted that, because up to then it had been persuading residents living in the vicinity of nuclear power stations that a major accident would not occur, it would be extremely difficult to now turn around and say that there was a need for emergency preparedness that assume a severe accident could occur. It also said that it was difficult to endorse changes to emergency preparedness that might cause confusion locally at a point when emergency preparedness had sunk in and emergency response drills were being properly implemented, and for this and other reasons it objected vehemently to adopting the new policies. In some respects also, the NSC had not

properly compared the details of the IAEA's new policies against Japan's system, and nor had it adequately assessed areas of difficulty on the implementation front, for example, and so ultimately the adoption of the IAEA's new policies was put off.

If this issue is assessed from the perspective of "deficiency analysis from a victim's standpoint," the following kinds of problem points surface:

(i) Even though the nuclear emergency preparedness framework is something decided in the interests of protecting regional citizens' safety, it ended up becoming nothing more than a token debate, when it came to the envisaged events to form the most important preconditions for the framework that a serious accident in the form of a damage to a reactor containment vessel would not happen, as a result of overconfidence on the part of the regulatory-related institutions.

(ii) Emergency preparedness is a key item in the "regional safety domain," and as previously mentioned they must be measures to prepare for a worst-case scenario, irrespective of the level of safety of the "system core domain." Nevertheless, the reality was that no such systems planning took place.

(iii) If regulatory-related institutions persuade regional citizens by simply insisting that nuclear power plants are absolutely safe, it becomes difficult to subsequently alter the emergency preparedness framework to make it safer.

(iv) To construct a genuinely safe social system there is a need for factual information concerning risks to be shared among regulatory-related institutions and citizens. However, in preparing the nuclear emergency preparedness framework, not enough information was supplied to citizens on the one hand, while aspects such as "nuclear power is safe" and "the disaster responses are infallible" were being overemphasized on the other. In connection with the above-mentioned opinion exchanges that occurred over the consideration that was given to revising that Emergency Preparedness Regulatory Guide, NISA Director-General Kenkichi Hirose reportedly made a comment, during a luncheon that was held with an aim of exchanging views with the NSC, along the lines of: "Citizens have at last calmed down over the issue of emergency preparedness. Let sleeping dogs lie." This can be cited as one example of just how lacking in the above-mentioned perspective ("deficiency analysis from a victim's standpoint") the regulatory-related institutions have been up to now.

(v) NISA argued that emergency response drills were being properly implemented, and cited

this as one reason why there was no necessity to change emergency preparedness again. However, the true state of emergency response drills was that at a single municipality on a week day, a few hundred citizens at most would participate, and consequently the drills were not substantial enough to enable a response in the event of a fully-fledged nuclear accident.

When the system's problem areas are studied and brought to the surface in this way, from the standpoint of the victims, it highlights just how many critical "holes" there are.

Similarly, when the "system support domain" also is verified from the perspective of "deficiency analysis from a victim's standpoint," various problem points surface: Will the facilities for measuring sources of radioactive material emissions and the monitoring facilities in neighboring regions be capable of functioning and properly communicating information even in an earthquake, a tsunami and power outage? Will SPEEDI information be able to be used effectively? Will Off-site Centers be able to function even while radioactive materials disperse? Has nothing been left to chance regarding the communications infrastructure and transportation infrastructure vital for the emergency response? Is the various support equipment infallible? This type of "deficiency analysis from a victim's standpoint" takes on considerable significance when it comes time to examine and analyze safety that empathizes with the seriousness and urgency citizens (the victims) feel.

The government and nuclear operators should take the improvement steps for flaws and defects in the safety measures that are identified through this analysis. It would probably be difficult to block up all the "pitfalls" immediately. Under such circumstances, it is important that information on the remaining measures and the related issues be released, and for regulatory bodies and local government bodies to discuss with residents the future measures to take, and, in cooperation, to come up with the next best solution. Only by capturing disasters from the perspective of the residents in the affected areas, and establishing safety systems accordingly, a truly safe and secure society will be created in Japan.

A lesson that can be drawn from the above analysis is this: **An accident at a nuclear power station has risks to bring about damage in vast areas. Nuclear operators on one hand, nuclear regulators on the other, should establish a systematic activity to identify all risk potentials from the "disaster victims' standpoint," when designing, constructing and operating such nuclear systems, for ensuring credible nuclear safety including evacuation**

**planning in the local society. Such an approach should be practiced.**

Moreover, as was also pointed out in the Interim Report, **with regard to the residents' evacuation plans and evacuation drills** that were mentioned here, we once again point out that **radioactive materials may disperse over vast areas due to an accident at a nuclear power station. The prefecture and local municipalities involved should closely collaborate in building up an effective system through evacuation planning and its drills for minimizing confusion.**

**(5) The issue of “beyond assumptions” and lack of the sense of crisis at the administrative bodies and TEPCO**

Government officials and TEPCO executives frequently used the expression “beyond the scope of assumptions” to describe the occurrence of a massive earthquake and massive tsunami that had caused huge damage to the Pacific coast of eastern Japan and triggered a nuclear accident. In the sense that not even earthquake specialists were predicting that several hypocenters would move almost simultaneously and a massive earthquake with a JMA seismic intensity of M9.0 would strike, there were certainly aspects to the events that transpired that were “beyond the scope of assumptions.”

Nevertheless, this only means that an earthquake occurred that was “beyond the scope of assumptions” if the scale and mechanism of the hypocenters were assessed in strictly scholastic terms. If the question asked is was there no forecast whatsoever in general terms of an earthquake likely to trigger a massive tsunami on the Sendai plain or the Fukushima Prefectural coast, then that is not necessarily the case.

To begin with, the word “beyond assumptions,” broadly speaking, can refer to two meanings. One means that an incident, which could not be predicted even with possession of the most advanced academic knowledge, occurred. The other one means that, in light of financial limitations and other limitations to the ability to respond to all predictable events in institutionalizing a system or constructing a building, or in predicting an occurrence of natural disasters, a line was drawn to exclude incidents that were realistically assessed to have a low probability of occurrence, and an incident of a scale far beyond that line occurred. Based on the study of the seismological progression and emergency preparedness administration over the

past ten or so years, it is recognized that the latter meaning held true in the case of the latest major tsunami.

Plate tectonics theory, which says that major earthquakes will occur as a result of the ocean floor (plates) sinking, appeared at the end of the 1960s, and since then understanding of the mechanisms that trigger major earthquakes has deepened. Additionally, thanks to the development of the GPS continuous observation network on the Japanese archipelago from the 1990s, observational evidence has shown that strain was building up as a result of plate subsidence in the Pacific Ocean off the coast of the Tohoku region. As a result, more researchers were realizing that a major earthquake occurring in the vicinity of the Japan Trench offshore of the Tohoku region was a possibility, or to put it another way, more researchers were realizing that it was dangerous to assume that just because it was a location where a major earthquake had not occurred within a history of several hundred years one would not occur there in the future. In the midst of that, in a long-term evaluation by the Promotion Center in July 2002, it was pointed out that there was a possibility of a tsunami earthquake occurring anywhere in the vicinity of the Japan Trench between offshore of Sanriku and offshore of Boso. This indicated that there was a possibility of a tsunami earthquake occurring even off the coast of Fukushima Prefecture, which had been positioned as a seismic gap. However, based on a strong request from the bureau in charge of emergency preparedness at the Cabinet Office, a proviso was added to this long-term evaluation (prediction), which cautioned that due to data limitations, the figures for the occurrence probability and earthquake magnitudes contained errors.

The decision to exclude seismic gaps from national disaster prevention measures was made determinably by the Central Disaster Prevention Council, which decided the country's overall disaster-prevention plan. As described in detail previously in Chapter V. 2. (2), at the second meeting of the "Committee for Technical Investigation on Counter-Measures for the Trench-type Earthquakes in the Vicinity of the Japan and Chishima Trenches" ("Trench Expert Committee") of the Central Disaster Prevention Council, the secretariat presented a proposal to compromise with the earthquakes to be covered in the review of disaster-prevention measures. This involved having disaster-response measures cover: (i) areas where large earthquakes had repeatedly taken place in the past; and (ii) areas where large earthquakes rarely occurred; but excluding from coverage (iii) areas where there was no record of a major earthquake occurring.

The reasoning behind this was that “no sufficient knowledge is yet available on the probabilities of occurrence (meaning scientific research was underdeveloped).”

In response to this, the earthquake and tsunami specialists among the members of this Trench Expert Committee argued that the seismic gap in the area running along the Japan Trench off the Fukushima Prefecture and Ibaraki Prefecture coasts should be covered under disaster-response measures for tsunami earthquakes, and that consideration should also be given to a Jogan-type tsunami, for which a true picture was beginning to emerge. However, the secretariat did not change its policy, pointing out that the disaster-response plan was legally-binding and because budget constraints and the ability of the municipalities concerned to respond are also involved, a fairly persuasive basis was needed when deciding to include an area in the plan’s coverage. Subsequently, this Trench Expert Committee compiled a report in 2006 that essentially complied with the secretariat’s above-mentioned policy, in which along with removing a tsunami earthquake in the area running along the Japan Trench off the Fukushima Prefecture and Ibaraki Prefecture coasts from its review coverage, it stated only that a Jogan-type tsunami “needs to be kept in mind.” Meanwhile, the area off the shore from Nemuro to Tokachi, an area with a “500-year earthquake recurrence interval,” was designated to be covered under the disaster-response measures, since owing to steady and cumulative studies research on the occurrence cycle and fault model had progressed to a point where the case that could be made for this review was persuasive.

It cannot be denied that the process of the government’s decision-making on emergency preparation that is outlined above was reasonable to a certain extent when the logical framework of government administration is taken into account. However, faced with the reality that close to 20,000 lives were lost as a result of a massive tsunami, and that well over 100,000 people were forced to evacuate after a massive tsunami over 14 m high struck and triggered a nuclear accident, can the government walk away simply by saying that it made no mistakes and that there was nothing they could have done more because this major earthquake and tsunami were “beyond assumptions”? If so, no lesson useful to create a safe society can be learned.

In order to look for solutions to this question, it becomes necessary to undertake analysis through approaches to accident research that are not bound by the administration’s logic. Approaches to accident research mean initiatives for carrying out cause analysis that ask

questions, regardless of the government's logic and whether the government held responsibility, such as: were there no other options or approaches available that would have even marginally reduced the damage and was there no means of reforming the administration's decision-making framework? When analyzed from this standpoint, the following problem points surface:

(i) Up to now there were considerable interest in the Nankai Trough among earthquake researchers, and research on a massive earthquake occurring in the Japan Trench and Chishima Trench was not sufficient. This has been influenced by the fact that clear historical records remain (in Nankai), and that social interest in an earthquake occurring in central Japan where a large number of people live was high. After pioneering research regarding a massive earthquake occurring in the Japan Trench and Chishima Trench, starting with the Jogan Earthquake, undertaken around 1990, only scant research was carried out in the 10-plus years subsequent to that. Japan is a "disaster-prone country" that has experienced historically a large number of earthquake and tsunami disasters. However, in publicly-funded research projects within the scientific research budget etc., the growing prevalence of a style of research that emphasizes narrow research targets has in some respects given rise to "places where the sun shines" and "places where the sun does not shine" in the field of earthquake research. It needs to be noted that relying on knowledge based on research of this type when assigning priorities in disaster-prevention measures may have increased the "beyond the scope of assumptions" risk. (This issue is similar in nature to the problem discussed above in (3), regarding the pitfalls that can develop as a result of concentrating solely on improving the accuracy of risk probability calculations). **Scientific knowledge of earthquakes is not sufficient yet. The latest research results should be continually incorporated in emergency preparedness. In other words, a policy/rule concluded at a certain point based on the then-available knowledge should be reviewed with flexibility and revised, without groundless procrastination, when new knowledge of earthquakes and tsunami become available.**

(ii) **If an area is excluded, due to limited financial resources or other reasons, from the areas for strengthening emergency preparedness because of low or unknown probabilities of occurrence, the damage would be extremely serious once a massive earthquake and tsunami hit the area. Administrative bodies should take initiatives of, for instance, launching research projects on earthquake evaluation in specific areas for which some**

**seismologists warn of risks, even if few in number, or which show traces of massive earthquakes and gigantic tsunami (tsunami deposits, for instance) from the remote past; or formulating an innovative disaster prevention plan in full cooperation of public administration, residents and experts through disclosing relevant information.**

(iii) Up to now, emergency preparedness plans decided on by the Central Disaster Prevention Council have moved forward without paying a particular attention to the regions where nuclear power plants are located. However, **disaster risks in nuclear power plant siting regions should be noted. It was the role of NISA to prepare for nuclear emergencies at nuclear power stations. However, the policy of the Central Disaster Management Council has strong relevance to the emergency preparedness at nuclear power stations. The Central Disaster Management Council should duly consider the nuclear power stations, too, in its policy making.**

On the other hand, how were TEPCO's tsunami responses?

TEPCO calculated the maximum wave height for tsunami to anticipate that could strike the Fukushima Dai-ichi NPS and Fukushima Dai-ni NPS using the Tsunami Assessment Method compiled by the JSCE in 2002. It obtained a figure of 5.4-5.7 m above the Onahama Peril for the Fukushima Dai-ichi NPS and 5.1-5.2 m for the Fukushima Dai-ni NPS, and took measures accordingly. Later, within the "Long-term Assessment" by the "Promotion Center," the observation was made that the possibility of a tsunami earthquake occurring offshore from Fukushima Prefecture could not be ruled out, and so from May to June 2008 TEPCO calculated the wave height of a tsunami envisaged to take place as the result of an earthquake in the class of the Meiji Sanriku earthquake (in 1896) occurring off the coast of Fukushima Prefecture, whereupon it obtained an extremely high figure for the Fukushima Dai-ichi NPS site, of 9.3-15.7 m. Additionally, around October of that year, TEPCO referred to a Jogan-type tsunami simulation conducted by another expert to estimate the tsunami wave height and similarly obtained high figures of 8.6-9.2 m for the Fukushima Dai-ichi NPS and 7.7-8.0 m for the Fukushima Dai-ni NPS.

However, TEPCO executives concluded that the earthquake predictions for the vicinity of the Japan Trench including the earthquake offshore from Fukushima Prefecture mentioned in the "Long-term Assessment" in 2002 and the new simulation research on a Jogan-type tsunami

simply pointed out possibilities, and that in fact no such tsunami would likely occur. And rather than embark on new tsunami measures immediately, they decided only on a plan to ask the JSCE for investigation, and to perform a tsunami deposit survey for the Fukushima Prefecture coast.

In the meantime, in response to requests from NISA, TEPCO reported the results of the above-mentioned tsunami calculations on three occasions – in September 2009, May 2010 and on March 7, 2011 (four days before the Tohoku District - off the Pacific Ocean Earthquake struck on March 11) – but because neither NISA nor TEPCO had a sense of urgency, this did not lead on to any action being taken to promptly implement proactive tsunami countermeasures, and the measures that had been based on the 2002 tsunami assumptions were left as they were.

Around this time the Earthquake Research Committee at the “Promotion Center” was compiling a new “Long-term Assessment” report, being scheduled to publish in October 2011, based on progress in research on Jogan-type tsunami and other developments. Getting aware of this, TEPCO made requests on March 3, 2011, to the Secretariat of MEXT’s “Promotion Center” that included stating that it “wants (the report) to describe the Jogan Sanriku-Oki Earthquake as can be interpreted that its seismic source has not been identified yet, and to think of modifying wording to describe the Jogan Sanriku-Oki Earthquake in the revised version since the text in the draft revision sounds as if the earthquakes frequently occurred.” This action cannot help but raise the suspicion that rather than taking sincerely the outcome of a government institution’s earthquake and tsunami forecasts, TEPCO was instead attempting to prevent being pressured to undertake measures to counter a massive, Jogan-type tsunami, or was attempting to avoid having questions raised about deficiencies in its tsunami defense measures.

When TEPCO’s responses, such as the ones outlined above, are examined in hindsight, it is to be mentioned that TEPCO lacked a sense of urgency and imagination toward major tsunami, which could threaten to deal a fatal blow to its nuclear power plants. Consequently, this could be considered as one of significant background factors that led to a serious nuclear accident and inadequate measures against the expansion of damage.

**(6) Issues of the government crisis management systems**

Following a criticality accident in 1999 at the JCO nuclear fuel fabrication facility (hereinafter referred to as “the JCO criticality accident”), the Nuclear Emergency Preparedness Act was enacted the same year with the goal of protecting people’s lives, personal safety and property from a nuclear disaster by strengthening measures to counter such a disaster. Based on the lessons of the JCO criticality accident, the Act stipulated that in the event of a nuclear disaster, a Local NERHQ would be set up near the accident site. It also stipulated that the Director-General of the Local NERHQ would be delegated with authority by the Prime Minister and would lead the response to the situation. The Nuclear Emergency Response Manual that was formulated based on the Act also assumed that the response to the situation would center on the Local NERHQ.

In fact, in the latest case also, in accordance with the Nuclear Emergency Response Manual, when disaster struck, core members of the Local NERHQ assembled on-site in order to perform the Local NERHQ’s functions, beginning with Motohisa Ikeda, Senior Vice-Minister of METI, who served as Director-General of the Local NERHQ, as well as TEPCO Vice-President Sakae Muto and others. However, at the Off-site Center that was to serve as the base for the headquarters, the communications equipment had been rendered all but unusable due to the earthquake, and so the Local NERHQ was not able to fully perform its function as a command center.

As a result, the NERHQ (the Director-General is the Prime Minister) set up in Tokyo had no choice but to stand at the forefront of the disaster response, including carrying out duties that should have been performed by the Local NERHQ. In the process, the capacities of the Crisis Management Center located belowground in the Prime Minister’s Office were not utilized, where officials from the relevant ministries and agencies had assembled, and decisions on key matters took place mainly on the fifth floor of the Prime Minister’s Office, centering on Prime Minister Kan. Moreover, the initial response to the nuclear accident took the form of Prime Minister Kan himself playing the lead role, including actively gathering information himself, and traveling to inspect the accident site.

In a hearing with this Investigation Committee, Prime Minister Kan commented on the fact that the fifth floor of the Prime Minister’s Office became a kind of command center, saying that

“Systems that had been envisaged during normal times did not work, and the Prime Minister’s Office had to seize the initiative, but effectively it was not a problem, because NSC Chairman Madarame and officials from NISA were on the fifth floor, and in each case I was deciding responses after listening to their opinions.” As a technology graduate Prime Minister Kan prided himself on “being familiar with” nuclear power (an expression he used during a hearing with this Investigation Committee). When it came to responding to the earthquake and tsunami disaster, Prime Minister Kan was deciding responses to the situation based on reports he was receiving on an as-needed basis from Crisis Management Deputy Chief Ito and other members of the Emergency Operations Team in the basement of the Prime Minister’s Office. In contrast, however, when responding to the nuclear disaster, he did not attempt to utilize the capacities of the Crisis Management Center located belowground at the Prime Minister’s Office for systematic responses in a coordinated manner. One of the adverse effects of this is that because, for example, officials from MEXT, which oversees SPEEDI, were not included among the decision-making members on the fifth floor of the Prime Minister’s Office, the opportunity was lost to learn of the existence of SPEEDI and consider the possibility of utilizing it.

This time, a command center was set up on the fifth floor of the Prime Minister’s Office, which had not been stipulated in the Nuclear Emergency Response Manual, and Prime Minister Kan came to the forefront to deal with the accident. The background to these circumstances can be attributed to the inability of the Local NERHQ to fulfill its original roles, as well as to inadequacies in the information consolidation scheme in the Prime Minister’s Office, and in the advisory function of the NSC. However, the Prime Minister’s original role is to give appropriate, final decisions on the most important matters brought up by specialized divisions along with suggested options and leave information gathering and response measures to each organization, department and agency of the government. Intervening in the site of the disaster as a commander may create confusion on-site, and lead to a loss in the opportunity of making important decisions or lead to making wrong judgment. As such, such an action should be viewed more as a possible cause of a greater harm than that of good.

**Learning from the experience as a result of the accident at the Fukushima Dai-ichi NPS, the crisis management system for a nuclear emergency should be urgently reformed, in which the nuclear emergency response manual should be revised assuming an occurrence**

**of a complex disaster combining an earthquake/tsunami disaster and a nuclear accident. In its reforming process, the strengthening of response capabilities of off-site centers is needed. In addition, it is also required to build a crisis management system by examining how to respond to a situation which a local nuclear emergency response headquarters cannot handle by convening personnel from relevant emergency response bodies.**

**(7) Issues of the provision of information and risk communication**

When a nuclear disaster that has a serious impact on a wide area occurs and additionally where the circumstances change from one moment to the next, the approach taken to disclosing information domestically and internationally by the institutions concerned is extremely important. There are many means of conveying information, including press conferences and websites, but unilaterally conveying a decision by the government or an expert is known as a risk message. However, when conveying information in the case of a nuclear disaster, unilateral risk messages will conversely pose a danger of fueling confusion and mistrust among the people, because it will involve communicating information on sophisticated scientific and technical matters and information on radiation and radioactivity that bears little connection to the everyday lives of the general public. It is desirable to communicate disaster-related information while getting feedback on things such as what kinds of information citizens need, particularly citizens in the vicinity of the accident site, and how these citizens are perceiving (interpreting) the information that has been communicated.

As already stated, the ways in which information was provided from the government to the public in the aftermath of this accident raised many questions and doubts as to whether the information had been communicated in a prompt and accurate manner, from the perspective of the residents in the surrounding areas who had had to evacuate, and the people at large. Examples are: the way of providing information on the situation and predictions of dispersion of radioactive substances, which is important in the evacuation of residents in the vicinity; way of providing information on the core conditions (in particular, core meltdown) and the critical conditions at Unit 3 of the Fukushima Dai-ichi NPS; and repeated explanations of “there is no immediate effect on the human body,” that were difficult to understand, when providing information on the impact of radiation on the human body.

In this way, irrespective of the circumstances, as a result of cumulative problems such as delays in the transmission and release of urgent information, the holding back of press releases and the lack of easy-to-understand explanations, citizens in the vicinity were prevented from making appropriate autonomous decisions. Additionally, these problems fueled doubts and mistrusts among citizens, including that “the government and TEPCO are probably covering something up.” As a risk communication approach at a time of an emergency disaster, it was inappropriate.

A fundamental principle of public relations is to convey facts promptly, accurately and in an easy-to-understand manner. Even in an emergency disaster, adhering to this principle is crucial because it serves eventually to help people in the vicinity to make appropriate autonomous decisions and prevents unnecessary uncertainty and confusion taking hold among citizens. At the same time “promptness” and “accuracy” are sometimes in conflict with one another. In that situation it should be kept in mind that if sacrificing “promptness” in order to ensure “accuracy,” there is conversely a danger of inviting citizen’s mistrust and concern. When a situation develops in which information cannot be obtained and accurate public relations are not possible, it is both necessary and important to communicate that situation as it stands.

Additionally, looked at from the standpoint of being “easy to understand,” the communication on evaluative facts requires particular consideration. As facts to be included in publicity, in addition to already-released and already-known simple facts (for example, an explosion occurred at the reactor building or contaminated water flowed into the sea, etc.), there are also evaluative facts that can be inferred from various already-known facts (for example, a core meltdown, or the impact of radiation on the human body, etc.). Unless these types of evaluative facts are explained with a great deal of care, more than occasionally it will be difficult to gain citizens’ understanding. Where evaluative facts are concerned, it may be believed that in some cases it is probably not possible to say anything conclusive due to insufficient information or the uncertainty of the situation, but even in those circumstances it would be desirable to provide an explanation to that effect and then disclose information as promptly as possible.

The following can be said for all emergency situations, not just for nuclear disasters, but **it is necessary to build mutual trust between the public and the government and to provide**

**relevant information in an emergency while avoiding societal confusion and mistrust. To this end, a risk communication approach on risks and opinion exchanges thereupon should be adopted for a consensus building among all stakeholders based on mutual trust.** This time, amid the state of confusion arising from the outbreak of a complex disaster, as previously noted a large number of problem areas could be detected in the government's public relations activities, including those of NISA, from a risk communication perspective. **The government should examine, by institutionalizing an appropriate body, how to provide relevant information in an emergency to the public, promptly, accurately, and in an easily understandable as well as clear-cut (not misleading) manner. Inappropriate provision of information can lead to unnecessary fear among the nation. Therefore, an expert on crisis communication may be assigned for providing appropriate suggestions to the cabinet secretary responsible for information provision to the public in an emergency.**

#### **(8) Importance of a safety culture vital to the lives of the public**

Safety culture of the nuclear power sector refers to “assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance.” This concept was first advocated by the IAEA's International Nuclear Safety Group (“INSAG”) in the “Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident” (1986). In its subsequent reports, INSAG adopted the concept as one of the fundamental principles for ensuring the safety of facilities. The essence of the concept is “the integration of temperament and awareness, and attitude, which organizations and individuals should possess in order to ensure that as an overriding priority, nuclear safety issues receive the attention warranted by their significance.”

Generally speaking, it is extremely rare for an accident to occur as the result of a single error or failure alone – it will normally take the form of a large number of overlapping elements. Furthermore, those unsafe factors tend to have been embedded in the organizations or systems before the accident, and in some cases an accident is the work of those temporally and spatially removed from the accident itself – the decision-makers at an operation (the management team or administrators) or the people who set the rules or created the manuals. J. Reason, who had a

major theoretical impact on the world's accident investigation systems, refers to these kinds of accidents as "organizational accidents."

Factors contributing to a lack of safety that gives rise to organizational accidents do not involve just the operators – in some cases they are created by the administrative organizations that are the regulatory authorities. Whether or not factors contributing to a lack of safety are likely to be generated is connected to the level of safety culture at that organization.

Safety culture such as this exists in the form of ingrained behaviors (or in the form of making behaviors second nature), approaches to decision-making and mindsets among the management team or administrators (in the case of operators) and leaders and officials (in the case of regulatory authorities). Specific check points for determining this level of safety culture, with reference to J. Reason's theories and other ideas, would be illustrated as outlined below:

- (a) The safety culture level at the operator
  - (i) Is safety officially expressed as a mission?
  - (ii) Is the management team able to make firm decisions on safety?
  - (iii) Is a policy in place to ensure safety independently, irrespective of the financial circumstances or sales results?
  - (iv) When unsafe factors or risks exist, are decisions on dealing with those issues not lenient, or are they not being made simply for the sake of appearances?
  - (v) Are there not thick vertically-segmented barriers that are hindering horizontal cooperation within the organization or the sharing of risk information?
  - (vi) Are there not frequent interruptions in communication between the headquarters and sites of the organization?
  - (vii) In managing a complex system and coping with problems that emerge, are there people in competent positions able to understand the system overall and deal with it?
  - (viii) If an accident occurs, is the organization not at risk of becoming dysfunctional?
  - (ix) Will no inconsistencies develop between the management team's decisions and instructions and the decisions and actions of those on-site?
  - (x) Is the management team undertaking frank disclosure of information with regard to safety efforts and evacuation measures for citizens in the vicinity?
- (b) The safety culture level at regulatory authorities

- (i) Is the promotion of nuclear power policies separated from regulatory duties?
- (ii) Is there an unfaltering will to make ensuring safety the mission, irrespective of the material and human resources situation?
- (iii) When safety measures to perfection cannot be adopted due to political or administrative limitations, is there an established stance of disclosing information to citizens and the general public regarding those circumstances and alternative plans?
- (iv) Does the authority concerned have staff possessing the specialized knowledge and ability, the level being equal to those of the staff at operators, to comprehend a complex technological system?
- (v) Are the inspectors equipped with adequate ability to understand technical issues and adequate ability to carry out inspections, and are they fulfilling their duties on-site?
- (vi) Is the approach to duties losing sight of a whole picture of safety importance, being pressed by not a hurried, summary examination of safety that pursues checks on technologically-insignificant details?

Additionally, in order to ensure safety, as well as organizational perspectives such as those above, the roles and duties of every individual attached to the organization are also important. It is essential that each individual develop a finely-tuned ability to sense risk, which each can express perceived risks or problems they have become aware of freely within the organization, and that this information is shared up to the organization's upper levels and appropriate responses are made.

The results of the investigation and inquiries undertaken by this Investigation Committee suggest that there are examples both on TEPCO and NISA which would be difficult to assert to have satisfied the conditions set out in some of the checkpoints mentioned above. For example, at TEPCO: In hindsight the company had not taken adequate measures with regard to the risk of the Fukushima Dai-ichi NPS being struck by a tsunami that exceeded assumptions; its workforce was vertically-segmented, and even in dealing with this accident a perspective of carrying out the necessary tasks based on a comprehensive overview of the situation was lacking; and the organizational information sharing system was not in place as can be seen in important steps relating to the handling of the accident being carried out without seeking direction from senior staff. Meanwhile, at NISA, the regulatory authority, failed to satisfy the

conditions set out in many of checkpoints above: There were problems with its information disclosure stance, including no thought whatsoever being given to releasing monitoring results and SPEEDI information in order to help with the evacuation, along with inadequacies in the release of information concerning the core meltdown also; in dealing with the accident, in some cases it lacked the capacity to properly grasp the conditions on-site and accurately explain them to the Prime Minister's Office etc.; its safety inspectors cannot be said to have performed their roles proactively at the Fukushima Dai-ichi NPS; and in the pursuit of short-term duties, adequate engagement in medium- to long-term issues was not taking place, in part due to insufficient organizational system. In this way, it is difficult to assess both the nuclear operator and the regulatory authority as having sufficiently established a safety culture.

**Well established safety culture is vitally important to people's lives in the nuclear power industry, which may cause serious situations once an accident occurs. In view of the reality that safety culture was not necessarily established in our country, the Investigation Committee would strongly require rebuilding safety culture of practically every stakeholder in nuclear power generation such as nuclear operators, regulators, relevant institutions, and government advisory bodies.**

**(9) Necessity of continued investigation of the whole picture of accident causes and damage**

**a. Need to continue uncovering the causes of the accident**

Although the responsibilities of the Investigation Committee are concluded with the submission of the Final Report, there are still many points that remain to be clarified, as raised in 1. (1) b. above of this Chapter, which were left due to the impossible on-site investigations in the reactor buildings as well as time limitations. These include: the details of the overall damage incurred, beginning with the damaged areas in the main facility of the Fukushima Dai-ichi NPS, their degree of damage, and the development of events over time; the background to the leakage of radioactive substances; and the cause of the explosion in the reactor buildings.

Meanwhile, the impact on residents' health, and contamination of air, soil, water and items such as the agricultural, farming, and fishery products, are issues that require continued investigation and verification going forward. The Investigation Committee has no choice but to conclude its investigations and verifications at this point in time. Furthermore, there are also

problems in repairing the damage that has been caused, and expected to require long-term response into the future, including decontamination and methods of compensation for damages caused. As such, items that were not subjected to investigation and verification by the Investigation Committee remain of great importance to the victims and affected areas, and are issues that are of great concern to the society.

**The government, nuclear operators, nuclear plant manufacturers, research institutions, academies, all such stakeholders (relevant organizations) involved in nuclear power generation should take active roles in investigating the accident and in fact analyses, and continue, in their respective capacities, their comprehensive and thorough investigations of the remaining unresolved problems. The government, in particular, should not conclude its investigations of the Fukushima nuclear accident at the time when this Investigation Committee or the Fukushima Nuclear Accident Independent Investigation Commission (“NAIIC”) of the National Diet conclude their activities. It should continue its initiatives to investigate the causes of the accident. On-the-spot investigations of reactor buildings should certainly be conducted in detail, including the impacts of earthquakes, as soon as the radiation level lowers.**

**b. Need to conduct investigations in order to clarify the full scope of damage**

This nuclear accident brought various forms of serious damage to regions covering a wide area. Citizens in areas contaminated with high concentrations of radioactive material were compelled to live as evacuees for long periods or to relocate (move to a new address), forcing circumstances upon them that included disaster-related deaths, suicide, break-ups of families, the inability to carry on operating farms (including orchards), livestock businesses, commercial pursuits, distribution services, food-processing businesses and small factories, etc., and losses of places of employment. The stress that was created by unstable living conditions such as this caused the health of more than a few middle-aged and elderly peoples to deteriorate and resulted in a string of people falling victim to what should be called disaster-related deaths.

Additionally, the damages suffered by the health and welfare sector include a significant decline in the number of medical institutions and medical practitioners in areas in the vicinity of the nuclear power station. This made it difficult for citizens to obtain medical treatment and

meant more than a few welfare facilities became unusable. The tragedies explained in detail in this Final Report are also included, such as the string of fatalities that occurred after long strenuous journeys on evacuation buses from Okuma Town's Futaba Hospital, where a large number of seriously ill elderly patients had been being treated.

In the farming sector, as a result of farmers losing their farmland and the cessation of livestock businesses etc., people were faced with the difficult task of having to change occupations. Also serious is the discarding of contaminated farm produce and the plunge in prices for produce due to harmful rumors and misinformation. The lifestyle prospects for self-employed people in various trades who have closed their stores or small factories are also bleak.

In areas contaminated by radioactive materials, the schools, kindergartens and day-care centers have been forced to close for long periods, making it necessary for them to utilize other schools and facilities long distances away for classes. Children faced a long continuous period of being unable to play outdoors, and conditions likely to put stress on both their mental and physical development continued.

Decontamination measures pose a large number of difficult problems in terms of cost as well as in terms of the decontamination efficacy, and the confused situation continues. It is not expected to be possible to decontaminate highly-contaminated areas, and there is no telling how those citizens who are unable to return home and who have "lost their hometowns" should go about rehabilitating their communities or go about living from here on.

In analyzing the damages of the nuclear accident, what is important is not to simply grasp the general situation in terms of total numbers, but rather to secure a specific grasp of the entire picture and details of the human suffering wherever possible – how were the lives and dignity of individual people threatened, and to what degree were lifestyles and lives distorted or disrupted? How were areas wrecked as a result of contamination by radioactive materials, and what areas were not able to be rehabilitated? Studies aimed at recording the entire picture and details of suffering such as this are not being underway at present. Additionally, administrative institutions have studied and are dealing with the damage situation to the extent necessary in terms of their jurisdictions, but they are not carrying out studies for the purposes of taking a straight look at the realities of the suffering and recording them.

**Japan as a country which experienced an unprecedented nuclear disaster should transfer as lessons to future generations the whole picture of “Human suffering” including the facts in detail. This can be done by: recording the results of a comprehensive investigation of academic study in respective specialized fields and collection of testimonies of an enormous number of stakeholders and victims; investigating the adequacy of relief, support and reconstruction programs for the victims; or transferring the facts showing how extensive and serious the damage by a nuclear disaster could be.** Comprehensive investigative records exist in Japan that are full of insights into the reality of the “human suffering” brought on by massive disasters in the past<sup>25</sup>. **The Investigation Committee believes that it is the national responsibility of Japan to transfer the whole picture of “Human suffering” to future generations based on the recorded results of comprehensive investigation of the Fukushima nuclear disaster. The investigation of the “Human suffering” may need the participation of a wide area of academic fields, vast costs and time. The Investigation Committee requests the government to actively build the investigation system, in cooperation with local municipalities, research institutions, private organizations and other relevant bodies, and provide necessary support to such investigation initiatives.**

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<sup>25</sup> Examples of detailed recording of the whole picture of human suffering by natural disasters are: Kaizosha, Taisho Daishinsai Kasaishi (Record of the Fire Disaster in Taisho Great Earthquake) (105,000 deaths or missing), 1924, concerning the Great Kanto Earthquake in 1923; and City of Nagoya, Isewan Taihoo Saigaishi (Record of the Isewan Typhoon Disaster) (5,098 deaths or missing), 1951, concerning the 1959 Ise Bay Typhoon. There are also very good model of a comprehensive investigation approach or recording the facts, although they are not caused by natural disasters: City of Hiroshima, Hiroshima Genbaku Sensaishi (Records of the Hiroshima A-bomb War Disaster) (5 Volumes), 1971; and City of Nagasaki, Nagasaki Genbaku Sensaishi (Records of the Nagasaki Atomic Bombing and Wartime Damage) (5 Volumes), 1977-1983, both of which dealt with the A-Bomb victims in 1945 (about 210,000 deaths or missing in total).

### **3. Recommendations for Preventing Recurrences of Nuclear Disasters and for Mitigating Damages**

This Final Report presented the necessary recommendations of the Investigation Committee, as previously stated, based on the facts identified as a result of its investigation and inquiries into the causes of the accident. Additionally, the Interim Report also presented a number of recommendations of the Investigation Committee based on the investigation and inquiries as of that point. The Investigation Committee believes implementing those recommendations will be effective and important in preventing recurrences of nuclear disasters and mitigating damages, and it strongly requests that the government, the municipalities concerned, nuclear operators and other related institutions reflect these recommendations and execute them in their future safety measures and emergency preparedness.

The rationale of the Investigation Committee making these recommendations is the Cabinet decision taken on May 24, 2011 that formed the basis for the establishment of the Investigation Committee, requesting that policy recommendations be made with regard to preventing damages caused by the accident at the Fukushima Dai-ichi NPS from spreading, and to preventing similar types of accidents from recurrence. As stated in Chapter I. 5. of the Interim Report, issues concerning nuclear power generation, such as whether or not nuclear power stations should be retained and whether or not they should be restarted, are not within the scope of this Investigation Committee's investigation. Furthermore, this Investigation Committee's proposals are not based on the premise that nuclear power stations should continue to exist and be utilized in the future also. Issues concerning the pros and cons of nuclear power generation should ultimately be decided based on the choices of the people, and this Investigation Committee does not possess any point of view whatsoever in regards to those issues. However, the reality is that Japan has a large number of nuclear power stations, and we would like to point out that irrespective of what is done with them in the future, safety measures and emergency preparedness are required.

It will be important to strive to implement these recommendations of the Investigation Committee promptly and reliably in all cases. Therefore, along with asking that the government instructs the agencies/ministries concerned and the departments/bureaus concerned to ensure the recommendations are substantiated by reflecting and implementing them, the Investigation

Committee also urges that conclusive follow-ups be conducted, including securing a grasp of the progress in the efforts being made by the agencies/ministries concerned and the departments/bureaus concerned, and then assembling and publishing those findings. Additionally, at the concerned municipalities, and at TEPCO and other concerned institutions also, the Investigation Committee urges that along with similarly reflecting and implementing the recommendations, follow-ups are undertaken regarding the progress of those efforts.

Here we categorize the recommendations made in the Interim Report and the Final Report into seven areas, and restate them:

**(1) Recommendations for a basic stance for safety measures and emergency preparedness**

**(2) Recommendations for safety measures regarding nuclear power generation**

**(3) Recommendations for nuclear emergency response systems**

**(4) Recommendations for damage prevention and mitigation**

**(5) Recommendations for harmonization with international practices**

**(6) Recommendations for relevant organizations**

**(7) Recommendations for continued investigation of accident causes and damage**

Within each area, fundamental and general items are recorded first, followed by specific and detailed items.

**(1) Recommendations for a basic stance for safety measures and emergency preparedness**

● **Recommendations for emergency preparedness in light of complex disasters in mind**

(Final Report VI. 2. (2))

When reviewing the existing safety measures at nuclear power stations, risks of a large scale complex disaster should be sufficiently considered in emergency preparedness.

● **Recommendations for changing an attitude to face risks** (Final Report VI. 2. (3))

(i) It is necessary to humbly face the reality of natural threats, diastrophism and other natural disasters, which are sizable in scale and time, keeping in mind that Japan has often had them in its long history.

(ii) Risk reduction should be tackled in a drastically different approach. In the government as well as in private entities, a new approach to safety measures and emergency preparedness

should be established for a disaster which potentially brings about serious damage in broad areas like a gigantic tsunami or the severe accident at the Fukushima Nuclear Power Station, regardless of its probability of occurrence.

(iii) An institutional framework is needed to ensure continued in-depth examination of “residual risks” or “remaining issues” without leaving them behind beyond the predetermined safety measures and emergency preparedness.

- **Recommendations for “deficiency analysis from the disaster victims’ standpoint”** (Final Report VI. 2. (4))

An accident at a nuclear power station has risks to bring about damage in vast areas. Nuclear operators on one hand, nuclear regulators on the other, should establish a systematic activity to identify all risk potentials from the “disaster victims’ standpoint,” when designing, constructing and operating such nuclear systems, for ensuring credible nuclear safety including evacuation planning in the local society. Such an approach should be practiced.

Radioactive materials may disperse over vast areas due to an accident at a nuclear power station. The prefecture and local municipalities involved should closely collaborate in building up an effective system for minimizing confusion.

- **Recommendations for incorporating the latest knowledge in the emergency preparedness** (Final Report VI. 2. (5))

(i) Scientific knowledge of earthquakes is not sufficient yet. The latest research results should be continually incorporated in emergency preparedness. In other words, a policy/rule concluded at a certain point based on the then-available knowledge should be reviewed with flexibility and revised, without groundless procrastination, when new knowledge of earthquakes and tsunami become available.

(ii) If an area is excluded, due to limited financial resources or other reasons, from the areas for strengthening emergency preparedness because of low or unknown probabilities of occurrence, the damage would be extremely serious once a massive earthquake and tsunami hit the area. In such specific areas for which some seismologists warn of risks, even if few in number, or which show traces of massive earthquakes and gigantic tsunami and massive tsunami (tsunami deposits, for instance) from the remote past, administrative bodies should take initiatives of formulating an innovative disaster prevention plan in full cooperation of public

administration, residents and experts through, for instance, launching research projects on earthquake evaluation or disclosing relevant information.

(iii) Disaster risks in nuclear power plant siting regions should be noted. It was the role of NISA to prepare for nuclear disasters at nuclear power stations. However, the policy of the Central Disaster Management Council has strong relevance to the emergency preparedness at nuclear power stations as well. The Central Disaster Management Council should duly consider the nuclear power stations, too, in its policy making.

## **(2) Recommendations for safety measures regarding nuclear power generation**

### ● **Recommendations for building disaster preventive measures** (Final Report VI. 2. (1))

Quite a number of issues exist in specifying concrete actions required, which need highly specialized nuclear knowledge over a wide range, for solving technical and nuclear engineering problems concerning the responses to the accident at the Fukushima Dai-ichi NPS, and the then-available emergency preparedness by the government, TEPCO and other organizations. These issues should be reviewed and shaped into concrete actions, through competent knowledge by stakeholders in nuclear power generation. In doing so, they should sincerely take into consideration the recommendations the Investigation Committee has made and they should do so with accountability to society for its process and results.

### ● **Recommendations for the necessity of comprehensive risk analysis** (Final Report VI. 1. (4) a.(b))

Nuclear facilities are constructed in a natural environment, which is really diversified. Nuclear operators should conduct comprehensive risk analysis encompassing the characteristics of the natural environment. In the analysis, they should include the external events, not only earthquakes and their accompanying events but also other events such as flooding, volcanic activities or fires, even if their probabilities of occurrence are not high, as well as the internal events having been considered in the existing analysis. Nuclear regulators should check the operators' analysis. Nuclear operators should actively utilize currently available methods in their analyses of such external events, even if the PSA approach is not firmly established for them. The government should consider support to promote relevant research programs for such initiatives.

- **Recommendations for severe accident management** (Final Report VI. 1. (4) a. (c))

In order to ensure maintaining nuclear safety at nuclear power stations, vulnerability of individual facilities for a wide range of characteristics of various internal and external events should be identified by comprehensive safety analysis. And appropriate measures (severe accident management) against such vulnerability should be examined and placed in shape accordingly, assuming a situation in which the core may have serious damage by an accident far exceeding the design basis. The effectiveness of such severe accident management should be evaluated through the PSA or other means.

### **(3) Recommendations for nuclear emergency response systems**

- **Recommendations for reforming the crisis management system for a nuclear emergency** (Final Report VI. 2. (6))

Learning from the experience as a result of the accident at the Fukushima Dai-ichi NPS, the crisis management system for a nuclear emergency should be urgently reformed, in which the nuclear emergency response manual should be revised assuming an occurrence of a complex disaster combining an earthquake/tsunami disaster and a nuclear accident. In its reforming process, not only the strengthening of response capabilities of off-site centers is needed, but it is also required to build a crisis management system by examining concretely how to respond to a situation which a Local NERHQ cannot handle by convening personnel from relevant emergency response bodies.

- **Recommendations for the nuclear emergency response headquarters** (Final Report VI. 2. b. (a))

The emergency response headquarters should, in general, be located close to the accident site where the relevant information is easy to obtain in a nuclear emergency, and the activities at the accident site are easy to grasp. To promptly collect accurate information is, needless to say, the fundamental principle in the nuclear emergency response. The government emergency response headquarters should be set up in a way which enables the government people access to the necessary information while staying in government facilities like the Prime Minister's Office, without moving to the nuclear operator's head office.

- **Recommendations for off-site centers** (Interim Report VII. 3. (1) a.)

The Government should take prompt actions to ensure that off-site centers are able to maintain their functions even during a major disaster, learning from the fact that the Off-site Center (in Fukushima) became unusable because the risks of radioactive contamination had not been adequately considered beforehand.

- **Recommendations for the roles of the prefectural government in nuclear emergency responses** (Final Report VI. 1. (2) c.)

In a nuclear emergency, the prefectural government should take a responsible role in front, because the damage can extend to a regional size. The nuclear disaster prevention plan should take this point into account.

#### **(4) Recommendations for damage prevention and mitigation**

- **Recommendations for the provision of information and risk communication** (Final Report VI. 2. (7))

It is necessary to build mutual trust between the public and the government and to provide relevant information in an emergency while avoiding societal confusion and mistrust. To this end, a risk communication approach on risks and opinion exchanges thereupon should be adopted for a consensus building among all stakeholders based on mutual trust. The government should examine, by institutionalizing an appropriate body, how to provide relevant information in an emergency to the public, promptly, accurately, and in an easily understandable as well as clear-cut (not misleading) manner. Inappropriate provision of information can lead to unnecessary fear among the nation. Therefore, an expert on crisis communication may be assigned for providing appropriate suggestions to the cabinet secretary responsible for information provision to the public in an emergency.

- **Recommendations for improving radiation monitoring operations** (Interim Report VII. 5. (2) d.)

(i) To ensure that the monitoring system does not fail at critical moments, and to ensure the collection of data and other functions, the system should be designed against various possible events, including not only an earthquake but also a tsunami, storm surge, flood, sediment disasters, volcanic eruptions and gale force winds. Measures should be taken to prevent the system from functional failures even in a complex disaster simultaneously involving two or

more such events. Furthermore, measures should be developed to facilitate the relocation of monitoring vehicles and their patrols even in a situation where an earthquake has damaged roads.

(ii) Training sessions and other learning opportunities should be enhanced to raise awareness of the functions and importance of the monitoring system among competent authorities and personnel.

- **Recommendations for the SPEEDI system** (Interim Report VII. 5. (3) c.)

In order to protect the lives and dignity of residents caught up in a disaster, and to prevent the spread of harm from the disaster, measures should be developed to improve operational guidelines of the SPEEDI system so that crucial information on radiation dose rates is provided promptly in a manner acceptable to the people. Measures, including hardware and infrastructure-related measures should be developed and implemented to ensure that SPEEDI functions remain operable even during a complex disaster.

- **Recommendations for evacuation procedures of residents** (Items (i) to (iv) in the Interim Report VII. 5. (4) c. and item (v) in the Final Report VI. 1. (4) b.)

(i) Activities to raise public awareness in daily lives are needed to provide residents with basic, practical knowledge of: how radioactive substances are released during a major nuclear accident; how they are dispersed by wind and other agents; how they fall back to the ground; and how the exposure to radiation can affect human health.

(ii) Local government bodies need to prepare evacuation readiness plans that take into account the exceptionally unusual nature of a nuclear accident, periodically conduct evacuation drills in a realistic circumstance, and take steps to promote the earnest participation of residents in those drills.

(iii) It is necessary to complete, during normal times, readiness preparations, such as drafting detailed plans for ensuring means of transportation, traffic control, securing evacuation sites in outlying areas, and securing water and food supplies at the evacuation site, taking into consideration the situation that the evacuees may number in the thousands to over a hundred thousand<sup>26</sup>. It is especially important to develop measures that support the evacuation of the

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<sup>26</sup> The Interim Report quoted “thousands to tens of thousands” as the number of evacuees. The number is hereby

disadvantaged, such as seriously ill or disabled people in medical institutions, homes for the aged, social welfare facilities, or in their own homes.

(iv) The above types of measures should not be left up to the local municipal governments, but need in addition to involve the active participation of the prefectural and national governments in designing and operating an evacuation plan and a disaster prevention plan, in consideration of the situation that a nuclear emergency would affect a large area.

(v) The existing Emergency Planning Zone (EPZ) had been set before the accident on the basic assumption of 8-10 km from a nuclear power station, so that the situation could be well dealt with even in an incident far exceeding a hypothetical accident. However, the accident has shown the need to reconsider what accidents to assume and how to designate evacuation areas. Furthermore, the roles of the government in a nuclear emergency are so large that the government responses should not be limited to those areas outside nuclear site boundaries such as the residents' evacuation. It should also be considered what the government should do to cooperate or support the nuclear operator in a nuclear emergency, in consultation with the operator.

- **Recommendations for the intake of stable iodine tablets** (Final Report VI. 1. (3) e. (c))

In the existing emergency preparedness, administration of stable iodine tablets is, in principle, subject to the judgment of the government NERHQ. A system which allows local municipalities to independently administer the tablets should be reconsidered, and so is the appropriateness to distribute them in advance to the residents as a precaution.

- **Recommendations for radiation emergency medical care institutions** (Final Report VI. 1. (3) e. (f))

A considerable number of medical facilities for initial radiation emergency medical treatment should be located in the area which is not likely to be included in an evacuation designated area, so that radiation emergency medical care could be provided even in a severe accident like the accident at the Fukushima Dai-ichi NPS. Those medical facilities should not be concentrated in the area close to the nuclear power station. At the same time, such medical care systems in a

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revised in consideration of the real number of evacuees. The number of evacuees may further increase, depending on the scale of an actual accident.

nuclear emergency would need to be coordinated for collaborating over a wide area across the prefectural borders.

- **Recommendations for public understanding of radiation effects** (Final Report VI. 1. (3) e. (g))

As many opportunities as possible should be institutionalized for the public to get knowledge and deepen their understanding of radiation. By doing so, the individuals should be able to judge the radiation risks based on correct information; in other words, they would be freed from unnecessary fears about, or from underestimating, the radiation risks because of the lack of information.

- **Recommendations for information sharing with, and receiving support from, overseas** (Final Report VI. 1. (3) g. (a) and (b))

Provision of information to overseas countries is equally important as to the Japanese public, especially to neighboring countries or those countries which have many of their nationals residing in Japan. Active and polite responses should be in place for prompt and accurate provision of relevant information with due consideration to language barriers.

International support in a nuclear emergency should be accepted and received as early as possible, when offered, for international comity and for urgently meeting national needs. To avoid confusion and inappropriateness experienced in the early stages at the time of the accident in Fukushima, operation manuals of competent ministries, nuclear operator emergency management operation plans and other relevant materials should prescribe how to respond to such international support.

##### **(5) Recommendations for harmonization with international practices**

- **Recommendations for harmonization with international practices such as the IAEA safety standards** (Final Report VI. 1. (7))

It is necessary to keep the national regulation qualities constantly updated in line with the nuclear knowledge accumulation and technological development in the international and national community in order to ensure nuclear power safety. To this end, continuous efforts are needed to keep the national regulatory guides newest and best while monitoring international standards, such as those at the IAEA. Lessons on nuclear safety should be extracted from the

accident, and those lessons and relevant knowledge should be provided to the international community so that they could contribute to the prevention of similar accidents, not only in our country but also in other countries. In the process of reviewing national regulatory guides, international contribution should be pursued by making efforts to propose them to incorporate into the IAEA standards etc., if they turn out to be effective and useful as international standards.

## **(6) Recommendations for relevant organizations**

### **● Recommendations for the nuclear safety regulatory body**

(i) The need for independence and transparency (Interim Report VII. 8. (2) a.)

An organization with regulatory oversight over nuclear safety must be able to make decisions effectively and independently, and must be able to function separately from any organization that could unduly influence its decision-making process. The new nuclear safety regulatory organization should therefore be granted independence and should maintain transparency.

The new nuclear safety regulatory organization must be granted the authority, financial resources and personnel it needs to function autonomously as an entity concerned with nuclear safety and should also be given the responsibility of explaining nuclear safety issues to the Japanese people.

(ii) Organizational preparedness for swift and effective emergency response (Interim Report VII. 8. (2) b.)

In light of the serious impact of a nuclear emergency on the nation, the nuclear safety regulatory organization, which would play a key role in emergency response, should, during normal times, work out an emergency prevention plan and implement emergency response drills to facilitate rapid response if an emergency occurs. Furthermore it should foster the specialized skills to provide individuals and organizations responsible for emergency response with expert advice and guidance, and should foster as well the management potential to utilize organizational resources effectively and efficiently.

In addition, the nuclear safety regulatory organization must be well aware that its role is to respond responsibly to crises. It should beforehand prepare systems that can deal with a major emergency if it occurs, and develop partnerships with relevant government ministries and

agencies and with relevant local governing bodies to create mechanisms for cross-organizational response, with the role of the nuclear safety regulatory organization clearly demarcated.

(iii) Recognition of its role as a provider of emergency-related information to Japan and the world (Interim Report VII. 8. (2) c.)

The new nuclear safety regulatory organization must be fully conscious that the way it provides information is a matter of great importance, and must also, during normal times, establish an organizational framework that enables it to provide information in a timely and appropriate manner during an emergency.

(iv) Development of competent human resources and specialized expertise (Interim Report VII. 8. (2) d.)

The new nuclear safety regulatory organization should consider establishing a personnel management and planning regime that encourages personnel to develop lifetime careers. For example, it should offer improved working conditions to attract competent human resources with excellent specialized expertise, expand opportunities for personnel to undergo long-term and practical training, and promote personnel interaction with other administrative bodies and with research institutions, including those involved in nuclear energy and radiation.

(v) Efforts to accumulate scientific knowledge and to collect information (Interim Report VII. 8. (2) e.)

The new nuclear safety regulatory organization to be established should keep abreast of trends embraced by academic bodies and journals in the field (including those in foreign countries) and by regulatory bodies in other countries, in order to continue acquiring knowledge that will contribute to its regulatory activities. It must also understand the implications of that knowledge, systematically share and sufficiently utilize such knowledge, and resulting outcomes should be archived and continually utilized as an organization.

(vi) Active relationship with international organizations and regulatory bodies of other countries (Final Report VI. 1. (5))

The limited number of personnel at a government administrative organization is a collective issue of the all administrative organizations, and not limited to an issue of NISA, etc. But that of the new regulatory body should be duly considered, because of the importance of nuclear safety.

The new regulatory body should secure its personnel, should establish an organizational system competent for international contribution, and develop human resources who can take a role in personnel interaction with international organizations or regulatory bodies of other countries.

(vii) Strengthening of the regulatory body (Final Report VI. 1. (5))

In order to ensure nuclear power safety, responses to individual problems encountered are not sufficient. Continuous efforts are needed to keep national regulatory guides updated at their newest and best qualities, with consideration to international trends of safety regulations and nuclear security, not only to the latest scientific knowledge in the country and overseas. Considering that the impact of a nuclear emergency on society can be sizable, emergency preparedness should be fully established during normal times by formulating an emergency prevention plan or by conducting nuclear emergency response drills so that effective and prompt responses could be taken in an emergency. The regulatory organization should foster the specialized skills to provide individuals and organizations responsible for emergency response with expert advice and guidance and should also foster the management potential to utilize organizational resources effectively and efficiently. Appropriate size of budget and human resources should be duly examined.

● **Recommendations for TEPCO** (Final Report VI. 6. e.)

TEPCO bears critical responsibilities to society as a nuclear operator primarily responsible for nuclear power plant safety. Nevertheless, TEPCO was not sufficiently prepared for such an accident, that natural disasters including tsunami may lead to large-scale core damage. Furthermore, TEPCO had not taken adequate preparedness for tsunami risks beyond design basis at the Fukushima Dai-ichi NPS. The accident showed quite a number of problems with TEPCO such as insufficient capability in organizational crisis management; hierarchical organization structure being problematic in emergency responses; insufficient education and training assuming severe accident situations; and apparently no great enthusiasm for identifying accident causes. TEPCO should receive with sincerity the problems which the Investigation Committee raised and should make further efforts for solving these problems and building higher level safety culture on a corporate-wide basis.

● **Recommendations for rebuilding a safety culture** (Final Report VI. 2. (8))

Well established safety culture is vitally important to people's lives in the nuclear power

industry, which may cause serious situations once an accident occurs. In view of the reality that safety culture was not necessarily established in our country, the Investigation Committee would strongly require rebuilding safety culture of practically every stakeholder in nuclear power generation such as nuclear operators, regulators, relevant institutions, and government advisory bodies.

**(7) Recommendations for continued investigation of accident causes and damage**

● **Recommendations for continued investigation of accident cause** (Final Report VI. 2. (9) a.)

Participants (organizations concerned) that are involved in some way in the generation of nuclear power, such as the government, power utilities, nuclear power plant manufacturers, research institutions and academic societies concerned, should actively contribute to verifying this accident and clarifying the facts, and should continue to comprehensively and thoroughly examine and verify these types of as-yet unexplained matters from their respective standpoints. In particular, the government should not consider that the accident investigations and inquiries surrounding the Fukushima NPS disaster have ended accompanying the winding up of the activities of this Committee and the National Diet of Japan Nuclear Accident Independent Commission. It should continue to spearhead efforts to investigate the causes of the accident. Above all, a detailed on-site investigation (including verifying the impact of earthquake ground motion) within the reactor buildings is a task that should be undertaken without fail. once radiation levels have declined

● **Recommendations for extended investigation of the whole picture of accident damage**

(Final Report VI. 2. (9) b.)

Japan as a country which experienced an unprecedented nuclear disaster should transfer as lessons to future generations the whole picture of “Human suffering” including the facts in detail. This can be done by: recording the results of a comprehensive investigation of academic investigation in respective specialized fields and collection of testimonies of an enormous number of stakeholders and victims; investigating the adequacy of relief, support and reconstruction programs for the victims; or transferring the facts showing how extensive and serious the damage by a nuclear disaster could be. The Investigation Committee believes that it is the national responsibility of Japan to transfer the whole picture of “Human suffering” to

future generations based on the recorded results of comprehensive investigation of the Fukushima nuclear disaster. The investigation of the “Human suffering” may need the participation of a wide area of academic fields, vast costs and time. The Investigation Committee requests the government to actively build the investigation system, in cooperation with local municipalities, research institutions, private organizations and other relevant bodies, and provide necessary support to such investigation initiatives.

## **Chairperson's Remarks**

The results of this Committee's investigation and inquiries, which were carried out over a period of one year and one month, are as described in the Interim Report and the Final Report. Through this investigation the Committee has succeeded to confirm various facts. With regard to the problems that surfaced from those facts, the Investigation Committee has discussed in Chapter VII of the Interim Report and Chapter VI of this Final Report, and made a large number of recommendations based on them with regard to preventing nuclear disasters from recurring, and approaches to specific policies and efforts to prevent damages from occurring and expanding.

This Committee's investigation and inquiries were unable to clarify some points regarding the event itself of the accident that had occurred, due to factors such as time restraints as well as the difficulties posed by on-site inspections – entering areas near the reactors was impossible because the radiation levels still remained high, for example. In addition to the seismic adequacy of Units 1 to 3, a great deal of attention is also focusing on the seismic adequacy of Unit 4, where large quantities of spent fuel are stored, but due to the time restraints it was not possible to investigate this point either.

Neither was the Investigation Committee able to carry out “reproduction experiments” as I had intended it would when I had been appointed as Chairman. Areas that can be assumed to be in particular need of reproduction experiments are the mistaken readings given by water-level indicators, as well as the hydrogen outbreaks and the leakage paths the gas followed. Incidentally, for some people the term “reproduction experiments” brings to mind large-scale experiments using the actual objects in question, but the reproduction experiments I refer to here are small-scale tests that straightforwardly reproduce phenomena with the equivalent conditions of the actual event using testable materials. Reproduction experiments are not only helpful in confirming the events that occurred – in some cases new facts and new perspectives can be discovered in the course of carrying them out, and consequently they can also prove extremely useful for deepening understanding and searching for effective countermeasures to utilize in the future. It is our strong hope that the various organizations and institutions connected to nuclear power will continue to clarify the full extent of the accident and investigate its causes with reference to the findings of this Committee's investigation and to strive to obtain the knowledge needed to construct comprehensive and genuinely effective measures and policies for preventing accidents. And in doing that, I hope that reproduction

experiments are also carried out.

This accident and the damages resulting from it still lasting and conceivably responses will become necessary on various fronts in the future also. One of those major challenges is the issue of decommissioning reactors. It has been decided that the four reactor units of the Fukushima Dai-ichi NPS where the accident occurred will be decommissioned, but the decommissioning work will conceivably take several decades at least. The decommissioning will require new, hitherto unseen technologies, as well as continued development and supply of capable engineers for years for the work. Other major challenges will include ensuring the safety of the personnel undertaking the decommissioning work, and regional issues. The institutions concerned, beginning with the government, must continuously monitor the decommissioning work until it becomes possible to say that the accident cleanup has ended and the accident is completely over.

It can be assumed that radiation will continue to have an impact for many years to come. The government must make an all-out effort to help victims and support the recovery, in line with the damage conditions. It is difficult to confirm how damages from radiation will actually present themselves until a considerable period of observation has passed. This Committee included in the coverage of its investigation and inquiries the situation of the damages resulting from the accident and measures to deal with them, but due to time constraints there were more than a few items that it could not pursue. The Investigation Committee hopes strongly that the institutions concerned, beginning with the government, continue to investigate damages such as these and respond to them, and do not assume the matter to have ended along with the investigation and inquiries of this Committee.

Despite the limits mentioned above, this Investigation Committee was able to shed a considerable amount of light on the background to the accident and the resulting damages during its more than one year of activities, I believe. A variety of knowledge has been gained in this accident, and that knowledge will undoubtedly also prove useful in preventing accidents and damages arising from the use of various technologies – not just nuclear power – in society.

The knowledge gained as a result of this accident is also applicable to other sectors, and in order to ensure that it stands up to evaluation in 100 years' time, it will be necessary to see that this does not end as simply knowledge about specific sectors, but rather that it is elevated to the level of being generally and universally known. Knowledge of that type will serve as a powerful reference when

our future society seeks to coexist with new technologies. From here on I would like to show what types of knowledge were obtained as a result of this accident and to present the main items, in order to conclude the investigation of the unprecedented disaster namely the Accident at the Fukushima NPS.

(1) Things that are possible happen. Things that are thought not possible also happen.

The direct cause of this accident can be traced back to the fact that everything was built and operated based on the premise that “an extended station blackout will not happen.” However, by rights the mindset should be “things that are possible happen.” In February 2012, after this Investigation Committee had compiled its Interim Report, an international meeting with participation of the foreign experts was held. At that meeting, experts from France and other countries pointed out that in the nuclear power sector “you have to think that the improbable may also happen (improbable est possible).” In considering what sorts of things should be thought about, the most important point is to think based on experience and logic. This involves learning about incidents and experiences that have taken place in the past both at home and abroad and considering all the elements involved, to discover the things that could logically occur. Something has a low probability of occurrence does not mean it will not occur. It is a mistake to believe that events with a low probability of occurrence or events that are not established as knowledge do not need to be considered and that responses to them do not have to be made.

Furthermore, there is a need to be aware at the same time that phenomena that are not even adequately recognized – in the sense that “we consider it impossible” – can happen as well. To put it another way: “Phenomena that have never even been thought about can also happen.”

(2) You cannot see things you do not wish to see. You can see what you wish to see.

When people see and think about things they tend to view only what they themselves consider agreeable and only the course they are trying to take; they cannot see things they do not want to see or things that are inconvenient\*. The impact of this kind of human psychology can be glimpsed in TEPCO’s natural disaster preparedness, which were not outfitted with AM measures for tsunami, and did not provide for a situation involving a simultaneous and complete loss of power at several reactor facilities. To prevent situations like this, there is a need to be constantly self-aware that one’s

views are biased not only by his/her own interests but by the various influences of the organization, society and the times that surround himself/herself, and to be conscious that something is always overlooked.

This is even applicable to this Investigation Committee's reports. This Committee has not shed light on the complete picture of the Fukushima NPS accident – it is simply one milestone on the road to clarifying the facts of the accident. I do urge that as a result of people striving to clarify the causes of the Fukushima NPS accident from here on, follow-up checks be made to see if there were omissions or errors, and that based on those findings ongoing efforts are made toward further clarifying the facts and preventing accidents.

\* In Volume III, Chapter 18 of the "The Gallic Wars," Julius Caesar's account of the successful ploy waged by his legate Sabinus against the Veneti, Caesar wrote that "fere libenter homines id quod volunt credunt" ("Men readily believe what they want to believe"). This phrase has been liberally translated as "people only see what they themselves want to see" or "people only see what they desire and want to see" and has come to be known as one of Caesar's maxims.

### (3) Assume to the extent possible and make full preparations.

It is important to assume to the extent possible and to prepare fully. It is also necessary to acknowledge the possibility that things may happen that have not even been thought of and make provisions so that they do not reach the point of becoming worst-case scenarios. In the Fukushima NPS accident, the result of investigations show that substantial provisions had been made against earthquakes and it was not possible to confirm that key facilities had stopped functioning as a result of the earthquake itself, but it is conceivable that because preparations were not in place for a scenario in which the site was struck by a tsunami that exceeded assumptions, disabling responses to the situation and this resulted in the major accident. If new knowledge – even if not fully confirmed – had been taken on board, with tsunami assumptions revised and adequate preparations made accordingly, or if adequate preparations had been made for the advent of unforeseen circumstances, there is a possibility the situation would not have escalated into a major accident of this level.

It is easy to say things like this in hindsight, but extremely difficult to adopt this mindset at a time when nothing is actually happening. Nonetheless, it is vital to take preventative measures for accidents and disasters by constantly reviewing what is possibly assumable, without adhering

tenaciously to assumptions made at a previous point in time, such as at the design stage. It is likewise essential to make adequate preparations based on the mindset that circumstances that have not even been thought of up to now can occur.

(4) Creating a framework alone does not mean it will function. Frameworks can be constructed but goals not collectively shared.

Operators, regulatory-related institutions and regional municipalities had each created frameworks to respond to nuclear accidents in a formal sense, but when an accident ultimately occurred those responses were found to be flawed in places. Conceivably, that was because the members of those organizations were not fully conscious of what those frameworks' goals were, and what was entrusted them with by society. Without creating an environment in which each member is conscious of what they have to do as a personal issue, even if a framework is created it will not function as one whole. That is because its goals are not collectively shared. The fact that SPEEDI's system, constructed for times of emergency, was not used for the evacuation strategy is most certainly an example of this.

In order to ensure sharing goals by all members of an organization, it is necessary to create an atmosphere in which each member is constantly thinking about what they have been entrusted with by society, what position they occupy in the organization overall, and how their job affects the organization overall. Furthermore, education and training is needed in order to maintain that atmosphere. Social management must be undertaken to ensure that each member is precisely aware of the matters that society has entrusted them with.

(5) Everything changes, respond flexibly to changes.

When given conditions are considered to be fixed, then detailed and (superficially at least) commendable responses are possible. However, given conditions are constantly changing, and unless responses that meet those changes are constantly sought out, they become inconsistent with the actual circumstances. For example, as a result of progress that had been made in investigative research on earthquakes and tsunami, a theory had emerged that it was possible an earthquake and tsunami on a larger scale than had previously been considered could occur off the coast of Fukushima Prefecture. Those concerned were aware of this new theory, and had taken measures of

sorts, but from the standpoint of preventing the disaster, ultimately those measures came up short. From here on, the only way to stop situations such as this from happening is to consider that all matters will change, pay scrupulous attention to observation, show humility in being open to external ideas, and continue to respond appropriately.

(6) Acknowledge that risks exist, and create a culture able to debate the risks directly.

Refusing to permit the existence of risks and reasoning that they should be completely excluded seems at a glance a sincere way of thinking, but on occasions this does not match reality. Asserting that risks should be completely excluded despite the fact that no-one is capable of foreseeing completely what type of situations may arise, has risks creating “a safety myth” in which the existence of unlikely risks is ruled out. Nuclear power has an extremely high energy density, and is essentially dangerous, yet it cannot be denied that in spite of that, attempts have been made to promote the use of nuclear power as an energy source with no risks in order to dispel society’s unease. Nuclear emergency response manuals were not equipped to deal with a large-scale disaster such as this one, and emergency response drills prior to the event were also insufficient, and in this and other ways the nuclear emergency preparedness was inadequate. There is no denying that the misguided perception that a major accident in which large quantities of radioactive material would be released could not happen at Japan’s nuclear power stations formed a backdrop to that inadequacy.

Denying the existence of risks will not only lead to a rigid mindset that becomes out of sync with the actual situation, it also makes it impossible to take the disaster-prevention and disaster-mitigation measures truly necessary. Trying to exclude risks completely generates unnecessary costs, and it also becomes impossible to discuss and carry out disaster-management measures in order to prevent damages from growing and alleviate their impact once risks end up becoming actualized. Without creating a culture in which risks are acknowledged as risks, and in which it is possible to debate those risks head on, major risks end up being shrouded in a veil of safety and left unresolved, and this is a pattern not limited to nuclear power.

That being the case, when examining one matter it becomes necessary to look directly and simultaneously at the benefits and risks it brings, and to make a judgment while undertaking a balanced consideration of those factors. At that point, if opposing ideas are negated and the matter in question is dealt with based on one side’s ideas alone without genuine debate taking place, the worst

path will be followed. This severe accident demands that we Japanese change our mindset.

(7) It is vital to be conscious of the importance of seeing with your own eyes, thinking with your own head, making decisions and taking action, and vital to cultivate such faculties.

In dealing with an accident or disaster that is beyond the scope of assumption and for which there is no manual to rely upon, the people concerned must consider the various possibilities based on the information each has at-hand, decide how they should deal with those possibilities, and take action. In this accident there were many cases in which inappropriate action was taken, but at the same time there were also a large number of cases in which people strove to overcome the situation using ingenuity and judgment, such as gathering together the batteries of cars in the vicinity and using them as an emergency source of power for operating measuring instruments in order to collect the minimum data in need. Responses such as this were made possible as a result of the people concerned thinking themselves about the outcomes they wanted to achieve, making judgments and taking action. To make the optimum actions possible in a situation in which there is nothing to rely on, it is necessary to have an attitude of thinking for yourself in order to face up to a situation, and a flexible and active way of thinking. It will be important to undertake organizational management to boost qualities and faculties such as these during ordinary (non-emergency) times, along with carrying out training and drills.

The accident at the Fukushima NPS was a major accident that is prominent during the whole history of humankind. The events that occurred within the nuclear power station after it was flooded as a result of the tsunami were a series of incidents that people involved with nuclear power generation in Japan had never encountered before, and without the actions of those involved in dealing with the accident at the facilities, who risked their lives, the accident would have worsened further and radioactive materials might well have dispersed over a clearly much wider area than at present. As stated in the Interim Report and this Final Report, it cannot be denied that some pieces of responses to individual incidents were not appropriate; but on the other hand, I by all means wish to record here that those undertaking tasks on-site have made an all-out effort.

With a nuclear power station accident an extremely long time is required between the accident outbreak and the point where the decommissioning work and other necessary measures end and it

becomes possible to say that the accident is genuinely over. Not only that, however, they are also dreadful events in which the lifestyles and social activities of people in a wide-ranging area are destroyed, since people living in the vicinity are torn from the area completely and unreasonably due to the released radioactive materials. The fact is large numbers of people continue to be harmed by this accident even now – in Fukushima Prefecture more than 100,000 people are still forced to evacuate, for example. The accident continues to exert a significant impact on the lifestyles of the nation's citizens also. People around the world also suffered a deep sense of shock and unease as a result of this accident. Everybody of us must put the matters learned from this accident to use in social management from here on. Everybody of us must treat this accident as a lesson from nature that human concepts can be found lacking, and continue to learn from this accident without ever forgetting it.

July 23, 2012

Chairperson of the Investigation Committee on the Accident at the Fukushima Nuclear Power Stations of Tokyo Electric Power Company

Yotaro Hatamura