VII. Observations and Proposals Regarding Problems Identified through Investigations and Inquiries to Date

1. Introduction

An extremely grave nuclear disaster, classified as a Level 7 Accident under the guidelines of the International Nuclear and Radiological Event Scale, occurred at the Fukushima Dai-ichi Nuclear Power Station (hereinafter referred to as "Fukushima Dai-ichi NPS") of Tokyo Electric Power Company ("TEPCO") on Marc375h 11, 2011, after the Pacific Ocean earthquake off the coast of Japan's Tohoku district and the massive tsunami waves. Another Level 7 Accident before then was the Chernobyl Accident in 1986. And another internationally known nuclear accident, although it was classified as Level 5, was the Three Mile Island Accident in 1979. However, those latter two events were accidents each involving a single nuclear reactor, whereas three nuclear reactors at the Fukushima Dai-ichi NPS all experienced cooling failures at the same time. The other two accidents occurred due to an internal failure — mainly equipment breakdown or improper operations — while the Fukushima Dai-ichi NPS accident occurred after the tsunami swamped the generating station facility, resulting in serious and simultaneous breakdown at the three nuclear reactor units.

This chapter sets out observations and proposals based on the facts presented from Chapter II to Chapter VI, which were elicited through our investigation and inquiry into what is now classified as a major severe accident at the Fukushima Dai-ichi NPS[1].

The proposals presented in this chapter are printed in bold font to identify them explicitly.

2. General Description of Problems Identified During Investigation and Inquiry into the Accidents

The external power supply and almost all AC power sources for the Fukushima Dai-ichi NPS were lost due to the earthquake and tsunami, and the cooling systems for the reactors and spent fuel pools experienced a failure in their cooling functions. Explosions occurred at Reactor Units 1, 3 and 4, presumably because large quantities of hydrogen generated after possible damage to the reactor cores had filled the reactor buildings. The reactor core at Unit 2 is also thought to have sustained damage, although an investigation into this matter has still not been completed. Large quantities of radioactive substances were emitted from

[1] All matters and events subject to investigation by this Committee are as set out in Chapter I 6 above. Issues remaining to be examined, which we were not able to deal with in this Interim Report, will be discussed in the final report, which is scheduled for release around the summer of 2012.

Fukushima Dai-ichi NPS, forcing many people to evacuate and causing serious radioactive contamination.

Since June 2011, this Committee has continued to investigate and inquire into the accidents at the Fukushima Dai-ichi and Dai-ni NPS, and at the present point in time the following deficiencies have become clear regarding that nuclear emergency:

(i) Problems in the responses of government bodies after the accident

Problems in the accident response of government bodies, such as the Nuclear Emergency Response Headquarters ("NERHQ") and the Local Nuclear Emergency Response Headquarters ("Local NERHQ") include the fact that the Off-site Center, which was supposed to serve as the base for response during the nuclear emergency, lost its functionality, and the fact that coordination among relevant organizations was inadequate.

(ii) Problems in the response at the Fukushima Dai-ichi NPS after the accident

Problems in how the Fukushima Dai-ichi NPS dealt with the accident include the fact that the emergency response centers ("ERC") at the TEPCO head office and at the Fukushima Dai-ichi NPS did not fulfill their expected roles properly, the operating status of Unit 1's isolation condenser (IC) was mistakenly identified, and the alternative water injection procedure for Unit 3 was mishandled.

(iii) Problems in efforts to prevent progression (expansion) of the disaster

These problems include: radiation monitoring systems and the System for Prediction of Environmental Emergency Dose Information (SPEEDI) did not work as they were designed and expected to do; the scale of the disaster that occurred had not been considered when preparing evacuation plans and evacuation drills; there was confusion at the accident site regarding the Government's evacuation directives; and not enough information was provided in Japan and abroad in a rapid, accurate, easy-to-understand manner.

(iv) Inadequate tsunami and severe accident preparedness measures

No measures were developed to prepare for a tsunami and severe accident that ended up greatly exceeding design basis assumptions.

This chapter now examines these problems in order, from Sections 3 to 7 below.

3. Problems in the responses of government bodies after the Accident

(1) Problems at the Local NERHQ

a. Loss of functionality at the Off-site Center

In the event of a nuclear emergency, the hub for emergency response measures is the local nuclear emergency response headquarters ("Local NERHQ") established near the accident site. The Government's Nuclear Emergency Response Manual stipulates that such a local NERHQ is to be given an important role. It is presumed that the local NERHQ will be established in that local Off-site Center. The Fukushima Dai-ichi NPS Off-site Center was established in Ohkuma city about 5 km from the accident site, but in the early stages of the accident under investigation it was unable to properly fulfill the role it was entrusted with.

The first reason for this was that headquarters personnel either did not assemble there, or assembled there late, so the local NERHQ could not establish the level of readiness befitting a local nuclear emergency response headquarters. This was primarily because transportation systems had been cut off or were extremely congested due to the earthquake. Also, of all the personnel expected to assemble from surrounding municipalities, only personnel from Ohkuma city actually did assemble — personnel from most municipalities did not, because they were too occupied dealing with evacuees from the earthquake and tsunami. The second reason why the Off-site Center did not fulfill its initially assigned role was that communications infrastructure was paralyzed because of the earthquake, monitoring posts were damaged or destroyed, roads had collapsed, electric power was unavailable, and supplies of food, water and fuel were lacking. And third, even though the Off-site Center was located about 5 km from the Fukushima Dai-ichi NPS, it had not been equipped with air cleaning filters to insulate it from radioactive substances, so on March 14, after the explosion in the reactor building of Unit 3 drove up radiological dose levels, forcing personnel leave the Center.

In other words, the Off-site Center ended up being prevented from performing its functions because (i) there had been no thought given to the fact that an earthquake and a nuclear emergency could possibly occur around the same time; and (ii) even though the Off-site Center was designed as a facility to be used in the event of a nuclear emergency, its structure did not take into consideration a possible rise in radiation dose levels.

With regard to this second issue, it was pointed out that radiation exposure reduction measures — for example, the installation of high-performance air filters — had not been implemented, as called for in the "Recommendations based on the results of administrative evaluation and inspection of nuclear disaster prevention programs (Second Issue)" issued by the Ministry of Internal Affairs and Communications in February 2009. Even though the Nuclear and Industry Safety Agency ("NISA") had developed a policy aimed at establishing ways to maintain air tightness at off-site centers and to control personnel access thereto, no concrete steps, such as installing air filters, were taken.

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 (being discussed in this section) became unusable because the risks of radioactive contamination had not been adequately considered beforehand.

b. Problems in the delegation of authority to the local NERHQ

Article 20 (8) of the Act on Special Measures Concerning Nuclear Emergency Preparedness ("the Nuclear Emergency Preparedness Act") stipulates that the director-general of the NERHQ may delegate part of his/her authority to the director-general of the local NERHQ to issue required directives. This provision is in place to ensure that emergency response measures are implemented accurately and promptly. For its part, the Nuclear Emergency Response Manual states that, when ministries and agencies responsible for nuclear safety (NISA, in the case of an accident at a commercial NPS) receive the notice of a decision regarding delegation of the NERHQ director-general's authority, they are to issue a notice stating that the authority has been delegated.

At around 15:36 on March 11, after the occurrence at Fukushima Dai-ichi NPS of a nuclear emergency situation as defined in Article 15 (1) of the said Act, NISA prepared a draft public notice declaring a nuclear emergency situation, and at the same time compiled a draft bulletin regarding the delegation of the NERHQ director-general's authority to the local NERHQ director-general. However, during the first NERHQ meeting, no mention was made regarding procedures delegating authority, and subsequently no bulletin regarding the delegation of authority was issued, either.

The local NERHQ understood that the legitimacy of its authority in making response-measure decisions, and the legitimacy of the directives it issued regarding those measures, in its relations with local public bodies, depended on whether it had been delegated that authority or not. It therefore asked the Emergency Response

Center (“ERC”) on numerous occasions to tell it how the authority-delegation process was unfolding, but was unable to receive a clear answer. Therefore, after conferring on this matter with the NERHQ Secretariat at the ERC, the local NERHQ took the position that delegation of authority formalities had been completed, so that it could implement all necessary measures rapidly and completely. In this situation, it took various decisions, including decisions regarding the implementation of evacuation measures, and put them into action.

If authority is not delegated, according to the Nuclear Emergency Preparedness Act (Article 17 (12)), what the local NERHQ director-general can do is limited to manage the affairs of that local NERHQ. He/she cannot issue enforceable instructions or the like to local public bodies or other entities. Therefore, any case where the delegation of authority has not been completed would become an issue of a crisis management nature that cannot be ignored. The Investigation Committee (“This Committee”) intends to continue examining why that type of situation occurred.

Although this Interim Report sets out only the abovementioned two problems regarding the local NERHQ, This Committee uncovered other local NERHQ problems that will continue to be examined and investigated further.

(2) Problems at the NERHQ

a. Response measures taken at the Prime Minister’s Office

In the event of a nuclear emergency, the NERHQ, with the Prime Minister as director-general, is to play a pivotal role in the Government’s emergency response measures. The Nuclear Emergency Response Manual stipulates that the NERHQ is to be established at the Prime Minister’s Office, and that the Prime Minister’s Office Emergency Response Office is to be established in the Crisis Management Center located belowground in the Prime Minister’s Office. This Emergency Response Office is to gather information, send reports to the Prime Minister, and coordinate the government response in an integrated fashion. In addition, in the event of an emergency situation, personnel at the director-general level from relevant ministries and agencies are to assemble in the Crisis Management Center, and to form what is called an Emergency Operations Team. The team is expected to quickly gather information possessed by government ministries and agencies, and to use it as the basis for reaching consensus in a flexible manner, so that decisions can be made rapidly and accurately during the emergency.

After a notice was issued at 15:42 on March 11 by TEPCO in conformity with Article 10 of the Nuclear Emergency Preparedness Act, the Prime Minister's Office Emergency Response Office for nuclear response measures was established in the Crisis Management Center at around 16:36 the same day. Even so, much of the decision-making regarding accident response was done on the 5th floor of the Prime Minister's Office, beginning after the earthquake and tsunami.

It was at the 5th floor of the Prime Minister's Office where cabinet ministers of relevant ministries, the Chair of the Nuclear Safety Commission of Japan ("NSC"), and other team members assembled, and it was there that TEPCO executives were called and joined in deliberations. That was where information came directly from TEPCO, and where direct contact was maintained with TEPCO head office personnel and Masao Yoshida, the site superintendent of the Fukushima Dai-ichi NPS ("site superintendent Yoshida").

However, the content and context of those deliberations were not completely understood by the Emergency Operations Team stationed in the basement. At a time when the Government should have been using all its resources in an integrated fashion to respond to the situation, the arrangements for communication between the 5th floor and the basement of the Prime Minister's Office were inadequate.

b. Problems in the gathering of information

The Nuclear Emergency Response Manual stipulates that, in the event of a situation like the one under investigation, the nuclear power operator is first to report the accident's circumstances to the ERC, after which information is to be conveyed to the Prime Minister's Office from the ERC. Very soon after the earthquake struck on March 11, several TEPCO employees were dispatched from TEPCO head office to the ERC and stationed there on a regular basis. Information regarding the Fukushima Dai-ichi NPS was conveyed through them to the ERC.

In the beginning, personnel from the Ministry of Economy, Trade and Industry (METI), NISA and other bodies who assembled in the ERC were very frustrated because the information from TEPCO was not being provided promptly. Almost none of the ERC members realized that the TEPCO head office and the Off-site Center near the Fukushima Dai-ichi NPS were obtaining information on the accident site via TEPCO's videoconferencing system, and nobody thought of installing a terminal of the TEPCO's videoconferencing system in the ERC. And no proactive steps, such as dispatching officials to TEPCO head office to obtain information, were taken at the time.[2]

Having the latest accurate information is a prerequisite for making rapid, accurate decisions. In the case of the accident under review, during the initial stages immediately afterward, channels for obtaining and conveying information were not established, and this created major problems, including problems in the provision of information to the Japanese people. Establishment of the Government-TEPCO Integrated Headquarters for Responses to the Incidents at the Fukushima NPS on March 15 can be regarded as a practical way to resolve the initial confusion, but further study is required to learn whether it was appropriate to establish an organization not specified in provisions in the Nuclear Emergency Preparedness Act, the Nuclear Emergency Response Manual or some other directive. Such a study should include an examination into whether those provisions should be amended.

(3) Remaining issues

The Nuclear Emergency Preparedness Act and the Nuclear Emergency Response Manual were drawn up to promote rapid, accurate response to the situation after the occurrence of a nuclear emergency. The principle behind the Act is to ensure rapid decision-making at the accident site. This is why, after an emergency situation occurs, a Joint Council for Nuclear Emergency Response is to be organized at the off-site center, and why the Joint Council is to promote consensus among the Government, local public bodies and other entities, and to function as a base for gathering information. In addition, the Manual stipulates that after the Prime Minister declares a nuclear emergency situation, part of the authority of the NERHQ director-general may be transferred to the local NERHQ director-general who is conducting accident response from his or her base at the off-site center. However, as explained above, this arrangement did not function properly. Furthermore, the Off-site Center, which was supposed to serve as the local NERHQ, was unable to perform as a nuclear emergency response base because the building itself lacked safeguards insulating it from radioactivity.

Because the existing manual and the organizations envisioned did not meet the needs of the occasion, on March 15 the Government-TEPCO Integrated Headquarters for Responses to the Incidents at the Fukushima NPS was established under the initiative of

[2] Later, on March 15, the Government-TEPCO Integrated Headquarters for Responses to the Incidents at the Fukushima NPS was established, making it possible to coordinate decision-making for response measures for the Fukushima Dai-ichi NPS plants. The Integrated Headquarters' establishment eliminated the information gap that had existed between the Emergency Action Room at the Fukushima Dai-ichi NPS and the Government.

Prime Minister Naoto Kan. The question remains, why were emergency response measures not promoted as called for in the manual? Were there problems in the crisis management responses being taken at the Prime Minister's Office, or could it be that the types of nuclear emergency responses envisioned in the current Nuclear Emergency Response Manual were not practical? This Committee intends to continue hearings with those who were involved at the time, and to include the results of the investigation into the above-mentioned types of problems in the final report.

4. Problems of responses to the Accident at the Fukushima Dai-ichi NPS

After the earthquake and tsunami on March 11, the situation at the Fukushima Dai-ichi NPS became grave, and failure struck the cooling systems for nuclear reactors Units 1, 2 and 3, and for the spent fuel pools for Units 1 through 6. This Committee is presently continuing an intensive investigation and inquiry into problems in TEPCO's response to the cooling system failures, and intends to cover the issue in its entirety in the final report. The problems that are now clear regarding Units 1 and 3 will be pointed out here.

(1) Mistaken assumptions regarding the operating status of IC at Unit 1

a. Lack of knowledge of IC functions and lack of experience in its operation

Even though the IC for Unit 1 at the Fukushima Dai-ichi NPS had malfunctioned, personnel were under the impression that it had been operating normally. This has already been pointed out in Chapter IV.

With regard to this point, this Committee believes that if the engineers, including those at TEPCO head office, had had an adequate understanding of basic IC functions, they would have realized there was a strong possibility that the failsafe system would have closed the IC isolation valves, immediately after the total loss of power.

In any case, there were signs that the IC was not functioning properly — for example, between around 16:42 and 16:56 on March 11 the reactor water level indicated a dropping trend, and at around 17:50 the same day radiation dose rates in the vicinity of the Unit 1 reactor building were so high that it was impossible to verify IC activation status. Because of these factors, personnel should have realized that all IC isolation valves were either closed or almost closed and so the IC system was not functioning, or at least that there was an extremely strong possibility this had happened. However, neither the on-duty staff at the Fukushima Dai-ichi NPS, nor anyone of the ERC at the NPS, nor anyone at the ERC at the head office realized this and took the appropriate steps (or gave the appropriate instructions).

And yet, at around 18:18 the same day, when the on-duty staff took an opening operation for the valves 2A and 3A, being aided by partial restoration of the status display on the control panel, they suspected that the IC might not be functioning, and reported this for consultation with the station emergency response center. However, the on-duty staff's explanation lacked substance, and the emergency response center did not alter its view of the situation. It would appear that instead, the emergency response center mistakenly interpreted the on-duty staff's report and conversation to mean that the IC valves were continuing to function as they had before the total loss of power (before the tsunami), and that the valve operation was part of that process.

According to the testimony of those dealing with the situation at the Fukushima Dai-ichi NPS, at the time there was nobody present in the NPS who had years of experience in IC operations, not even training or experience in IC inspections. All they had had, apparently, were brief verbal instructions given by operators during past operations. Some perfunctory education and training sessions in IC functions and operation procedures had been given, but as far as the various steps taken indicate, those sessions were not effective.

As the above demonstrates, it appears that not only the on-duty staff but the ERC at the NPS and at the head office as well, lacked a sufficient understanding of IC functions, and the employees were not skilled in IC operation. During such an emergency, operating the cooling system to prevent reactor damage is obviously of vital importance. The fact that this was the reality of the corporate culture with regard to the knowledge and skills of IC functions and its handling, which are expected to play such an important role, indicates the extreme inappropriateness as nuclear operators.

b. Impacts on the handling of Unit 1

Because of the malfunction in the IC system, it became imperative to cool Reactor Unit 1 as quickly as possible using an alternative water-injection method. This meant that the pressure had to be reduced to permit the water to be injected.

In actual fact, the measure taken for Unit 1 was primarily an alternative water-injection procedure using fire engines and pressure venting of the primary containment vessels. As already described, instructions to prepare for these two operations were issued at around 17:00 on March 11 and around 00:00 on March 12, respectively, but even so the operations themselves only began at around 4:00 and around 14:00 on March 12, respectively. Thus, a great deal of time elapsed before the operations were performed, and this ended up delaying efforts to cool the reactor core.

The mistaken judgment concerning the IC operating status can be regarded as a major factor leading to this delay.

During a total loss of power, which is an emergency situation, the most important thing above all else is obviously to take steps to cool the reactor core. And yet, ERC at the NPS and at the head office both misunderstood the IC operating status for a long time, and because of this they did not rush to implement an alternative water-injection procedure, and were late issuing the order to pressure-vent the primary containment vessel. In other words, their misunderstanding of the IC operating status led to a series of delays in dealing with Unit 1.

c. Problems at the ERC at the NPS and at TEPCO head office

The Report on the development of the accident management at the Fukushima Dai-ichi NPS (issued by TEPCO in May 2002) stipulates that, in the event of a complicated situation during an emergency, an engineering assessment and a wide range of information are vital to properly understand the situation and decide which accident management actions to select. To ensure these goals, the Report says a support group should conduct the engineering assessment and assist in the decision-making process.

The support group, composed of special-function teams at the NPS ERC, such as an Intelligence team, Engineering team, Health physics team, Recovery team and Operation team, is expected to obtain all information required, conduct an engineering assessment, and provide advice and instructions to the shift supervisor. In other words, a support group would need information on the operating status of the IC that is designed to fulfill its role in the reactor core cooling process. If the support group obtains that information from the on-duty staff, it should use it to properly assess IC operating status while, if it has not obtained that information, it should obtain it in a proactive fashion by contacting the said on-duty staff. However, during the accident under investigation, neither was done.

Furthermore, support teams entrusted with specific functions were on duty at the ERC at the company's head office to coordinate with the ERC at the NPS, and it was expected that each of these teams would gather vital information via a videoconferencing system and assess this information calmly — in a manner somewhat more detached than would be possible for the NPS ERC being fully preoccupied dealing with the accident. The teams were also expected to provide support to the ERC at the NPS. However, in actual fact there is no indication that the teams at the head office's ERC performed their roles or provided appropriate instructions to the NPS ERC. As pointed out in a above, throughout the company there was a lack of a proper understanding of the function of the IC system and this appears to be the main cause of the problem. At any rate, the ERC at both the head office and the NPS were unable to provide effective advice and instructions for a serious situation of delayed cooling of the reactor core.

(2) Mishandling of the alternative water injection at Unit 3

a. Mistakes in the alternative water-injection procedure; defective information-sharing system at the NPS

After the reactor building for Unit 1 exploded at around 15:36 on March 12, the need to keep cooling all reactor cores became an even greater matter of urgency. If one means of water injection got in trouble, it was absolutely essential that personnel switch to another method without any delay.

At Unit 3, the High Pressure Coolant Injection (HPCI) system was kept running for a long time at a rotation speed below the preset RPM (revolutions per minute) the operating range for the turbine while the reactor core was under low-pressure status. This made the on-duty shift operators concerned that the HPCI system was not injecting enough water, and they switched off the HPCI system manually at around 2:42 on March 13. At that time, even though an effective alternative water-injection method had not been ensured, the on-duty shift operators underestimated the risk that the batteries depletion. The result was that they failed to reduce pressure for the alternative water-injection method. In addition, these actions were reported from the power group attached to the NPS ERC to the station executive managers after the fact, rather than promptly. Because of these factors, alternative water injection only started around 9:25 on March 13. This can only be characterized as an extremely unfortunate turn of events.

Moreover, these decisions were made only by the on-duty shift operators at Unit 3 and some members of the Operation team attached to the NPS ERC. They did not seek for instructions from the executive managers. Such situation is problematic in light of crisis management procedure. If personnel at the NPS ERC had been made aware of the fact that the HPCI system had been manually switched off, the mistaken step taken by the on-duty shift operators — to manually stop the HPCI system without first initiating an effective alternative water-injection method — could possibly have been corrected at an early stage. With regard to the problem of just a few employees at the accident site coming to decisions on their own, according to those involved at the Fukushima Dai-ichi NPS the crew on duty had a strong sense of responsibility, but this led to them trying as much as possible to resolve problems on their own, with the result that their reports tended to be late. If this is true, that type of mindset needs to be corrected.

b. Lack of a sense of crisis at the NPS ERC regarding the need for early alternative water injection

In a situation where AC power supply is completely halted, the substitute battery-powered electricity supply is bound to deplete at some time or other. Even in the midst of confusion, Fukushima Dai-ichi NPS personnel should have been concerned before dawn on March 13, more than a day after the total loss of AC power, about the depletion of the batteries required to operate the HPCI and the Reactor Core Isolation Cooling (RCIC) system for Unit 3. If there had been such a concern, one can presume that, rather than resting content to simply operate the HPCI, etc., the NPS ERC would have taken action by making quick use of the fire engines to inject water.

Indeed, before dawn on March 12 the fire engines, which were parked near Units 5 and 6 after the removal of rubble, were available for use, and personnel could also have obtained more batteries for operating the main steam safety relief valves (SRV) to reduce pressure.

Instead, at the time, the NPS ERC was only considering and preparing for an alternative water-injection method using the standby liquid control system, to be carried out over the mid- to long-term, which would require the restoration of power. Until the message came from Unit 3 on-duty shift operators regarding trouble after the HPCI system was stopped manually, no effort was made to switch to an alternative water-injection method using the fire engines. With regard to this point, Fukushima Dai-ichi NPS personnel told this Committee, "At the time that didn't cross our minds." However, at around noon on March 13, before the RCIC system for Unit 2 stopped, the site superintendent Yoshida gave the order to prepare for an alternative way to inject water, which means that if staff had had a correct understanding of the situation, they could certainly have taken the same steps for Unit 3 before the HPCI stoppage. One must conclude that the NPS ERC' lack of awareness of the necessity, indeed urgency, of an alternative water-injection method for Unit 3 delayed this response.

(3) Possible relation to explosions in the Units 1 and 3 reactor buildings

It would be natural to believe that the explosions at the reactor buildings of Units 1 and 3 were caused by the hydrogen gas generated in a large amount due to the possible damaged cores and filled in each reactor building.

However, one cannot presently arrive at a definitive conclusion as to whether the explosions could have been prevented if pressure venting and alternative water-injection for Units 1 and 3 had been done at an earlier stage, without first verifying a number of still undetermined factors, such as: Would the situation actually have permitted water to be injected earlier? And, what was the actual state of the reactor cores during those moments? However, one can presume that if the pressure had been vented at an earlier stage, and if alternative water-injections using the fire engines had proceeded well, the progressive damage to the cores might have been mitigated and the amount of radioactive substances emitted might have been less, compared to what actually happened.

5. Problems of Hazard Control Measures

(1) Unique characteristics of a nuclear accident at a power station

A major accident at a nuclear power station is very extraordinary, by giving serious impacts that are not seen in other types of accident: serious damage to power generating facilities and equipment; threat to the health and lives of power station personnel and people at large residing in wide areas, by dispersing radioactive substances released and subsequent contamination; contamination of urban areas, agricultural fields, forestry and the ocean; they stagnate economic activities; and eventually jeopardize local communities. In investigating and evaluating such extraordinary nuclear accidents, it is not sufficient to clearly identify the causes of the accident and its underlying factors. Whether or not were the efforts to prevent the occurrence and expansion of the disaster appropriate? Why were they not sufficient, if they were not? These types of issues have to be investigated and analyzed at multiple levels to identify suitable measures to prevent harm in the future.

Having taken into consideration facts that have become clear so far through our investigation and inquiry, we, this Committee, present below problems seen in the nuclear accident under review, particularly the dispersion of radioactivity and radiation monitoring, the utilization of information from the System for Prediction of Environmental Emergency Dose Information (SPEEDI), efforts to evacuate residents, measures to protect plant workers and residents from exposure to radiation, and the provision of information to the Japanese people and the international community. We shall also present below necessary recommendations.

(2) Problems of the initial monitoring

a. Problems seen during the initial monitoring stage

Radioactive substances emitted by a nuclear accident do not spread concentrically from the nuclear power plant, but instead spread in an extremely irregular fashion, depending on the wind direction, strengths, currents, topography, etc. Consequently, the concentrations of contamination do not necessarily depend on the distance. Hot spots with unusually high radiation levels may arise even 100km or more off the accident site. Therefore, in order to protect the lives and health of the people from radiation exposure after a nuclear accident it is necessary from the very beginning of the accident to estimate the dispersion of radioactivity and its concentrations and to reflect it to the planning of evacuation and other protective measures. To this end, indispensable are not only the monitoring set-ups but also the information system for effective use of monitoring data for evacuation and other purposes, the strong sense of responsibilities and the response capabilities of the relevant staff in charge, etc. But, as mentioned already in Chapter V.1, following problems have been noted in these items during the accident under review, including the initial responses, which are especially important.

b. Problems in the organization of a monitoring system

Beginning some time before the accident, the Fukushima prefectural government as well as TEPCO had installed monitoring posts at key locations t, and owned a number of monitoring vehicles. However, in the context of locations and capabilities, those monitoring posts were not prepared for the need to respond to a multidimensional disaster involving an earthquake, a tsunami and a power outage. For example, 23 of the 24 monitoring posts owned by the Fukushima prefectural government were swept away by the tsunami, or rendered inoperative by power cuts, and two of the four germanium analyzers installed at the Environmental Radioactivity Monitoring Center near the Fukushima Dai-ichi NPS became inoperable from the seismic shocks.

Moreover, backup provisions were inadequate. With the Fukushima prefectural government unable to perform almost any monitoring, MEXT decided to provide assistance with its own monitoring vehicles, but support group personnel in the four vehicles dispatched only arrived at the local Off-Site Center during the morning of March 13. Even worse, they could not function as intended, because the earthquake had badly damaged roads in many areas, some of those vehicles ended up with flat tires, some fell into crevices, and the fuel shortage made planned monitoring impossible. On March 15, two days after their arrival, none of those vehicles were able to perform monitoring activities — only vehicles owned by the Fukushima prefectural government remained active.

c. Problems in utilizing the monitored data

After the tsunami's onslaught on March 11, the loss of electric power placed the Fukushima Dai-ichi NPS in a crisis situation. The Reactor Unit 1 building explosion the next day (March 12) heightened the fears of nearby residents regarding airborne radioactive substances. In such a situation, if explanations to the resident population are to be persuasive, they absolutely must be backed up by monitored data. However, during the first five days of the emergency situation, the local NERHQ at the Off-site Center experienced a quake-induced telecommunications breakdown, hindering its response to the monitored data. What could be done about the monitored data during this period was that the NERHQ secretariat released only some of the data it had received.

In the midst of a situation where the local NERHQ was not functioning, and when high radiation dose levels were being registered at Hirusone in Namie-machi during the night of March 15, a clear-cut delineation of roles had still not been established for evaluating those kinds of high readings and disclosing information about them. Competent personnel were at a loss on how to proceed. It was only beginning on March 16 that the Government delineated roles for the bodies responsible for monitoring data, and that the Ministry of Education, Culture, Sports, Science and Technology (MEXT) compiled and released the data to the public.

This shows how the emergency response during the initial stages of the accident was confused in its use and management of monitored data. The disclosure of obtained monitored data was especially problematic — the Government did not demonstrate a readiness to quickly disclose it, and even when a disclosure was made, only fragments of part of the information were released. Because the Chief Cabinet Secretary was giving press conferences on a regular basis on matters that included an evaluation of monitored results, the NSC did not disclose the results of monitored data assessments until March 25.

The fact that the competent authorities did not take proactive steps to disclose information on monitored results would seem to indicate a mindset that gave little priority to the lives and dignity of residents who were incurring harm and damage from the dispersion and contamination of radioactive substances, and gave little regard to the importance of disclosing data. Factors leading to these failings include: (i) local disaster readiness systems and evacuation plans had been drawn up only for form's sake, without a realistic vision of the type of situation local residents would face if a major nuclear accident were to emit large quantities of radioactive substances; and (ii) the competent authorities had no deep-seated awareness of the importance of telling residents about the various risks in the event of a major accident at a nuclear power plant, beginning with what they would desperately desire — as their need would grow for information to help them understand the situation they would find themselves in, they would want the authorities to disclose that information rapidly.

d. Measures required to improve monitoring operations

During a nuclear emergency, radiation dose rate data monitored over widespread areas is essential for determining measures to protect residents from radiation exposure and to prepare evacuation. In light of the problems seen during the accident under review, this Committee calls on competent authorities concerned to take prompt actions for improvement on the following points for monitoring systems:

(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 for them to function even in a multidimensional disaster simultaneously involving two or more such events to prevent the loss of system functions. 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 among competent authorities and personnel of the functions and importance of the monitoring system.

(3) Problems in the use and management of the System for Prediction of Environmental Emergency Dose Information (SPEEDI)

a. Problems relating to the instructions of evacuation

SPEEDI is designed to play an important role in response measures to protect local residents from radiation exposure and to help them evacuate. However, after the accident under review, SPEEDI was not used when evacuation instructions were issued over several times. The gist of those instructions was simply "Just get out of the demarcated area!" Residents, not knowing how far to go to be safe, or in which direction, had no other option to take other than following decisions made blindly by the heads of their municipal governments.

And yet, even when source term information cannot be obtained, SPEEDI can obtain the results of predictions for the unit amount of discharge (1 Bq/h), and actually did so. This means that if unit quantity emission predictions had been provided, the various municipal bodies and residents would probably have been able to decide which evacuation routes and directions were most suitable for them, taking advantage of their firsthand knowledge of local road conditions.

The fact that SPEEDI was not used effectively indicates that it did not occur to any of the competent authorities that the system could serve a role in evacuation, and that no clear-cut decision had been made in advance regarding which other organization should take over the role of the local NERHQ at the Off-site Center when it lost its functionality to provide information to the public.

b. Confusion over which entity has responsibility for SPEEDI use and management

The Nuclear Emergency Response Manual stipulates that the local NERHQ (under the jurisdiction of the NERHQ) or NISA is in charge of information disclosure in general to the public regarding nuclear emergency measures. This means that the manual is inferring that the local NERHQ or NISA is to provide the Japanese people with information obtained from SPEEDI. In the case of the accident under review, as the local NERHQ lost its functionality, the NERHQ above it or NISA should have assumed that role. However, it did not occur to either of these organizations to provide SPEEDI information to the public.

During the accident under review, although MEXT was not primarily responsible for providing information to the public, since SPEEDI fell under its jurisdiction, it was expected to assume the role of giving the NERHQ advice on how to take advantage of it. However, it did not occur to the ministry to provide the public with SPEEDI-related information either through its own offices or through the NERHQ. In addition, beginning on March 16, the situation evolved without MEXT and the NSC being able to determine among themselves which organization would use SPEEDI primarily (including which would release calculation results), and this was another factor delaying the disclosure of SPEEDI results.

c. Matters requiring improvements for the future

When the Fukushima Dai-ichi NPS accident forced nearby residents to evacuate, SPEEDI was not able to fulfill its original function. At a time when source term information of discharged radioactivity from the Emergency Response Support System (ERSS), was not available and the local NERHQ was not functioning, SPEEDI could have been used as much as possible. This indicates the weak point in SPEEDI operation management, especially the lack of a clear delineation of the roles of the various competent authorities. **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 SPEEDI's management system so that crucial radiation dose rate information is provided promptly in a way that the Japanese people find persuasive.**

The initial stages of the accident were the most urgent time for data to be collected and acted upon quickly, but it was during this time that it became impossible to use the ERSS data circuit, due to quake-induced damage. **Measures, including hardware and infrastructure-related measures should be developed and implemented to ensure that SPEEDI functions remain operable even during a multidimensional disaster.**

(4) Problems of the decision-making of evacuation of residents and the confusion experienced by the affected communities

a. Problems in the evacuation decision-making process

Evacuation directives were issued from the Government on a number of occasions, as described in Chapter V 3 above. When the directives were drawn up, they took as their point of reference only the information and opinions communicated by some senior executives from government ministries and agencies, and TEPCO executives, who had assembled on the 5th floor of the Prime Minister's Office. The Nuclear Emergency Response Manual stipulates that the content of evacuation directives should be determined at the local off-site center by the local NERHQ. However, as mentioned in this report in numerous places, the local NERHQ, including the Off-site Center, was practically paralyzed in conducting their tasks during the initial stages of the accident, so despite the Manual's stipulation, evacuation directive content was determined on the 5th floor of the Prime Minister's Office.

There is no indication that personnel from MEXT, the ministry which had jurisdiction over SPEEDI and which had dispatched senior executives to the Emergency Operations Team, were stationed on 5th floor of the Prime Minister's Office. So the ministry's expertise in SPEEDI was not used when making decisions, even though the system is designed to provide vital data for making decisions on evacuation parameters and areas. Actually, the SPEEDI's data transmission circuit was inoperable at that time and SPEEDI could not be used with complete inputs, so it would have been impossible to use the system in its optimal condition. This means that even if MEXT personnel had mentioned SPEEDI's existence, the decisions regarding evacuation parameters would presumably have been the same. However, it must still be pointed out as a problem that the use of SPEEDI was not even brought up as an option, when evacuation measures were discussed. If the existence and its capability of such a system had been taken up as a subject for consideration, it is possible that discussions on the correlation between containment vessel venting and evacuation direction would have had a different perspective, when subsequent evacuation measures were developed.

b. Problems at the local government level, and in resident evacuation

From March 11 into the 12th, the situation at Fukushima Dai-ichi NPS progressively deteriorated into crisis proportions, and the areas under evacuation or in-house sheltering expanded more and more by the Government directives under the supervision of Prime Minister Kan. There was presumably an unavoidable side to this, because in such an extreme situation it has been impossible to obtain an accurate understanding of the overall nuclear plant situation. But even so, the residents in those areas ended up with the impression they were being trifled with.

A look at the situation in municipalities subjected to evacuation directives during the initial stages is instructive. For example, in the Namie-machi district, town hall functions and residents near the nuclear power plant were evacuated to an outlying area in the same district, but then on March 15 that location was also reported to be dangerous. They were forced to evacuate again, this time to the city of Nihonmatsu (about 50km NWW). Later it was realized that their evacuation route followed exactly the same direction as the spread of airborne radioactive substances. In the case of the Tomioka-machi district, residents evacuated first to the village of Kawauchi-mura (about 20 km to the west), but then had to evacuate again, this time with the residents of that village together, to the city of Koriyama (further west).

The Government evacuation directives did not all arrive quickly at the offices of municipal governments for areas to be evacuated, and in any case the directives lacked details, saying basically only "Leave the area!" The municipal governments could obtain information regarding the nuclear accident situation only from media reports — mostly via television and radio — and in such circumstances they had to make their own decisions on resident evacuation, find destinations for refuge, and determine evacuation methods.

One can presume that one of the underlying reasons for these circumstances was that the Government and the power generation industry had not made enough effort to address the following issues: If a nuclear disaster were to occur, what type of situation would likely arise in the surrounding area? What type of knowledge and state of readiness would be necessary for effective evacuation? And, what types of evacuation drills are necessary to ensure readiness beforehand?

c. Problems in resident evacuation; issues to tackle for the future

Radioactive substances can cause serious harm to human health, and their inexplicable nature, being invisible with no smell, can cause fear and anxiety among people. The following is a list of actions that should be taken in answer to these concerns, with a view to preventing damage from becoming compounded.

(i) Activities to raise public awareness are needed to provide residents with basic, customary knowledge of how radioactive substances are released during a major nuclear accident, how they are dispersed by wind and other agents, and how they fall back to earth, as well as knowledge of how the exposure to radiation can do to health.

(ii) Local government bodies need to prepare evacuation readiness plans that take into account the exceptionally grave 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) Beginning in times of normalcy, there is a need for readiness preparations, such as drafting detailed plans for ensuring modes of transportation, organizing transportation, establishing evacuation sites in outlying areas, and ensuring water and food supplies in places of refuge, taking into consideration the situation that the evacuees may number in the thousands or tens of thousands. It is especially important to develop measures that support the evacuation of the 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 drawing up and administering evacuation and disaster readiness plans, in consideration of the situation that a nuclear emergency would affect a large area.

Beginning on March 12, local government bodies that were themselves forced to evacuate fell into a state of confusion. One can presume that a major reason for this confusion was that preparation of the above types of measures had been insufficient. Katsutaka Idogawa, head of the Futaba-machi district which is in the vicinity of the Fukushima Dai-ichi NPS, recalled, “Whenever we asked, ‘Are you sure that the nuclear power station will never cause an accident?’ TEPCO and NISA always answered, ‘No, there’ll never be an accident.’ The evacuation drills were all just go-through-the-motions, following a template scenario.” The blind assumption of invulnerability, persistently insisting that the facility was 100% safe and making light of the possibility of any other scenario, should be seen as an example of prior neglect.

(5) Problems of provision of information to the nation and the international society

As mentioned in Chapter V 8 above, viewed from the perspective of residents near the disaster site who were forced to evacuate, and from the perspective of the Japanese people as a whole, in many ways the manner in which the Government provided information to the Japanese people after the accident created the impression, indeed the suspicion, that it was not telling the facts rapidly and accurately. When explaining the reactor core situation (especially the core meltdown issue) and the crisis situation at Unit 3, and when conveying information on the effect of radiation on the human body, the Government frequently repeated difficult-to-understand explanations such as, “The situation is not something that would have an immediate effect on the human body.”

In the event of a nuclear emergency, which can gravely affect large areas and where the situation can change from moment to moment, the way the competent authorities provide information within the country and abroad is an extremely important issue. In the case under investigation, the evident tendency was to be slow in communicating and disclosing urgent information, holding back on press releases, and giving vague explanations, and this type of risk communication during an emergency cannot be regarded as acceptable, regardless of the situation. This Investigation Committee intends to continue investigating and inquiring into this issue further, and shall present necessary proposals regarding it in its final report.

There is something to be noted, too, with regard to providing information to other countries. Immediately after the decision was made to discharge contaminated water into the sea, the decision was executed without prior explanation to neighboring countries (see Chapter V 9 above). This event included elements that led other countries to distrust Japan’s nuclear emergency response, even if the action did not flout treaty obligations (for example, the Convention on Early Notification of a Nuclear Accident). This should serve as an important lesson for the future.

(6) Review of other hazard control measures

a. Increase in screening criteria levels

In order to properly address residents' fears that they might have been exposed to radiation, it is essential to have in place a system for screening and subsequent remedial actions (for example, decontamination of the entire body). The Fukushima prefectural government performed the screening, with the initial criteria for conducting total body decontamination being a minimum 13,000 cpm, but it then raised this minimum to 100,000 cpm, without obtaining the approval of the NERHQ. The difference of opinion between the national and prefectural governments was due primarily to two factors: (i) the prefectural government had not prepared for the possibility of widespread exposure, and lacked enough facilities and human resources for such an amount of total body decontamination, so it was forced to raise screening criteria; and (ii) the person responsible for the local NERHQ's Medical treatment team was unable to quickly and smoothly promote a consensus among the national government and the Fukushima prefectural government because personnel from the Ministry of Health, Labour and Welfare ("MHLW"), the government organization expected to play a key role in conferring and coordinating with prefectural government staff regarding such an issue, did not assemble at the Off-site Center until March 21, and the Center's telecommunications circuits were difficult to access.

This Investigation Committee is presently investigating and making inquiries into whether the 100,000 cpm criteria set by the Fukushima prefectural government was appropriate.

b. Problems in criteria for the use of contaminated schoolyards

With regard to criteria for the use of schoolyards, a number of issues remain: (i) when determining criteria for the use of schoolyards, where children congregate on a daily basis, was it appropriate to set the value at 20mSv/year, the same as for a deliberate evacuation area? (ii) an examination of individual schools shows that some districts had a group of schools registering at least 3.8μSv/h (when accumulated over one year, a value equivalent to 20mSv), creating doubts whether deliberate evacuation areas should have been established in those districts, and those doubts have not been sufficiently alleviated; and (iii) in light of the fact that an advisory from the International Commission on Radiological Protection (ICRP) states that 20mSv/year is the upper limit for an existing exposure situation, and the fact that radiation dose levels need to be reduced as much as possible, was the decision to unconditionally use schools registering under 3.8μSv/h not inappropriate?

This Committee is now investigating and inquiring into these issues.

c. Problems in assigning emergency radiological exposure treatment to medical institutions

Five hospitals had been designated as medical institutions to treat initial cases of radiological exposure if an accident were to occur at Fukushima Dai-ichi NPS, but four of them were included in the evacuation area after the accident, making it impossible for them to fulfill this designated function. This Committee is now conducting an investigation and inquiry into appropriate ways to assign medical institutions such a designation.

6. Inappropriate precautionary measures against tsunami and severe accidents

Some specialists who have looked for causes of the Fukushima Dai-ichi NPS accident have suggested that, before the tsunami struck, seismic activity may have partially damaged the nuclear pressure vessels, primary containment vessels and key piping. We, this Investigation Committee, have not yet been able to ascertain this. The final answer, whether damage was caused by seismic activity or not, will have to wait some time in the future, when it is possible to gain access to the reactors for visual inspections. So we will focus on precautionary measures to prevent damage from a tsunami and to prevent a severe accident before it occurs.

(1) Inappropriate measures against tsunami and severe accidents

a. Tsunami and severe accident prevention measures at the Fukushima Dai-ichi NPS

Permits for the construction of the Fukushima Dai-ichi NPS were granted between 1966 and 1972, as explained in Chapter VI 3 (1), based on a design-basis tsunami wave 3.122 m high, taking into account the height of the 1960 tsunami due to an earthquake in Chile. The construction permits authorized the installation of emergency seawater pumps for Units 1 to 4 on 4-meter high bases, and the reactor and turbine buildings on 10-meter high bases, meaning that if the facility was hit by a tsunami wave more than 4 m high it would lose its ability to use seawater for cooling, and if the wave was more than 10 m high its DC power source and emergency diesel generators would no longer function.

Later, the nuclear operator revised its possible tsunami scenario. A methodology "Tsunami Assessment Method for Nuclear Power Plants in Japan" ("tsunami assessment method") was developed by the Tsunami Evaluation Subcommittee, Nuclear Civil Engineering Committee of the Japan Society of Civil Engineers ("Tsunami Evaluation Subcommittee" — the Society has today the status of a public interest incorporated association). This led to the adoption of a scenario of a possible tsunami wave of 5.7 m high (later recalculated as 6.1 m) striking the Fukushima Dai-ichi NPS, and the raising of the base of the emergency seawater pumps there in 2002. Consequently the theory was that even if a tsunami wave of that height struck, the many facilities installed on 4-meter high bases would be flooded and damaged, the emergency seawater pumps would survive and would be able to maintain their cooling function to protect the reactor cores from damage. However, the Pacific Ocean earthquake off the Tohoku district coast created a tsunami wave measuring more than 10 m in height, and this caused the total loss all AC power supplies and the nuclear reactors' cooling functions were lost.

The basic principle of ensuring nuclear safety of nuclear power reactors is that the license is granted to the facility, which ensures nuclear safety in the design basis, and that serious accidents beyond design basis are handled by means of the accident management strategy, if they damage nuclear fuels or the reactor core. Even if the design basis is exceeded, the accident is not generally designated as a severe accident if the core is not largely damaged. But if a tsunami far exceeding the design basis height hits the plant, wide range of safety functions may be lost simultaneously by common mode failures. Discussions on the severe accident preparedness was prompted internationally after the 1979 Three Mile Island nuclear accident and the 1986 Chernobyl accident, and severe accident prevention measures to guard against such accidents and mitigate their effect were established in individual countries during the 1980s and '90s.

b. Problems in tsunami scenarios

(a) Regulatory bodies

The NSC, a body responsible for developing regulatory guides for safety review in Japan, began work on revising the Regulatory Guide for Reviewing Seismic Design of Nuclear Power Reactor Facilities ("Seismic Design Regulatory Guide") in July 2001. Before the work, the effect of earthquakes had been studied by the Nuclear Power Engineering Corporation, but there had been no independent study of the effect of a tsunami. Furthermore, although there were several members on the Seismic Design Regulatory Guide Review Sub-committee for revision specializing in seismology, no tsunami expert was involved. The reason given for this was that tsunami are phenomena arising from seismic activity, and even in the absence of tsunami experts the seismologists on the sub-committee would, it was thought, be able to deal also with tsunami issues.

And yet, it is not necessarily easy for seismologists to deal with issues like past damage from tsunami, their historical impacts, and their unique features. So the fact that tsunami experts were not included on the sub-committee demonstrates an insufficient awareness within the NSC of that time regarding the significance of risks posed by tsunami.

Setting out valid assessment criteria for tsunami assessment methods and tsunami preparedness is one role of regulatory authorities, but during our investigation this Investigation Committee found no indication they had exerted such efforts. In March 2002, TEPCO gave NISA a report on the results of safety assessments performed using the tsunami assessment method, but NISA did not respond by setting out any specific instructions or suggestions.

The work that began in July 2001 on revising the Seismic Design Regulatory Guide finally ended in September 2006, taking a full five years to complete. It is commendable that guidelines on tsunami countermeasures were finally put in writing, but the appearance of the guidelines was not used as an opportunity to develop new concrete preparedness measures.

(b) Tsunami Evaluation Subcommittee studies

As explained in Chapter VI 3 (3), in February 2002 the Tsunami Evaluation Subcommittee, the Nuclear Civil Engineering Committee of the Japan Society of Civil Engineers developed the tsunami assessment method, taking into consideration the results of joint research conducted by electric power companies. One of the results of the new method's application was that the worst-case tsunami scenario for the Fukushima Dai-ichi NPS posited a height of 5.7 m, up from 3.1 m. The tsunami assessment method included an excellent way of estimating tsunami wave levels, but it had the following drawbacks.

During the subcommittee's studies, the possibility of a tsunami exceeding the hypothesized water level was discussed, but the assessment method that was finally developed made no reference to the eventuality of a wave exceeding a computed level. Also, if the subcommittee had written down application limitations and key considerations regarding the method being proposed, it is possible that care would have been taken later to consider tsunami issues when revising the Seismic Design Regulatory Guide. However, neither the limitations nor the considerations were written down.

The tsunami assessment method examines past tsunami which have generally reliable recorded trace heights, and posit possible future tsunami high water levels. Therefore, only information for tsunami that occurred as far back as about 300 or 400 years ago can be included in the calculations. Even if tsunami had taken place in a longer time lapse — every 500 or 1,000 years, for example, if there are no written records or documentation for such an event, there is a strong possibility they would not be included in the calculations. The tsunami assessment method was taken up in the "Report of Survey of Disaster Prevention Plan Procedures for the Earthquakes and Tsunamis on the Pacific Seafronts" (see Chapter VI 3 (2)), which was commissioned by relevant government ministries and agencies and examined tsunami countermeasures, but the tsunami assessment method is simply a way to posit tsunami water levels — the report did not indicate what types of countermeasures should be developed in answer to those levels.

(c) TEPCO

As mentioned in Chapter VI 3 (7) and (8), in 2008 TEPCO reviewed the tsunami risk to examine whether the long-term assessments done by the Headquarters for Earthquake Research Promotion, established under MEXT, conflicted with TEPCO's own safety assessments in 2002 at the Fukushima Dai-ichi NPS, for which the tsunami assessment method had been used. That study obtained values of a posited tsunami height more than 15 m at that NPS. In the same year, TEPCO performed other calculations and arrived at a worst-case scenario tsunami height of more than 9 m, using the tsunami source model described in a paper entitled "Numerical Simulation of the AD 869 Jogan Tsunami in the Ishinomaki and Sendai Plains" ("Satake Paper"), by Kenji Satake, Yuichi Namegaya and Shigeru Yamaki (see Chapter VI 3 (6) a (iii) and (7) b (d)). TEPCO did not view the basis for these findings positively, stating that, the first height scenario (more than 15 m) gave only a virtual figure arrived at by taking a tsunami source model for the Sanriku offshore and using it provisionally for the Fukushima offshore, and with regard to the second height scenario (more than 9 m), the Satake Paper had not confirmed the tsunami source model as being conclusive. TEPCO did not begin any concrete tsunami protection measures for the Fukushima Dai-ichi NPS. Thus, although there had been an opportunity in 2008 for TEPCO to enhance protection measures, it made no changes and as a result was unable to prevent the nuclear accident under review. This Investigation

Committee believes that a natural disaster entails big uncertainty, first of all, and, especially in the case of a tsunami, the old tsunamis with written records are limited, and that secondly, that if a nuclear power station were to be hit by a tsunami far beyond design basis, the facility would incur simultaneous, widespread loss of its safety functions due to its common cause vulnerabilities. Therefore, this Investigation Committee is of the opinion that it would have been better to have developed definite tsunami protection measures, including severe accident protection measures, to prevent a nuclear emergency. This is a matter that all those involved in nuclear power generation, including national government authorities and specialists, should take to heart when considering future preventative measures, and should accept as a lesson for the future.

c. Severe accident prevention

A tsunami far beyond design basis would most likely result in a simultaneous, widespread loss of safety functions due to the common cause vulnerabilities, immediately leading to a severe accident in a high likelihood. The Fukushima Dai-ichi NPS accident demonstrates this fact. And yet, this was not properly recognized in the form of severe accident prevention measures in the past. The "Guideline #2 Design Considerations against Natural Phenomena" of the Regulatory Guide for Reviewing the Safety Design of Light Water Nuclear Power Reactor Facilities ("Safety Design Regulatory Guide") states that the design of a nuclear reactor must take into account the possibility of a natural disaster, with a view to keeping it secure in the face of an "earthquake" and "natural events other than an earthquake." In the Guidelines' commentary section, "natural events other than an earthquake" are enumerated as examples: a flood, tsunami, gale-force winds, freezing, heavy snow accumulation, and landslide. This goes to show that tsunami were at least considered when the Safety Design Review Guidelines were being drawn up.

From the above it follows that severe accident prevention measures should, by their very nature, be concerned with individual events that could possibly exceed the design basis. In July 1992, after the Ministry of International Trade and Industry (its name at the time) released a document entitled "Roadmap of Accident Management ('AM')", studies began in Japan as well regarding accident management as a way to prevent a severe accident. In the early days of that discussion, the ministry intended for its focus to extend beyond internal events such as mechanical failure and human error to include external events such as fires and earthquakes. But this early intention was not actualized, and the accident management measures that ended up being promoted focused only on internal events such as the above-mentioned mechanical failure and human error. External events — fires, earthquakes, tsunami, etc. — were not raised as a specific subject to be examined. Indeed, the possibility of the occurrence of a severe accident was considered to be quite small, and regulatory approaches were hardly explored. Accident management was not designated as a regulatory requirement, but rather as a program to be implemented as part of a nuclear operator's voluntary safety initiatives.

Thus, the development of accident management programs was placed in the hands of nuclear operators. Program development was completed in 2002, and in 2004 the effectiveness of the programs were reviewed by the regulatory bodies.

The Fukushima Dai-ichi NPS accident demonstrates the vital importance of severe accident prevention measures that reduce as much as possible damage from a severe accident once it occurs unfortunately. The regulatory bodies and the nuclear operators believed that the nuclear power plants had sufficient safety, and did not proactively promote the expansion of accident management severe accidents to include a focus also on external events. The Fukushima Dai-ichi NPS accident demonstrates that severe accident countermeasures should not have been left up to a voluntary safety program administered by the nuclear operator itself, but should instead have been considered by the competent regulatory authorities and, if necessary, made subject to legal requirements.

(2) Problems of measures against natural disasters that had been taken by TEPCO

a. Insufficient countermeasures against "a situation in which major damage to reactor cores is incurred by a natural disaster"

Before the Fukushima Dai-ichi NPS accident, TEPCO did not put in place tsunami protection measures as part of its accident management program. The TEPCO's measures against a situation, in which reactor cores are seriously damaged by a natural disaster other than a tsunami, were also quite deficient. This is known from the testimony of several TEPCO officials during hearings conducted by this Investigation Committee, such as: "Yes, in hindsight, we were not sufficiently prepared at TEPCO, in terms of awareness and organization, to introduce comprehensive measures to address the risk of natural disasters"; "We never thought of the occurrence of natural disasters beyond design basis assumptions"; and "We believed that if one were to begin to assume an external event in the form of a natural disaster there'd be no end to it."

At the Fukushima Dai-ichi NPS, three of its nuclear reactors got severe simultaneous damage. After flooding cut off all power supply, there was no defense at all to deal with this, making it extremely difficult to cope with the situation. One can only conclude that TEPCO's lack of prior accident management measures to deal with a tsunami was an extremely serious problem.

b. Specific examples of deficiencies revealed by the accident

(a) Lack of preparedness against a total loss of power

TEPCO's preparedness for a total loss of power depended on the normal functioning of either nuclear reactor unit of adjoining units. No consideration was given to a situation where an external event in the form of a natural disaster caused simultaneous damage and failure to several reactors, eliminating any flexibility in obtaining power from an adjoining reactor. Furthermore, no emergency power supply measures were adopted to provide for diversification or redundancy approach for the emergency diesel generators and power distribution panel locations. In other words, no consideration was given to the possibility of a beyond-design-basis tsunami striking the facility. No steps had been taken to prepare for a simultaneous loss of multiple power sources or a total loss of power, including DC power.

As a result, no preparations were in shape to take into account the possibility of the type of situation that occurred — there were no systems for recovering the functions of the measurement hardware, the electric supply systems, or the primary containment vessel pressure venting system, and there was no manual explaining the use of safety relief valves to reduce pressure. And employees were not trained in these operations either. Moreover, the materials and resources required to perform these operations, such as batteries, air compressors, power-supply vehicles and electric cables, were not available on the Fukushima Dai-ichi NPS site.

(b) Lack of preparedness for injecting water and/or seawater by fire engines

The Niigataken Chuetsu-oki Earthquake in July 2007 caused a fire at the Kashiwazaki-Kariwa Nuclear Power Station ("Kashiwazaki-Kariwa NPS",) and this spurred TEPCO to prepare fire engines at all of its nuclear power stations. This it had accomplished by February 2008. And yet, despite the knowledge among some company personnel that the fire engines could be an effective way to inject water, this method was not ranked as a measure within the accident management program — injecting seawater was seen as one option in a worst-case situation, but it was assumed that the worst case would never happen. It was not considered as an accident management measure. In addition, it was not clearly established which team or group in the NPS emergency response center would operate the fire engines to perform alternative water-injection using the fire protection lines.

Consequently, when the site superintendent Yoshida instructed staff, at around 17:12 on March 11, to consider injecting water with fire engines, none of the section chiefs and personnel who received this instruction thought of it as a directive for themselves or their own teams. No team began preparing for the operation right away. This is one of the main reasons why it took about 9 hours before preparations were begun for the water-injection operation, and about 11 hours before water was actually injected.

For the fire engines to continually use that alternative method, a water source was required, and in the end it became necessary to use seawater. However, no thought had been given beforehand to seawater injection preparedness. When it came time to inject the seawater, the crew encountered difficulties setting up the water injection lines quickly.

(c) Inoperative emergency communications channels

During an emergency, it is vital that plant workers, NPS emergency response center personnel, and main control room staff all be able to maintain close contact in order to share information. This applied also to power plants other than the Fukushima Dai-ichi NPS. Thus, communication channels had to be always available for use, both during everyday operations and during an emergency.

Before the accident, communications at the Fukushima Dai-ichi NPS had often been done using a personal handy-phone system (PHS), and it was assumed that the system could be used in an emergency as well. In actual fact, though, the devices used to collect PHS waves (the PHS remote system) were equipped with backup batteries capable of lasting only about three hours. The total loss of AC power led eventually to the PHS devices failing one after the other, beginning in the evening of March 11. This cut off PHS communications among the workers trying to restore plant operations, the NPS ERC, and the main control room. Although wireless devices were then used as an alternative, conveying information with them faced major hurdles, too — for example, transmitting and receiving could be done from only a limited number of locations. So, for some time after the accident, the workers at the accident site, personnel in the NPS ERC and the main control room found it difficult to share information.

TEPCO had set a capacity of at least one hour for storage batteries for its communication devices at the nuclear power station, including PHS equipment. This was based on the premise that AC power from the plants would be restored within one hour after a total loss of AC power. A situation involving a total loss of power for many hours like what happened during the Fukushima Dai-ichi NPS accident had not been considered.

(d) Problems in arrangements for operators of machinery and fire trucks during an emergency

Fire engines and heavy machinery had always been operated at the Fukushima Dai-ichi NPS by subcontractors, but no definite arrangement had been made on operating them there in the event of an emergency or other extraordinary situation.

Flotsam washed up by the tsunami blocked roads on the power station grounds, greatly hindering the movement of personnel and vehicles. Attempts to remove it with heavy machinery were made, but nobody on site was able to operate the backhoes and other heavy machinery. The only option was to ask contractors to quickly send some of their employees. Similarly, for water-injection operations using the fire engines, the company had always consigned all fire engine operations to a contractor, and in the early stages of the accident no TEPCO employee on the grounds was able to operate them. This led to a delay before the water injections could begin. And so, even though some essential machinery and vehicles were available, the lack of arrangements for personnel to operate them created a major obstacle to their being used rapidly in the early stages.

7. Why were the measures against tsunami and severe accident insufficient?

(1) Limitation of voluntary safety initiatives

Technology for nuclear power generation is fine-tuned on site and becomes more advanced over time. The knowledge and problem-solving skills required to promote nuclear safety exist on site. Therefore, safety assurance at a nuclear power plant must be achieved through the nuclear operators' own, independently administered safety programs. The Safety Fundamentals of the International Atomic Energy Agency (IAEA) also advocates in its first principle that the prime responsibility for safety must rest with the person or organization responsible for facilities and activities.

And yet, being a private enterprise, the purpose of a commercial plant is to grow its profits. There is no assurance that the prioritization of various safety measures by nuclear operators is optimized in an environment of two conflicting goals of economics and safety. Individual safety measures may not necessarily be appropriate, either. And, there are also limitations for nuclear operators on their own to acquire constantly the state-of-the-art knowledge relevant to nuclear safety or technologies, which develop one day after another. This leads to the conclusion that voluntary safety measures have limitations.

As explained in Chapter VI 5 (1), TEPCO believed that the possibility of a tsunami exceeding a wave event posited by the tsunami assessment method was small, small enough that it did not consider it necessary to develop safety measures for such a possibility. In a sense, it is perhaps natural that, as a private enterprise, a nuclear operator would feel justified in being reluctant to develop safety measures that it thought were unnecessary. The fact that TEPCO found itself unable to include measures against a tsunami beyond the scope of assumptions would seem to indicate the limits of a safety program administered by a company itself.

(2) Insufficient organizational capabilities of regulatory bodies

Because the knowledge and problem-solving skills promoting the safety of nuclear energy exist at the nuclear power generating station itself, a regulatory body may find it difficult to achieve a high enough level of competency. To properly fulfill its role, its knowledge of nuclear safety and technologies must be at least as advanced as that of the nuclear power operators, in addition to which it needs advanced expertise in conducting safety reviews and performing its own operations. And, not only must this expertise be held by personnel in charge of regulating and inspecting, but the regulatory body as a whole must have it.

This fact was not adequately considered by NISA ever since its establishment in 2001, because it was preoccupied with long-term administrative issues and was then too busy dealing with ongoing problems at the Kashiwazaki-Kariwa Nuclear Power Station. NISA did not take adequate steps to raise the specialized expertise of its personnel. Even the NSC Secretariat, which worked on regulatory guide revisions, did not have adequate staffing — for example, those involved in technical issues requiring specialized know-how were part-time technical councilors. Relevant research and knowledge continue to advance quickly on daily basis.

Regulatory bodies should focus their efforts on formulating and updating the guidelines and standards by acquiring the latest expertise. This makes it essential that regulatory bodies have a solid, comprehensive base. Intellectual discussions with no quick resolution could be left to the work of academic circles.

(3) Adverse effect of specialization and division of professional expertise

The third reason for the lack of sufficient tsunami preparedness was the adverse effect of the division of professional expertise into sectoral specialist fields.

The following testimony was given during a hearing held by this Investigation Committee: “People who specialize in nuclear system safety and people who specialize in seismic safety occupy quite different technical fields, of course, and this is even reflected in the way the review committee of the Nuclear Safety Commission and the advisory board of the Ministry of International Trade and Industry each form their own panels. The panels generally operate independently of each other. To review nuclear power plant safety, the NSC and the Ministry each formed three different working groups, for system safety, radiation exposure and seismic safety. As part of the process of reactor core analysis, the system safety working group would, after their review, discuss their radiation exposure assessments, and often the radiation exposure working group would join them for those assessments. However, we didn’t see the need to meet with the other working groups because the theory was that one need think of nothing stronger than an S2 earthquake, which is definitely not strong enough to cause the failure of equipment critical to safety. Personnel in charge of the review division oversee everything, but they never joined in a meeting with the advisory board. NSC members discuss practical matters with the working groups, but I never heard of those discussions being held at the review committee level.”

This testimony clearly demonstrates the adverse effect of the extreme division of professional expertise into the sectoral fields of nuclear energy specialists and engineers.

A division of labor is needed to raise expertise in specialized fields, and dividing fields of expertise into smaller units boosts knowledge and technology. This is seen, for example, in the turf occupied by university faculties and in their fields of study. In private companies, too, engineers group themselves within their own fields of expertise, and this is reflected in organizational structure. Groups of engineers with similar backgrounds establish their own culture within the company, and this strengthens the technical potential of the group. There can be a negative side to this, however — the high degree of specialization does not encourage consideration of issues that extend across various fields of expertise productively, and as a result the various groups may not do everything necessary in order to elevate the safety in totality. Successful tsunami preparedness requires the knowledge and technical expertise of different fields, and it is important that groups of specialists and engineers, each with their own academic culture, work together to find solutions. To mitigate the adverse effect of specialization, it is necessary to develop organizational structures that extend across the lines that divide the various fields of expertise.

(4) Difficulties in supplying risk information

One can presume that the following are reasons why accident management against a severe accident was not subjected to regulatory oversight, and why nuclear operators ended up running their own, voluntary safety initiatives : The provisional value of core damage by the probabilistic safety assessments (PSA) was 10^{-6} per reactor per year, which was considered under existing regulations to be well within safety levels; the PSA method was actually not advanced enough to be used to back up regulatory requirements; and in addition, during litigation in the past aimed at withdrawing permits for a nuclear reactor installation, the Government had explained the deterministic approach regarding design-basis events and the reasoning behind that approach, and had argued that existing regulations ensured satisfactory safety levels — this historic background created concern that, if regulatory oversight were to be required for severe accident preparedness, it would logically follow that the existing regulations had been inadequate and their application had been deficient. This concern demonstrates the complications that can arise when presenting risk information in the public sphere. If one attempts to make improvements to raise safety levels higher, the paradoxical result is the negation of the validity of past practices.

It is not easy to accept that absolute safety does not exist and then face the risk to live. Nevertheless, it is necessary to make effort toward creating social conditions where difficult-to-convey risk information can be presented, and people are allowed to make reasonable choices based on the facts.

8. Recommendations on a New Nuclear Safety Regulatory Body

(1) Problem identification

NISA is a specially designated entity of the Agency for Natural Resources and Energy, which is a government agency under METI and has oversight over nuclear safety regulations governing nuclear power stations, and under the Nuclear Emergency Response Manual it is expected to act within the NERHQ Secretariat and play a key role responding to a nuclear emergency, such as an accident at a commercial nuclear reactor.

After the Fukushima Dai-ichi NPS accident a number of issues — especially NISA's poor initial response, its inadequate disclosure of information, and the fact that no attempt was made to use SPEEDI to support the evacuation — ended up creating strong feelings of mistrust among the Japanese people. Even before the accident, NISA's lack of a proactive attitude regarding safety checks was evident: for example, by simply waiting for nuclear operators to provide voluntary reports on seismic back-checks, NISA did not motivate them to report on the current state of their tsunami preparedness.

On August 15, 2011, the Cabinet decided to remove NISA from under METI and restructure it as an external bureau under the jurisdiction of the Ministry of the Environment, integrating its functions with those of the Nuclear Safety Commission. The government aims to launch a new body hopefully in April 2012, known provisionally as the Nuclear Energy Regulatory Agency.

This Investigation Committee believes that, while preparing for the launch of the new body, the Government, in addition to of course determining what type of entity it will be within the government, should also consider certain issues to ensure the new entity achieves results befitting an organization with regulatory oversight over nuclear safety. This Committee requests the Government to take the following points into its own discussions in establishing the new regulatory body, regarding its functions and role.

(2) Framework for an effective organization with regulatory oversight over nuclear safety

a. The need for independence and transparency

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 IAEA Safety Fundamentals also ranks this as a key safety principle. **The new nuclear safety regulatory organization should therefore be granted independence and should maintain transparency.** As mentioned above, the Government is moving forward with efforts to establish the Nuclear Energy Safety Agency (provisional name), with a view to separating regulation from use, and this Committee believes it is extremely important that the regulatory body enjoy a higher level of independence from entities promoting the use of nuclear power, so that it will truly function as a nuclear safety regulatory organization, and regain the trust of the Japanese people.

But simply changing the new organization's status within the Government would not establish it as an effective regulatory body. Therefore, **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.**

b. Organizational preparedness for swift and effective emergency response

If a serious nuclear emergency arises, the result could be massive emissions of radioactive substances dispersed over a wide area, leading to grave and long-term consequences for many residents and tremendous damage to economic activity and society as a whole. To ensure a proper response to such a situation, all government bodies would need to work together to tackle it, and specialized knowledge and special equipment would be required. The Government's role and responsibility in this regard are very great.

In light of the terrible impact a nuclear disaster would have on the nation, the nuclear safety regulatory organization, which would play a key role in disaster response, should, beginning in times of normalcy, draw up disaster preparedness plans and implement drills to facilitate rapid response if a disaster occurs, should foster the specialized skills to provide expert advice and guidance that competent personnel and organizations responsible for emergency response will need, and should foster the management potential it needs to apply its 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 prepare systems that can deal with a major disaster 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.

c. Recognition of its role as a provider of disaster-related information to Japan and the world

During the Fukushima Dai-ichi NPS accident it became obvious that NISA did not properly fulfill its obligation to manage information appropriately during the emergency, or to rapidly and accurately disclose information that needed to be disclosed, when releasing monitored results and SPEEDI-related information, and when providing information to neighboring countries regarding the release of contaminated seawater into the ocean.

More consideration must be given to the issue of risk communication, specifically the question: How should information be provided after the occurrence of a nuclear disaster or other emergency situation? If an organization with regulatory oversight over nuclear safety issues does not have a deep-seated awareness of when and how it should convey information in its possession to people in Japan and abroad, and if the general public cannot depend on it to receive that information in an acceptable manner, the Japanese people will mistrust it. Information regarding nuclear emergency and radioactive materials emissions is a matter of great concern to the Japanese people, a matter on which hinge the credibility of Japan in the eyes of the international community, and for these reasons too it is essential that the way information is provided is carefully considered. **The new entity with regulatory oversight over nuclear safety issues must be fully conscious that the way it provides information is a matter of great importance, and must also, beginning in times of normalcy, establish an organizational framework that ensures it will, during an emergency, be able to provide information in a timely and appropriate manner.**

d. Retention of first-rate human resources; greater specialized expertise

If an entity with regulatory oversight over nuclear safety is to fulfill the authority and obligations granted to it through legislation, it needs sufficient knowledge and capabilities to perform its functions, enough personnel to deal with its work volume, and management capabilities that use human resources efficiently and effectively to achieve its objectives.

Personnel involved in nuclear safety regulation are expected to have an especially high level of expertise and the ability to perform their professional duties well. Unfortunately, during the recent nuclear emergency, officials at times demonstrated an inability to respond with vigilance and flexibility. And prior to the emergency, they did not apply new tsunami-related knowledge in their investigation and inquiries during seismic back-checks. And, although NISA prioritized earthquake-resistance assessments in light of the damage caused by the Niigataken Chuetsu-oki Earthquake, it conducted only some limited tsunami-preparedness assessments.

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 and retain talented 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. These types of human resource initiatives will create an attractive organization where expert personnel will have enthusiasm for the future and be motivated while pursuing well-defined career paths. This will result in greater technical and management expertise among personnel, which in turn will result in a regulatory organization that fulfills its functions more effectively.

An organization depends on its workforce. Personnel at the new nuclear safety regulatory organization will be expected to take full advantage of the opportunities they are given to raise their specialized expertise and operational abilities, while remaining conscious of the great responsibility the Japanese people have invested in them to ensure nuclear safety.

e. Efforts to collect information and acquire scientific knowledge

Advances are being made daily in the scientific understanding of seismic activity, tsunami and other phenomena, as they apply to nuclear safety. Unfortunately, though, NISA apparently did not strive hard enough to obtain the results of research conducted by other administrative bodies, or to use that knowledge in its own regulatory activities. **The new 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 absorbing knowledge that will contribute to its regulatory activities. It must also understand the implications of that knowledge, share it and use it systematically, and convey it and pass it on as befits an organization of its nature.**

Scientific knowledge promoting nuclear safety keeps evolving in multiple directions, and ongoing efforts are required to obtain and understand it, and to properly apply it during the regulatory process. The regulatory body to be established will face strong demands that it always act in this way, in light of the vital importance of nuclear safety.

9. Recapitulation

The Fukushima Dai-ichi NPS accident forced residents within an approximately 30-km radius from the facility to take refuge for a long time, and the radioactive contamination over wide areas caused serious damage to livelihoods and businesses.

This Committee is presently continuing its investigation and inquiry into the accident, which had such wide repercussions, and intends to shed light on it in its entirety. The facts that have become clear through our investigation to date indicate that many of the problems that either caused the accident or affected the subsequent response sprang from the following three major failings: (i) inadequate preparedness for a severe accident precipitated by a tsunami; (ii) a lack of awareness that a nuclear emergency could occur as part of a multidimensional disaster; and (iii) a lack of an all-encompassing perspective of a nuclear emergency.

(i) Lack of severe accident preparedness for tsunamis

TEPCO did not develop measures in response to a scenario in which a tsunami of the proportions that did strike would cause a severe accident, and the regulatory authorities were similarly remiss. Why did they not proceed on the assumption that such a severe accident could occur? What underlying factors resulted in the scenario not being considered? One answer to these questions is most likely that their severe accident preparedness approach placed priority on an accident caused by an internal event, such as mechanical failure or human error, and did not place importance on an external event such as a beyond-design-basis tsunami. This Investigation Committee will continue to examine this further.

Even though the probabilistic frequency of a tsunami of that scale is assessed to be low, it is nevertheless predicted that if one were to strike, the extent of the damage would be enormous. This indicates the need for a new risk awareness regime under which the required measures would be developed, and the possibility of damage would not be ignored.

(ii) Lack of awareness of the ramifications of a multidimensional disaster

The emergency under review took place amid widespread damage caused by an earthquake and tsunami, which in turn led to the severe accident at the nuclear power station, and therefore demonstrates a classic multidimensional disaster.

When a multidimensional disaster occurs, a number of predicaments arise at the same time, creating a situation different from a single accident or a single disaster. In the case under review, the national and municipal governments were faced with a situation requiring simultaneous response to multiple disasters. Confusion reigned at many levels, response actions were delayed, and the earthquake and power outage paralyzed telecommunications infrastructure. In the midst of these difficulties the Off-site Center, the keystone in accident response, ceased to function. Infrastructure that would have been key in responding to the nuclear accident, such as roads and monitoring systems, sustained damage, making radiation dose measurements difficult, sometimes impossible.

The fact that no consideration was given to a scenario involving a nuclear accident within the context of a multidimensional emergency was a major failing that threatened not only the safety of the nuclear power station itself but also the safety of people around it. Developing measures to respond to the possibility of a multidimensional disaster will surely be an important part of future efforts to revise preparedness at nuclear power stations.

(iii) Lack of an all-encompassing perspective

There is no doubt that organizations and officials responsible for nuclear emergency preparedness and response, as well as the people managing and operating the nuclear power station, had only a weak conception of overall nuclear emergency preparedness. This failing, which has already been mentioned in detail in this report, is apparent in the fact that preparedness for a severe accident hardly took an external event into account, the fact that after the accident the damage spread to local communities, and the fact that not enough steps were taken to prevent the situation from deteriorating further. And the excuse that nothing could be done in the face of an extraordinary situation involving the onslaught of a tsunami beyond all assumptions is not convincing — rather, the only conclusion is that there existed major problems in nuclear emergency preparedness.

The three failings detailed above demonstrate the need for a transformation (a paradigm shift) in the basic framework for disaster preparedness and countermeasures for a huge system that risks tremendous damage if an accident occurs.

10. Conclusion

In our final report, scheduled for release in the summer of 2012, this Committee will submit to the Government general recommendations based on our investigation and inquiry into the causes of the accidents at the Fukushima Dai-ichi and Dai-ni Nuclear Power Stations. Sections 3 to 7 in this chapter of this Interim Report present recommendation formed after our identification and analysis of various issues. Section 8 of this chapter contains recommendations on five issues that we feel should be considered when preparing for the establishment of the new organization with regulatory oversight over nuclear safety. Section 9 examines the situation from a broad perspective, suggesting there is a need for a paradigm shift to prevent the recurrence of a nuclear disaster in Japan.

Beginning almost immediately after the serious nuclear accident at the Fukushima Dai-ichi NPS on March 11, 2011, officials said again and again, “An event beyond the scope of our assumptions occurred.” The meaning of “beyond the scope of assumption” is basically, “We didn’t think such an event would happen.” But when many Japanese people heard this they interpreted it to mean not only “We didn’t think it would happen,” but also “Something beyond the scope of assumption happened, so it couldn’t be helped — we are not responsible.” When those in charge said, “It was beyond the scope of assumption," the Japanese people would think, "It was your duty to assume that such a terrible event could happen."

So what is implied by the words "within the scope of assumption" and "beyond the scope of assumption"? To assume something is to determine the parameters of something assumable and the parameters of something not assumable, and to draw a dividing line between the two. When we humans think of something, if we don't determine the scope of what we are thinking about we won't be able to think about it properly. In other words, when we prepare to think about something, we draw a dividing line that forms the parameter for what we will think about. After we decide on the parameter, we apply our mind to what is inside the parameter, and proceed within it.

How, then, do we establish that parameter? That decision is influenced by various limitations. There are economic limitations, of course, and social limitations, limitations imposed by the past, regional limitations, and so on. The parameter is established by satisfying the demands of those limitations. Those limitations are not necessarily clearly identified. They may not be spelled out in writing. We must be careful to realize that some limitations may exist as a premise that is implicitly understood among those involved, but not verbalized.

As for what is outside the parameter, we decide that we're not going to take it into consideration, so we don't. Once an assumption is made, we forget which limitations influenced the formation of the parameter. After an accident happens, our judgment is only concerned about the dividing line between what was within the scope of an assumption and what was beyond it. If we don't clearly identify how the dividing line was drawn, we won't be able to pinpoint the true failing.

With regard to the accident under review, the possibility of a colossal tsunami striking, or a total loss of AC power occurring for many hours, was thought to be very small, so those matters were treated as beyond the scope of assumption. Many Japanese people felt this was irresponsible, but the main thing is to ask, why did something beyond the scope of assumption end up happening?

A nuclear power station is, by nature, a high-energy-density generator, and if it breaks down or is involved in an accident there is a risk of the disaster becoming greater than anything experienced by humanity so far. Those involved regarded the matter as a technical issue that could possibly end up becoming beyond human control, something difficult to talk about, and they did not clarify the matter for the general public. This reticence was seen most clearly in the catch phrase, "Nuclear energy is safe." Once nuclear energy is presented as safe, from that time on it becomes difficult to consider what types of issues lurk within the elements of nuclear power that are dangerous, in what directions a dangerous situation could evolve, and what could be done to contain it. It cannot be denied that these factors were behind the "beyond the scope of assumption" events that occurred.

One cannot plan something, then draft the plan and implement it, without making assumptions. In other words, making assumptions is something one simply has to do. And one should, while making those assumptions, remain conscious of the fact that some things may be beyond the scope of assumption. Even in the case of an event whose probability of occurring is slim, one needs to think, "Things that could happen sometimes do." One cannot ignore a possibility just because its probability rate is low. Not thinking about what could happen, and then, if that event does happen, thinking "The probability rate was low so it couldn't be helped," is not an appropriate response. Even if the probability rate is low, one should still consider it necessary to prepare for it, especially since, if the event were to happen, recovery would be extremely difficult. The accident under review serves as a critical lesson, indicating how to act with regard to a matter that is "beyond the scope of assumption."

The nuclear emergency is still not over. Even now, many people are forced to live day after day in refuge, and radioactive contamination has caused many people much trouble. Many worry about how their health may be affected by exposure to radiation, how the air, soil and water may have been contaminated, how their food may not be safe. This Committee shall bear all this in mind as we continue our investigation and inquiry, while working on our final report, which is scheduled for release around the summer of 2012.