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Fukushima Nuclear Accident Summary & Nuclear Safety Reform Plan

March 29, 2013

Tokyo Electric Power Company, Inc.

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Organization of this Report

This document summarizes the Fukushima Nuclear Accident and describes the Nuclear Safety Reform Plan as concerns mainly the nuclear power departments. We believe that the investigations and analyses conducted so far have made progress in ascertaining many of the facts related to the progression and cause of the Fukushima Nuclear Accident. However, the remaining records and field investigations are still limited, and there are unverified or unclarified matters related to the damaged areas, the extent of damage, the cause of damage and other particulars associated with the progression of the accident after the Tohoku-Chihou-Taiheiyou-Oki Earthquake. Therefore, TEPCO will continue to make every effort to understand the behavior and other actions of the nuclear reactors during the accident by systematically conducting field investigations and analytical simulations, and will take every necessary measure. In addition, please refer to other materials disclosed for information about approaches to decontamination, damage compensation, reactor decommissioning and so on.

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- Implementation, evaluation and improvement of the Nuclear Safety Reform Plan
(3. Enhancement of measures to improve safety for power stations is already underway. The status of such implementation will be announced when appropriate.)

1. Overview

On June 20, 2012 TEPCO compiled and published the Fukushima Nuclear Accident Analysis Report (hereinafter, “Internal Accident Analysis Report"). The Internal Accident Analysis Report consolidates the results of detailed investigations into the factual relationships regarding the circumstances leading up to and following the accident. However, the report has been severely criticized with some stating that the report does not provide the results of a sufficient analysis regarding the reasons why the accident was not prevented and that the report is from beginning to end a self-justification, mainly of the internal investigation. On account of these criticisms, we established the Nuclear Reform Special Task Force in September 2012. Under the supervision of the Nuclear Reform Monitoring Committee, we have made the analysis regarding the organizational causes behind the Fukushima Nuclear Accident in addition to the analysis of causes of the accident from the technical aspects. The results of these activities have been put together in the "Reassessment of the Fukushima Nuclear Accident” and "Nuclear Safety Reform Plan," which is a countermeasure based on this reassessment.

(1) Reassessment of the Fukushima Nuclear Accident

In our reassessment of the Fukushima Nuclear Accident, TEPCO profoundly regrets the following two points:

Point 1: Imperfections in the nuclear power station equipment and facilities

In July 1966, to obtain an Establishment Permit for the Fukushima Daiichi Nuclear Power Station (NPS), TEPCO submitted to the government an establishment permit application detailing the specifications of the nuclear power facility, the safety design policy and the results of safety analyses. The document described that, in the event of an accident, the multiplexed safety equipment and facilities would reliably operate to shut down and cool the nuclear reactor and prevent the release of radioactive materials. However, nearly all the safety equipment and facilities ceased to function as a result of the earthquake and tsunami of March 11, 2011. The factor that allowed this type of situation to occur was that ample consideration was not given to common cause failures arising from external events (earthquakes and tsunamis) during the design stage, and afterward, which resulted in bringing about the severe situation of the loss of all power sources (see Attachment 1-1).

Additionally, even after operation had commenced, continuing efforts to reduce risks were not ample, including the collection, analysis and utilization of information from other countries concerning safety enhancement measures, as typified by the United States anti-terrorism measures (B.5.b[5]), and operational experience, and the consideration and implementation of new technological knowledge. Preparation for a severe accident was somewhat deficient in terms of facility and personal deployment (see Attachment 1-2).

As stated above, TEPCO profoundly regrets that a severe accident was caused in which there were core meltdowns and, moreover, the release of a large amount of radioactive material over a wide area due to a shortfall in technological capability at the design stage and efforts that fell short in continuously striving to improve safety thereafter.

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5 Article B.5.b included in order for interim safeguards and security compensatory measures issued by U.S.NRC. It requires the formulation of mitigating measures capable of maintaining and restoring the core cooling capacity, containment function for the containment vessels and cooling function for the spent-fuel pools even under conditions where a large portion of the facility has been lost due to a large-scale fire or explosion resulting from phenomena, including impact by an aircraft.

Point 2: Public relations activities during the accident

Since the accident occurred on March 11, 2011, all public-relations activities did not have ample promptness and accuracy. Particularly, the announcement that a core meltdown had occurred was significantly delayed and made on May 24. This delay was caused by the following (see Attachment 1-3):

a. The situation wasn't correctly perceived
b. A positive inclination toward the prompt release of information was missing
c. It took time to coordinate with external organizations.

We profoundly regret that there was not ample promptness and accuracy in our public-relations activities caused unease and mistrust among the people of siting communities, Japan and the entire world.

(2) Nuclear Safety Reform Plan

Based on the aforementioned remorse, we will fundamentally reform our approach to safety by eradicating the arrogance and overconfidence which we held toward conventional safety measures and by identifying issues which have existed within our organization. More precisely, as described below, we will enhance measures to improve the safety of power stations as well as implement measures to resolve issues that exist within our company organization.

I: Enhancement of safety improvement measures for power stations

In addition to strengthening measures to improve safety under the supervision and monitoring of TEPCO's Nuclear Reform Monitoring Committee, we will undertake the step-by-step enhancement of safety improvement measures which have been proposed in the various accident investigation reports issued by the National Diet, Japanese Government and private institutions as well as those provided in the report by the U.S. Institute of Nuclear Power Operations.

Also, based on the results of the analysis as to how the Fukushima Nuclear Accident progressed and the experience gained in responding to the accident, we believe it is necessary for our company to reassess our approach to safety design. We will pursue safety designs which are highly effective and well-balanced for the overall system, doing so with a focus on the following two points:

- For each layer of defense in depth[6], the emphasis will be placed on diversity and positional dispersion in ensuring reliability not on traditional multiplexing
- From the standpoint of enhancing defense in depth, consideration will be given to the superiority of permanent facilities and portable facilities.

We will promptly implement a variety of safety improvement measures with respect to facilities and operations.

II: Measures for resolving issues that exist within our company organization

To prevent severe accidents caused by a variety of initiating events not limited to tsunami, it is necessary to bring to light and solve the issues immanent within TEPCO's organization which was not amply prepared to deal with such accidents. Based on an analysis of the accident's root

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6 A concept in which multilayered safety measures are implemented to ensure overall safety even if some measures are compromised. More precisely, it comprises: (1) preventing an anomaly from occurring, (2) preventing an accident from spreading, (3) preventing core damage, and (4) mitigating the impact from core damage, and (5) undertaking an emergency response outside a power station.

causes, we reached the conclusion that problems of a deficiency in “safety awareness,” “technological capabilities” and “dialogue skills” were factors underlying the accident, and that, in the nuclear power department, “preparations for accidents were not ample owing to the assumption that safety was already guaranteed and the perception that capacity utilization rates, etc. were the management’s most important challenge.” The following six measures will be adopted to resolve these intrinsic problems within the organization.

Measure 1: Reform starting from management[7]

The Management must be strongly conscious of the special risks inherent in nuclear power, be aware that the nuclear power operator bear responsibility for safety, demonstrate leadership in order to raise safety awareness throughout the entire organization, and strive to develop human resources. In order to satisfy these objectives, management will undergo:

- Training to improve awareness of nuclear power safety.
- Periodic and objective evaluations on awareness of nuclear power safety, after which the result will be utilized for continuous improvement.

In addition, in order to raise the level of safety awareness throughout the entire organization, we will construct mechanisms where cross-sectional and multitiered discussions related to safety can be continued.

Measure 2: Enhancement of oversight and support for management

The Nuclear Safety Oversight Office will be established, which is an internal regulatory organization under direct control of the Board of Directors for the purpose of bolstering the Board’s management of nuclear safety risks. While effectively utilizing expert third-party knowledge independent of executive management, the Office will independently and directly evaluate the corporate officers’ operations of nuclear power business, and reports to the Board of Directors. Corporate officers will be monitored and advised by the Nuclear Safety Oversight Office with respect to nuclear power safety.

Measure 3: Enhancement of ability to propose defense in depth

In order to decrease residual risks to a socially permissible level, it is necessary to continuously make an effort to enhance safety improvement measures. For this reason, we will construct a system for developing the technological capability for promptly proposing the enhancement of highly cost-effective measures to improve safety in accordance with defense in depth. Also, we will be conscious that accident and problems which have arisen anywhere around the world may also occur at our power stations, and will construct a system which appropriately applies operational experiences and information including those from other countries and other industries.

Measure 4: Enhancement of risk communication activities

People at TEPCO had “stopped thinking through the belief” that, if newly discovered risks were announced, requests for excessive countermeasures would be demanded by regulators and siting communities, and furthermore, that long-term reactor shutdowns might be unavoidable. In order to extricate ourselves from such thought-stopping patterns, risk communication will be promoted under the concept "there is no absolute safety[8] (zero risk) in nuclear," which will be

7 The term “management” in the Nuclear Safety Reform Plan refers to all corporate officers.
8 Simply stated, “safe” refers to there being no unacceptable (intolerable) risks.

the consistent opinion throughout the company, to proactively announce risks and foster a relationship of trust through communication with siting communities, society and regulatory authorities regarding measures to further reduce risks. To reliably implement this risk communication, we will post expert risk communicators, who have had specific training and possess excellent technological knowledge, in TEPCO's Corporate Communications Department and Plant Siting & Regional Relations Department, to carry out risk-communication activities.

In addition, risk communication will not be limited to the field of nuclear safety, but applied to all business operations, especially those in the nuclear power departments, to continuously check and correct the gaps with the society in the criteria for evaluations and ways of thinking; and through such process, we will enlighten the organization and the individuals. For this purpose, the Social Communication (SC) Office, which will include outside experts, will be established to collect and analyze risk information in a broad and integrated manner so as to serve as a systematic consultation services and to give any necessary instructions. The SC Office will use risk communicators to, first, provide daily cooperation and support among organizations and personnel in the nuclear power department in order to make a response which is not just in compliance with the law, but also conforms to social standards.

Measure 5: Reform of power station and Head Office emergency response organizations

The factors which caused confusion at the on-site response of the Fukushima Nuclear Accident were as follows among other reasons:

- The chain of command system was unclear
- Information was not fully shared

This is believed to be because the design of the emergency response organization was not meant to deal with an actual severe accident or simultaneous disasters at multiple reactors. Therefore, the emergency response organization will be reorganized in order to have the following characteristics, being modeled after the ICS (Incident Command System), which has been introduced in fire-fighting and other organizations in the United States:

- The number of people to be managed under one supervisor will be limited
- A clear command system will be created
- Roles and responsibilities will be clearly identified
- A flexible organizational structure will be ensured that can be reduced or expand in size in keeping with the scale of the disaster
- Forms and tools will be prepared and utilized for the effective sharing of information throughout the organization
- Skills and requirements will be identified as well as education and training thoroughly implemented

Also, training will be repeated so that the safety improvement measures and the emergency response organization itself can actually be utilized effectively.

Measure 6: Reassessment of non-emergency power station organization
and enhancement of capability for direct maintenance work

The Nuclear Safety Management Center will be established to bolster the capability to take a comprehensive view of nuclear safety at power stations. Also, we will increase manpower capable of duties such as operation of the power supply vehicles and fire engines as well as installation of temporary equipment, which are necessary during time of emergency. Moreover, in order to develop the applied skills which enable TEPCO personnel to understand the state of damage to important facilities related to stable cooling of the nuclear reactors, to make a quick response regarding such damage and to deal with situations exceeding assumptions, meaningful tasks will be extracted from the maintenance work traditionally performed entirely by contractors and will be carried out by TEPCO personnel themselves to augment technological capabilities.

(3) Conclusion

The operator bears responsibility for operating nuclear power equipment with its special risks. Based on a safety awareness that goes far beyond that seen in general industry, the operator thus occupies a position wherein it must always be looking at the operational experiences and technological progress around the world, acquire solid technological capabilities, and continue to make efforts to reduce risks every day. Accordingly, the cause of the accident should not be treated merely as a natural disaster on the grounds that it was difficult to forecast an enormous tsunami. We believe it is necessary to seriously come to terms with the fact that TEPCO was not able to avoid an accident which might have been avoided through ample preparations made in advance with fully utilizing human knowledge.

As stated above, we profoundly regret that we were not able to prevent this accident which might have been prevented, and we again sincerely apologize to the residents of siting communities, the people of Japan and throughout the world for the great inconvenience and trouble that has been caused to them with this accident. In the future, we will strive with unwavering resolve to carry out the safety improvement measures for nuclear power stations as well as to reform our company organization.

2. Fukushima Nuclear Accident, etc. in Retrospect

In order to contribute to the future Nuclear Safety Reform Plan, the Nuclear Reform Special Task Force will perform the Root Cause Analysis (RCA) from the following three perspectives, and will identify the organizational and operational causes, including underlying factors, as to why this accident was not prevented.

(1) Severe accident assumptions and countermeasures

The severe accident countermeasures were completed in 2002. If the severe accident countermeasures had been continuously improved thereafter, could the impact of the accident have been mitigated even a little?

(2) Tsunami height assumptions and countermeasures

When reassessing the tsunami height before the accident occurred, could any measures have been taken to mitigate the impact of the accident even a little?

(3) Lessons to be learned from the accident response

If practical training had been implemented and if equipment and materials had been prepared assuming a severe accident and simultaneous damage at multiple units, could the impact of the Fukushima Daiichi nuclear accident have been mitigated even a little? Also, what was the difference from the response at Fukushima Daini where a cold shutdown was achieved without resulting in the release of radioactive materials?

In addition to these questions, a retrospective look at previous issues and approaches of the nuclear power departments has been taken. In taking a look back, the main events leading up to March 2011 are as described in Attachment 2-1.

2.1 Severe Accident Assumptions and Countermeasures

(1) History

Based on a request (in July 1992) to consolidate accident management (AM) measures from the then Ministry of International Trade and Industry, which request was made in response to “Accident Management as a Measure against Severe Accidents at Power Generating Light Water Reactors (decision of the Nuclear Safety Commission, May 1992),” TEPCO prepared AM measures, which included primary containment vessel venting systems and accommodations for emergency diesel generators between units, over the period from 1994 to 2002.

However, thereafter, because of the following reasons, there was an understanding that it was more important to continue to conduct daily activities for ensuring safety rather than incorporate the new AM measures:

- No new knowledge regarding severe accidents was found and there was the perception that safety had been adequately secured by the current AM measures.
- When the risk of core damage was assessed during Periodic Safety Reviews[9] (PSR), it was verified that there was no inferiority in comparison to existing reactors in other countries.

Nevertheless, the United States and European countries were proceeding with AM measures in light of external events (flooding at the Blayais Nuclear Power Plant in France, 1999) and terrorist incidents (September 11 attacks in the United States, 2001). If we had continued working on AM measures after 2002 in step with such overseas trend, it might have been possible to provide common effective measures for the long-term station

[9] An activity in which operational experience and adoption of the latest knowledge are assessed periodically (every 10 years)

blackout and loss of the ultimate heat sink and to quickly and surely mitigate the impact of the accident, even though there are differences in the precipitating events, the tsunami as compared to the terrorist activities.

Here, we have looked back at the approach and actions of our organization at the time, and performed a root-cause analysis from the following questions (see Attachment 2-2): What kinds of behavior could be identified as "problematic"?; What kinds of underlying factors were latent in such problems?; And, what kinds of improvement would have helped us to take appropriate action?

(2) Results of Root-Cause Analysis

We conducted the root-cause analysis starting with the following three points in order to identify the causes as to why the progress made in implementing severe accident measures fell behind in comparison to efforts in other countries.

a) AM measures had not been continuously enhanced
b) Anti-terrorism measures already in place in the United States had not yet been implemented
c) Information about Operational Experiences (OE), which would have been a pre-indicator for a severe accident, was not sufficiently utilized

a) AM measures had not been continuously enhanced

Upon completion of the AM measures for internal events[10], although personnel responsible for reactor safety forecast that the impact of an external event would be greater than that of an internal event, no notable measures to address external events were undertaken even after 10 years.

Problem (Severe-i): The former nuclear power management[11] did not understand the occurrence of a severe accident to be a management risk nor did it clearly indicate that continuing activities to improve safety as an important management task.

(Underlying factors)
- The former nuclear power management was short of the strong awareness that nuclear power generation is a business involving special risks.
- The former nuclear power management classified safety measures as a management risk having an excessive cost burden from the perspective of risk management based on the idea that nuclear power safety had achieved a sufficient level.
- Items directly related to the "capacity factor" (such as measures to counter stress corrosion and fracturing, measures to counter aging, nuclear fuel cycles, etc.) were primarily selected as the important management challenge, and a large portion of the budget were allocated to such items.

Problem (Severe-ii): The Federation of Electric Power Companies (FEPC), which includes TEPCO, was strongly opposed to the government's idea to make AM measures a regulatory requirement.

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10 In contrast to events initiated by natural phenomena such as earthquake and tsunami which are called external events, those events initiated by equipment failures such as a ruptured pipe or a failed emergency diesel generator are called internal events.

11 “Former nuclear power management” refers to the president and directors concerned with nuclear power prior to the transition to a company with committees in June 2012.

(Underlying factors)

-FEPC was afraid that, if new safety measures are incorporated into regulatory requirements, it would have adverse impact on lawsuits, in light of the discussion in the lawsuit for rescission of the establishment permit for the Ikata Nuclear Power Station operated by Shikoku Electric Power Co.,Inc.

- FEPC did not feel it necessary to disclose risks to society.
- FEPC was afraid that regulations would be put in place and measures disproportionate to their cost would be demanded.
- There was a shortfall in technological capability and the communication skills to discuss safety issues with regulatory authorities in an open forum.

Problem (Severe-iii): Organizational structures concerned with reactor safety at power stations had weakened.

(Underlying factors)

- In the late 1990s, the Fukushima Daiichi Engineering Group drafted plans for countermeasure works against interior flooding and fire, but they did not have sufficient capability to follow through with the subsequent implementation.
- During the organizational revision implemented after the 2002 nuclear power scandal in which the facts were hidden, the function for overseeing nuclear reactor safety within the power station disappeared when some of the Engineering Group functions were transferred to the Safety Management Group and some to the Plant Operation Assessment Group.
- Currently, groups in the Maintenance Department were separately proposing counter measure works related to reactor safety, but AM measures such as those for power source cross-ties between Units 1-4 and Units 5 & 6 have a low priority on the risk-management list being considered as rare occurrence phenomenon. Therefore, it has been difficult to secure funding.

Problem (Severe-iv): It took a long time to develop Probabilistic Risk Assessment (PRA) methods for external events

(Underlying factors)

- It was technically difficult to develop PRA methods for external events (earthquake, tsunami and fire) that involve considerable uncertainty.
- The department responsible for safety design believed that rational explanations could not be given for facility measures requiring huge expenditure unless reliable PRA methods were perfected and it would be difficult to obtain consent within the company.

b) Anti-terrorism measures already in place in the United States had not yet been implemented

Following to the September 11th terrorist attacks in the United States, the Nuclear Regulatory Commission (NRC) issued a directive in 2002, ordering the implementation anti-terrorism measures. The response actions urgently taken on-site during the Fukushima accident, such as the injection of cooling water from fire engines as well as restoring functionality of water-level gauges and main steam-release valves using provisional batteries, were very similar to actions required under anti-terrorism measures. Therefore, if such measures had been implemented by TEPCO in advance, it might have been possible to slow down progression of the accident and mitigate the situation somewhat.

Problem (Severe-v): Failure to obtain Information related to anti-terrorism measures.

(Underlying factors)
- When the member for the Nuclear power departments at TEPCO's Washington office or observers from our Head Office or power stations visited nuclear power plants in the United States, they did not notice that anti-terrorism measures had been adopted.
- There was information indicating anti-terrorism measures included in reports published by the U.S. Congress, Nuclear Regulatory Commission, U.S. Electric Power Research Institute (EPRI) and other such institutions, but our personnel did not pick up on the importance of such information.
- As a member of the World Association of Nuclear Operators (WANO), TEPCO underwent periodic peer reviews, but we failed to receive such information.
- When we received a request from the American Nuclear Regulatory Commission (NRC) in 2009 to assess the impact of an aircraft collision, the manager in charge of nuclear reactor safety raised questions and went to pose them to the Japanese Nuclear and Industrial Safety Agency. However, we did not receive any information.

Problem (Severe-vi): Failure to implement our own countermeasures in spite of having seen the September 11th terrorist attacks

(Underlying factors)
- Security was tightened in accordance with the instructions received from the Japanese Nuclear and Industrial Safety Agency concerning anti-terrorism measures, but not to the extent of implementing the impact mitigation measures as the United States and other countries had done.
- Awareness toward anti-terrorism measures was not ample or at a level far below the international perspective. It was believed that terrorism would not occur in Japan.
- We were satisfied with simply responding to decisions and requests from regulatory authorities. Awareness of safety and the technological capability to independently surmise and resolve threats posed by terrorism on nuclear power stations was not ample.

Problem (Severe-vii): There were no ideas for countermeasures from the perspective of defense in depth

(Underlying factors)
- In studying accidents involving airplane crashes, after it was concluded that the fuel pool would remain sound, the review ended as the probability of an accidental airplane crash was low. They ended the evaluation at that point, and the examination did not lead to the enhancement of countermeasures with respect to additional defense in depth.

c) Information about operational experiences (OE), which would have been a pre-indicator for a severe accident, was not sufficiently utilized

If some measures had been taken based on the following three accidents, the Fukushima accident could have been mitigated even a little.

- Le Blayais Nuclear Power Station (France), December 1999

At the Le Blayais Nuclear Power Station, three plant buildings were inundated by water from a flood, resulting in a loss of power accident. At Le Blayais, the flood prevention walls took into account the maximum tidal level, but consideration was not given to any additional dynamic impact from waves. This caused the flood prevention walls to collapse. However, in the design of domestic nuclear power station, it was confirmed that the most severe conditions conceivable for tsunami and high tides were taken into consideration. In the evaluation of this event, attention was focused only on the causes of the accident and attention was not paid to the fact that a flood could easily bring about the loss of all power sources, as well as what sort of measures were implemented.

We were persistently trapped by the view of the safety review guideline in which the probability of a loss of all power sources for extended period of time in Japan was stated to be very low. We were wanting of the inclination to reconsider on their own the possibility of losing all power sources if a similar accident occurred at one of TEPCO's plants. Additionally, it is believed that TEPCO took a passive stance toward such an investigation because of the following concerns:

- The cost burden would increase if additional measures were required.
- There was apprehension that, if the possibility was acknowledged that a situation exceeding design standards might occur, it might lead to the cancellation of the establishment permit or prolonged shutdown.
- The implementation of additional measures meant an additional workload.

- Maanshan Nuclear Power Station (Taiwan), March 2001

At Maanshan Nuclear Power Station, a loss of off-site power occurred due to a power line accident and this was compounded when the emergency diesel generators failed to start up, resulting in an accident where all power was lost. At the time, we concluded our investigation of the accident, stating that "because inspections and maintenance are appropriately performed, the likelihood of a similar accident occurring is very low, and, even if it would occur, the situation could be addressed at an early stage." We received instructions to conduct an investigation and verification from the Nuclear Safety Commission and the Nuclear and Industrial Safety Agency, and we submitted the above statements as our verification and report, which was accepted, and the investigation was terminated.

In this example as well, the focus was only on the cause of the accident and not on the impact of a station black out or the measures adopted in response. The underlying factors are similar to the results of the analysis concerning Le Blayais Nuclear Power Station.

- Madras Atomic Power Station (India), December 2004

Due to the tsunami resulting from the Sumatra Island Earthquake, the seawater pumps at the Madras Atomic Power Station flooded. Aside from the seawater pumps, the plant was not damaged. Because the accident was classified at level 0 on the INES[12] scale, the accident did not receive any attention nor was it subject to evaluation. Also, the evaluation results at the time for tsunami height based on "Tsunami Assessment Methodology for Nuclear Power Plants in Japan" was considered to be sufficiently conservative, so measures were not taken immediately, but a review was conducted of the water-tightness of pump and motors as a long-term response. However, this information did not concern measures to address the cause of

[12] The International Nuclear Event Scale (INES: International Nuclear Event Scale) established by the International Atomic Energy Agency (IAEA), etc.

a loss of seawater pump function, but attention should also have been paid to it as an accident from the standpoint of measures to address the result which was a loss of the ultimate heat sink.

Problem (Severe-viii): Passive approach toward appropriately capitalizing on investigations of operational experiences in other countries to formulate safety-improvement measures

(Underlying factors)
- We avoided cost increase that additional measures would have incurred.
- We worried that the implementation of measures would lead to social unease about current safety, that it would impact the lawsuit seeking to revoke the establishment permit, and that it would lead to a prolonged shutdown of the power station. There was a sense that the measures were unnecessary.
- As to the foregoing, the same feeling of the former nuclear power management was reflected throughout the organization.
- If it was acknowledged that there was an effect and measures would be implemented, it would lead to extra workload. Therefore, the investigation was passive.
- Because screening, investigations, requests for cooperation and report drafting were all done by departments within the nuclear power division such as the Nuclear Quality Management and Safety Department and Nuclear Power Plant Management Department, it was easy for a passive thought process to function.

Problem Severe-ix): Procedure for reviewing information about operational experiences made it difficult to pick up lessons to be learned

(Underlying factors)
- The evaluation focused only on the causes of accidents and did not pay attention to the impact incurred by accidents or to measures adopted by the operator at the time.
- Because upper management did not participate in the initial screening stage, the process did not result in an evaluation from a broad perspective. On this point, the problem was that the upper management did not perform its duty appropriately.

Problem (Severe-x): TEPCO relied too much on the judgment of regulatory authorities, and it fell short of the inclination to discover problems by independently observing events carefully

(Underlying factors)
- There was a shortfall in awareness of safety as well as the technological capability needed to discover problems on our own.

(3) Summary

The root causes obtained from the analysis performed in (2) are as follows:

Root causes: Being persistently trapped by past determinations and believing that the likelihood of a severe accident occurring due to a loss of all power sources was sufficiently low, and furthermore, that there was little need to make further safety improvements, the augmentation of severe accident measures stagnated.

Based on the analysis results, the items identified as problem areas have been arranged as follows from the perspectives of "safety awareness," "technological capabilities" and "communication skill."

[Problems pertaining to Safety Awareness]

- In contrast to "capacity factor" which was ranked as a management challenge, and permeated widely throughout the organization, the "continuous improvement of safety" was not ranked as an important management topic, and therefore, was not commonly recognized throughout the organization.
- We were overconfident that the severe accident measures thus far implemented under the AM measures were sufficient. We strongly objected to regulatory authorities making AM measures requirements based on the concern that costly measures might be demanded.
- Above-mentioned perception of the former nuclear power management influenced the process of formulating and implementing measures in the field, and made it difficult to secure funding or to implement such measures appropriately.

[Problems pertaining to Technological Capabilities]

- Despite having seen information pertaining to operational experiences and acts of terrorism in other countries, we failed to believe the risk that a loss of all power sources might occur due to an external event (natural phenomena or terrorism) and result in a severe accident cannot be ignored.
- We had a shortfall in the technological capability to discover problems on our own from foreign information and information concerning operational experiences at other power stations, and to identify more beneficial measures.
- We were fixed on the development of Probabilistic Risk Assessment (PRA) methods for external events, delaying the proposal of concrete measures.
- The ability to make good use of limited resources and to consider reasonable safety measures over a short time period was not ample.
- Because proposals for measures meant an increase in work, investigations took on a passive character.

[Problems pertaining to Dialogue Skills]

- If the need for severe accident measures was acknowledged, it would become very difficult to explain that current nuclear power stations were sufficiently safe, and we believed that such acknowledgment would have an adverse effect on a lawsuit seeking revocation of the establishment permit.
- We did not feel it was necessary to disclose risks to society.
- We had a shortfall in the communications skills needed to discuss safety issues with the regulatory authorities at an open forum.

2.2 Tsunami Height Assumptions and Countermeasures

(1) History

At the establishment permit application stage for the Fukushima Daiichi NPS, we assumed, for purposes of the design conditions, a tsunami height equal to that of the Chilean tsunami (Onahama Point (O.P.) +3.122m), which was the highest tsunami in the past, because there was no other definitive standard. In 1970, “Regulatory Guide for Reviewing Safety Design of Light Water Nuclear Power Reactor Facilities” was formulated; where it was provided that nuclear power reactors should be designed to withstand the natural forces thought to be the most severe natural conditions as predicted from past records. The design conditions based on the Chilean tsunami satisfied these guidelines. For this reason, the design conditions for the establishment permit have not changed since that time.

The Southwest-off Hokkaido Earthquake (and tsunami) in 1993 and The Southern Hyogo prefecture earthquake in 1995 triggered a rising trend nationwide toward strengthening prevention against disasters on many fronts. From the standpoint of further improving the safety of nuclear power stations in connection with tsunamis, the Japan Society of Civil Engineers (JSCE) began to examine methodology for predicting and assessing tsunami height in 1999. In February of 2002, the JSCE specified the "Tsunami Assessment Methodology for Nuclear Power Plants in Japan." Using such assessment procedure, we became able to reflect a variety of uncertainties, which were involved in the process of tsunami prediction, in design of a station, while referring to the highest recorded tsunami. As a result, it was thought that such assessment procedure was conservative enough by having the assessment result be approximately twice as high as the highest recorded tsunami. Using this approach, we revised the design conditions for the Fukushima Daiichi from the previous O.P. +3.122m to O.P. +5.4-5.7m, and implemented necessary measures such as raising the pumps and making buildings watertight. “Tsunami Assessment Methodology for Nuclear Power Plants in Japan” demonstrates the determinism-based tsunami assessment methods. We had not assumed any sources of tsunami wave along the Japan Trench off the coast of Fukushima Prefecture because there were no records of any previous large-scale tsunami.

In July 2002, the central government’s Headquarters for Earthquake Research Promotion (HERP) released a report entitled "Long-Term Assessment of Likelihood of Earthquake" and put forth the opinion that an earthquake with M8.2 could occur anywhere along the Japan Trench from the northern area off the coast of Sanriku to offshore from Bousou. Accordingly, the same conditions would apply to tsunami prediction. The opinion is quite different from the past, and it indicated the possibility of a tsunami along the Sea of Japan Trench off Fukushima Prefecture, despite the fact that no tsunami had been previously recorded. It was easy to imagine (i) that the tsunami height in the design conditions for Fukushima Daiichi NPS and Fukushima Daini NPS would increase if it were to be assumed that a large tsunami would occur along the ocean trench off the coast of Fukushima Prefecture and (ii) that we thought it necessary to more advanced methodology for predicting tsunami height and decided to work with the long-term evaluation opinion in the JSCE that had been examining probabilistic tsunami assessment methods since 2003.

The Japan Society of Civil Engineers began their investigation of probabilistic tsunami analysis methods in 2003. In such analysis method, the tsunami wave source model, which had previously been treated deterministically, would now be dealt with probabilistically. However, the probabilistic analysis had limitations that there was little existing data for estimating wave sources, and a method was devised in which the results of a vote among experts would be taken into consideration. However, in this case, there were significant differences in the assessment results depending on how experts were selected, and there were many problematic issues remaining in actual application to tsunami prediction.

In December 2004, a huge tsunami occurred off of Sumatra, which was caused by the earthquake with M9.1. We should have evaluated this earthquake more carefully because:

- The earthquake was caused by the interlocking movement of faults over a wide area.
- It cast doubt on the conventional opinion that a huge tsunami would be unlikely to occur on the western edge of the Pacific Ocean
- The seawater pumps at the Madras Power Station in India flooded as a consequence of the event.

However, it was soon after the new assessment methodology was stipulated by the Japan Society of Civil Engineering, and we still believed that the methodology applied was sufficiently conservative. Therefore, no concrete measures were considered.

Upon gaining new knowledge about the Sumatra tsunami and the investigation into interior flooding which occurred in the United States, the Japan Nuclear and Industrial Safety Agency held the Flooding Study Group from January to July 2006, and TEPCO participated as an observer. Taking into account the discussion in such study group, a trainee, who were stationed at the headquarters at that time, evaluated the impact and necessary countermeasures corresponding to incremental tsunami heights exceeding assumptions, taking as an example the Unit 5 reactor at Fukushima Daiichi NPS. Among the countermeasures, some were useful even from the current point of view. However, because we believed the assessment methodology of the Japan Society of Civil Engineers was sufficiently conservative, these countermeasures were not seriously evaluated.

Accompanying a revision of the Seismic Resistance Guidelines in September 2006, a seismic safety assessment (anti-seismic back-check) was commenced. The anti-seismic back-check was conducted in order to reassess the design basis seismic ground motion in accordance with the new Guidelines as well as to verify whether or not ground foundation, buildings, and equipment would be sound with respect to the new seismic ground motion. In July 2007, the Chuetsu-Oki earthquake occurred, temporarily halting work on the anti-seismic back-check. However, the anti-seismic back-check was restarted with additional new knowledge gained from the Chuetsu-Oki Earthquake. The final report on the anti-seismic back-check required that evaluation be performed, based on the latest knowledge also with regard to tsunami.

In the process of conducting the anti-seismic back-check from March to July 2008, when provisional calculations were conducted as an internal review using a tsunami wave source model for the Meiji Sanriku-Oki Earthquake based on the opinion from HERP that "an M8.2 earthquake could occur anywhere along the ocean trench from the northern area off the coast of Sanriku to offshore from Bousou," we computed the tsunami height showing a maximum of 15.7m (analytic value). In June and July of the same year, the cost of constructing flooding embankment (several tens of billions of yen) to protect against tsunami and the impact on surrounding areas were evaluated. The reliability of the computational result was also discussed. As it was concluded that the technological validity could not be verified, in June 2009, we commissioned the Japan Society of Civil Engineers to undertake a review of the wave-source model and advise us as to what ought to be hypothesized as a tsunami source.

In August 2010, two years after provisional calculations of tsunami height had been worked out, the Tsunami Measures Working Group was formed based on the opinion of the person coordinating this issue at TEPCO who was concerned that measures would be further delayed if we waited until the review results were received from the Japan Society of Civil Engineers. The Group set about conducting a full-scale examination to study measures for reducing the impact of tsunami.

As stated above, certain improvements based on new knowledge were tried after the power stations had been built. After the Japan Society of Civil Engineers decided on a tsunami assessment methodology in 2002, there were several opportunities to evaluate effective measures against tsunami:

1. In 2002, when HERP issued its opinion that "an M8.2 earthquake could occur anywhere along the ocean trench from the northern area off the coast of Sanriku to offshore from Bousou"
2. In 2004, when the tsunami occurred off the coast of Sumatra
3. In 2006, when the impact of tsunami was evaluated in relation to the Flooding Study Group
4. In 2008, when provisional calculations were made, placing the source of a tsunami wave off of the coast of Fukushima Prefecture

Instead of relying only on evaluation by the Japan Society of Civil Engineers, if we had taken the initiative to consider necessary measures and had implemented countermeasures such as waterproofing battery rooms or preparing back-up power sources, we might have mitigated to a certain extent the impact of the Tohoku-Chihou-Taiheiyo-Oki Earthquake and Tsunami and might have prevented the worst case situation in which a large amount of radioactive materials were released.

Similar to severe accident assumptions and countermeasures, we looked back upon the approach and actions of the organization at that time, and performed a root-cause analysis from the perspective of what we should identify as a problem and what are the factors underlying these problems, and, also, what sort of improvements we should make in taking appropriate action (see Attachment 2-3).

(2) Results of Root-Cause Analysis

The issues and underlying factors obtained from the root-cause analysis have been arranged as shown below.

<u>Problem (Tsunami -i): There was a shortfall in the humility to deal prudently with a large natural disaster involving tsunami, which encompassed great uncertainty.</u>

(Underlying factors)

- The length of research period on tsunami within the pacific coastal area of eastern Japan is about 400 years. The division in charge of tsunami evaluation regarded risks of tsunamis whose reoccurrence period is over 400 years as the ones that could be still hedged by conservativeness of the evaluation procedure. However, the department did not communicate that every related division should not be rely only on the tsunami height evaluation results but implement measures for tsunami disaster prevention because insufficiency of tsunami related knowledge in comparison with other natural phenomena inevitably put substantial uncertainties in the evaluation.
- The departments in charge of safety did not request to the department in charge of tsunami evaluation to actively investigate the occurrence of past tsunamis with a mind toward the problem that the tsunami, which occurred in 1960 right before construction, was assumed to be the highest level of a tsunami in contrast to the fact that it was considered that events having a frequency of less than once in a million years can generally be ignored in the safety design of nuclear power facilities.
- The department in charge of facility design neglected the fact that if a tsunami struck which exceeded assumptions, the power station would immediately be thrown into to a serious situation in which, among other problems, the heat sink would immediately be lost (or loss of all power sources depending on plant design), which may lead to a possibility of a core meltdown resulting ("cliff-edge," i.e., safety limit event).
- The former nuclear power management had not provided training to the civil engineering and construction departments in preparation for nuclear power risks and severe accidents. In addition, personnel in the tsunami evaluation department were not given the opportunity to understand how much the uncertainties in their tsunami evaluation would impact safety of the reactors.
- The former nuclear power management did not have ample consciousness to quickly undertake countermeasures in light of the extensive impact when an accident occurs (cliff-edge event), because their attention was focused entirely on whether an enormous tsunami would occur or not.

Problem (Tsunami -ii): Satisfying laws, standards and guidelines was considered to be sufficient, and there was a shortfall in the ability to proactively conduct careful risk investigations which surpassed standards and guidelines.

(Underlying factors)

- The departments in charge of safety and facility design were unaware that "Tsunami Assessment Methodology for Nuclear Power Plants in Japan" issued by the Japan Society of Civil Engineers (JSCE) did not assure the view that there was no tsunami wave source along the trench off the coast of Fukushima.
- The departments in charge of safety and design did not pay ample attention to the fact that the evaluation results based on JSCE's "Tsunami Assessment Methodology for Nuclear Power Plants in Japan" varied greatly depending on configuration of the wave source model.
- The former nuclear power management considered the in-house provisional calculations alone would be a weak basis for countermeasures, so they requested experts at JSCE to conduct the study, therefore countermeasures were not implemented quickly.
- The former nuclear power management thought that announcements to the public would be better understood if the calculations were performed in accordance with methods of academic societies and other such institutions rather than the results of in-house reviews.
- The entire organization in charge of nuclear power, including the former nuclear power management, had many occasions to respond to the instructions of the regulatory agency and other legal requirements, and they tended to think that just undertaking these responses was enough.

Problem (Tsunami -iii): Although conservative determinations are generally accepted in nuclear power-related designs, new knowledge and views were reluctantly incorporated.

(Underlying factors)

- The opinions of the HERP are the conclusions of a gathering of many experts. The former nuclear power management did not have ample initiative not to rely solely on the JSCE but also listen sincerely to proposals.
- The former nuclear power management should have carefully considered the fact that although some members of the JSCE mentioned the possibility of a tsunami beyond expectations, their opinions had not been incorporated since they were in the minority.
- With a keen awareness toward safety, the former nuclear power management should have carefully considered the risk of a natural disaster leading to a nuclear disaster and should have implemented measures in accordance with defense in depth.

Problem (Tsunami -iv): Although tsunami prevention measures employing flooding embankments were taken into account, consideration did not go so far as to come up with flexible ideas, such as mitigation measures after a nuclear disaster has occurred, thereby not adopting a measure that would have been effective and quickly applicable.

(Underlying factors)

- Because of the high cost, the Nuclear power departments thought it would be difficult to secure funding for tsunami preventions measures, such as constructing flooding embankments, without sufficient technological studies and public explanations pertaining to their necessity.

- The departments in charge of safety, facility design and tsunami evaluation had based their measures on completely preventing tsunami and did not have ample imagination to come up with measures for mitigating impact (third and fourth layers of defense in depth).
- As to the examination of tsunami height, we relied too heavily on the Civil Engineering Division, and there was an attitude in which other design divisions could not begin studies on countermeasures unless the Civil Engineering Division determined the height of the tsunami as a prerequisite for design.
- The division in charge of facility design, which examined the countermeasures, had a shortfall in technological capability and awareness of safety to raise issues and solve them on their own. In addition, the division in charge of tsunami evaluation did not actively participate in investigations unless instructed to do so by the former nuclear power management.

Problem (Tsunami –v): It was assumed that only measures that would perfectly contain the impact of a tsunami would convince siting communities and regulatory authorities.

(Underlying factors)

- The division in charge of facility design assumed that just acknowledging the necessity of a tsunami countermeasure would mean that the current power station is unsafe and, as a result, the siting communities and regulatory authorities would seek excessive measures.
- Since we could not explain that the risk of a nuclear disaster was zero, we hesitated to actively explain to those outside the company the possibility remained that a tsunami exceeding assumptions might strike.

(3) Summary

The root cause obtained from the analysis in (2) can be summarized as follows:

Root cause:
Despite our knowledge regarding tsunamis being scant, we judged the possibility of a tsunami strike exceeding expectations to be low, and we therefore did not have ample initiative to come up with countermeasures on our own and prepare defense in depth.

Based on the analysis results, the items identified as problem areas have been arranged as follows from the perspectives of "safety awareness," "technological capabilities" and "communication skill."

[Problems pertaining to Safety Awareness]

- The former nuclear power management fell short of the inclination to emphasize safety and proactively implement countermeasures based on the understanding that records of natural phenomena were limited and highly uncertain.
- The former nuclear power management was short of the outlook to implement countermeasures involving the third and fourth layers of defense in depth, such as readying portable power supply and cooling water injection operations, even though the possibility of such an occurrence was low, because they limited themselves to studying first-layer defense in depth measures such as flooding embankments and were biased by their level of trust in calculations on tsunami height.

- The former nuclear power management did not put importance on the opinions of HERP experts who said that the occurrence of a massive earthquake (i.e. great tsunami) along the ocean trench from the northern area off the coast of Sanriku to offshore from Bousou, including off the coast of Fukushima Prefecture, could not be ruled out.

[Problems pertaining to Technological Capabilities]

- The former nuclear power management relied too heavily on the JSCE's judgment and fell short of the inclination to proactively strengthen its review.
- The divisions in charge of safety and facility design did not believe that the "Tsunami Assessment Methodology for Nuclear Power Plants in Japan" did not guarantee that there would be no tsunami wave source along the ocean trench off the coast of Fukushima Prefecture.
- The divisions in charge of safety and facility design did not pay ample attention to the fact that evaluation results based on the JSCE's "Tsunami Assessment Methodology for Nuclear Power Plants in Japan" varied greatly depending on the configuration of the wave source model.
- The divisions in charge of safety and facility design did not have ample flexible thinking to formulate measures which would be very cost-effective and able to be implemented in a short period.
- The division in charge of tsunami evaluation did not provide training in nuclear power risks and severe accidents for the civil engineering and construction divisions, and were complacent regarding the expanding impact of tsunami in a cliff-edge manner.

[Problems pertaining to Dialogue Skills]

- We had a shortfall in the technological capability to explain reasonable tsunami countermeasures to regulatory authorities and thought that we would be forced into taking excessive measures.
- We fell short of the inclination to communicate with siting communities and regulatory authorities about the necessity for tsunami countermeasures out of fear that we would be required to take excessive measures.

2.3 Lessons to be Learned from the Accident Response

2.3.1 Lessons Learned from Accident Response at Fukushima Daiichi NPS

Power station personnel on site during the Fukukshima Nuclear Accident gave their utmost effort to bring the situation under control, but the response was limited by an imperfect framework, equipment and materials. They were not able to prevent core meltdowns at Units 1- 3 and the subsequent release of large amounts of radioactive materials.

Here, we will reflect on the major turning points during progression of the accident at each unit and identify problems in terms of the kind of preparation that was necessary, based on the an awareness of the problem that perhaps the impact of the accident could have been mitigated even a little if we had assumed simultaneous disasters at multiple units as well as a severe accident and had been prepared for such with practical training, equipment and materials.

(1) Shutdown of Isolation Condenser System Function at Unit 1

At Unit 1, the situation progressed to a reactor core meltdown within a short amount after the tsunami arrived. Among the facilities for cooling the reactors when all power sources had been lost, the condition of the isolation condenser system (IC[13]) had a significant impact on progression of the accident. Here, we reflected on the reasons "why we did not prioritize

[13] This is an apparatus for lowering pressure inside the reactor by guiding reactor steam and converting it back to water when the reactor pressure rises (installed only at Fukushima Daiichi Nuclear Power Station Unit 1)

checking the status of and restarting the IC" (see Attachment 2-4-1).

Problem (Accident -i): The Power Station Emergency Response Headquarters at the power station believed that the IC was working until midnight on March 11 when they confirmed that the dry well (D/W) pressure was abnormally high.

- Before arrival of the tsunami, the Power Station Emergency Response Headquarters had information that the IC was working.
- After arrival of the tsunami, the Power Station Emergency Response Headquarters did not have any information that the IC system had shut down.
- After arrival of the tsunami, the Power Station Emergency Response Headquarters had the following information which allowed the assumption that the IC was working:
  - At 16:44, personnel of the Operation Generation Team of the Power Station Emergency Response Headquarters checked the condition of an IC steam pipe along a wall of the reactor building and reported that steam was coming out. (It was an oral report without any photos or other such evidence, and the situation was such that it could have easily been misunderstood that the IC was in operational condition.).
  - At 18:17, a report from the main control room (MCR) stating that the valve was opened was relayed by the Operation Generation Team to the Power Station Emergency Response Headquarters as "injection had commenced."
  - At 18:25, a report from the MCR that the valve had been closed did not reach the executive members of the Power Station Emergency Response Headquarters.
  - At 21:30, indications from the water gauge were restored. Although it showed an incorrect value, we believed it since there was no other value we could compare it to.
- Although some information was received which indicated that the IC was not operating, this information was not fully shared with the Power Station Emergency Response Headquarters.
  - Even though there were people who claimed to have seen that almost no steam was coming out of the IC, there was no systematic information collection effort such as taking photos for the purpose of verifying the IC operation condition so that it could be conveyed clearly to the Power Station Emergency Response Headquarters.
  - Between 16:42 and 17:00, it was confirmed through indication on the temporarily recovered water gauge that the level was decreasing.
  - Based on the above-mentioned downward water level trend, the engineering team predicted that the level would drop to the top of the reactor core at around 18:00.
- As contradictory information became increasingly complicated, most of the executive members of the Power Station Emergency Response Headquarters guessed "The IC would probably continue to work even with the loss of power, because it does not require a power supply." The reasons underlying this assumption were as follows:
  - Many of the executive members of the Power Station Emergency Response Headquarters did not understand the particulars concerning IC function.
  - Personnel who understood the details of the IC's functions were attending to duties away from where executives of the power station's emergency response headquarters were located.

Problem (Accident -ii): The executive members of the Power Station Emergency Response Headquarters believed that the situation at Unit 2 was more severe than at Unit 1.

- We were not able to grasp the operating conditions of the reactor core isolation cooling system (RCIC)[14] or the reactor water level at Unit 2. (It was apparent that the DC power

[14] Cooling water injection apparatus which drives a pump via a turbine by using steam generated from decay heat

sources had been lost when the tsunami struck and that the RCIC could not be started up again once it had shut down.)

Problem (Accident -iii): The executive members of the Power Station Emergency Response Headquarters could not afford to slow down and think because they were busy planning the recovery activities necessary for each unit and ascertain the status of the responses.

- The accident was progressing simultaneously at Units 1-6.
- The personnel, who should have focused on plant recovery led by the site superintendent, were overwhelmed with handling reports and responding to outside inquiries, including those from the Head Office, that the situation did not allow them to concentrate on their duties.

Problem (Accident -iv): The chief of the Power Station Emergency Response Headquarters considered the top priority to be power restoration of the standby liquid control system capable of high pressure cooling water injection.

- We hoped for a recovery by taking advantage of the power source for the cooling water injection facility, which had stopped functioning due to total loss of power (a depressurization operation could not be performed because DC power sources had also been lost, and restoration of the high pressure cooling water injection facility was needed.)

(2) Loss of Cooling Water Injection Function at Unit 2

At Unit 2, although DC power sources were lost after tsunami arrival, the RCIC, which was started up prior to the tsunami, was still working. Later, at shortly past 13:00 on March 14, we determined that the RCIC had lost function and attempted to transition to a low pressure water injection system, but this transition took time, resulting in the interruption of cooling water injection for approximately six-and-half hours. In response, we have examined the question of why the cooling water injection function was lost at Unit 2 (see Attachment 2-4-2).

Problem (Accident -v): After loss of RCIC function, it took some time until alternative water injection (fire engine) could be started.

- Due to the hydrogen explosion at Unit 3, hoses which had been laid out were damaged and rendered unusable.
- In a very difficult operating environment due to impact of the hydrogen explosion at Unit 3, although the drive power source (battery) for opening the safety relief valve (SRV) [15] to depressurize the reactor had been connected to the circuit in advance, operators were not able to open the valve for a while. The cause is thought to have been contact resistance at the point of connection with the battery to which it was connected, but the specific cause has not been identified as of the current point in time.
- It took some time to discuss with the headquarters via teleconference to make a determination on whether to give priority to PCV venting or reactor depressurization.

Problem (Accident -vi): We believed that cooling water injection by fire engine had begun, but the fire engine was actually out of fuel and shut down.

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of the reactor core in consideration of a situation where AC power is lost (installed at Fukushima Daiichi Nuclear Power Station Unit 2 and units constructed later).

[15] Valve for releasing steam into the pressure suppression chamber to protect the pressure vessel in the event reactor pressure experiences an abnormal rise.

- The fire engine experienced an automatic shutdown as it ran out of fuel because we were unable to continuously monitor the status.
- Radiation levels were high in the field and we only dispatched personnel to the site when refueling.
- We assumed that the fire engine would not run out of fuel as long as it was refueled regularly.

(3) Loss of Cooling Water Injection Function at Unit 3

At Unit 3, because the DC power sources were usable even after tsunami arrival, reactor cooling was first performed using the RCIC and then using the High Pressure Core Injection System[16] (HPCI). However, late on the night of March 12, the HPCI was in such a condition that cooling water injection could not be continued as described below.

- Since the number of turbine revolutions was below the operating range and the number was on a downward trend, there was a possibility that the turbine had been damaged and reactor steam was leaking.
- The reactor pressure and HPCI discharge pressure indicated almost the same level so that in such a situation cooling water was not being injected into the reactor.

In addition, the condition indicator lamp for the SRV was lit, so it was believed that the reactor could be depressurized as the SRV was operable (able to be opened).

As a result, the HPCI was shut down, and an attempt was made to inject cooling water into the reactor using the diesel-driven fire pump (D/D FP)[17]. However, this switching operation required approximately seven hours during which cooling water injection was discontinued. Here, we have reflected on "why the cooling water injection function was lost at Unit 3" (see Attachment 2-4-3).

<u>Problem (Accident-vii): High pressure injection systems other than the HPCI (standby liquid control systems) could not be restored.</u>

- The operating environment was very challenging, due to the impact of the hydrogen explosion at Unit 1.

<u>Problem (Accident -viii): We manually shut down the HPCI.</u>

- In the main control room (MCR), we wanted to shut down the HPCI early, which was operating unstably to prevent leakage of reactor steam caused by the damage to the HPCI.
- In the MCR, we believed it was meaningless to keep the HPCI activated, because reactor pressure had fallen to a level that made HPCI cooling water injection difficult.
- In the MCR, we determined that it was possible to depressurize by using the SRV after shutdown of the HPCI, and be able to switch the source of cooling water injection to the lined up D/D FP.

<u>Problem (Accident -ix): It took a long time to transition to low pressure cooling water injection (D/D FP or fire engine).</u>

- Some time was required to prepare the drive power source (battery) for opening the main SRV in order to depressurize the reactor.

<u>Problem (Accident -x): The executive members of the Power Station Emergency Response Headquarters could not afford to slow down and think because they were busy</u>

[16] A high pressure pump driven by the steam turbine, and an apparatus used for injecting cooling water into the reactor.

[17] Pump driven by a diesel engine installed in the fire protection system.

planning the recovery activities necessary for each unit and ascertain the status of the responses.

- The accident was progressing simultaneously at Units 1-6.
- The personnel, who should have focused on plant recovery led by the site superintendent, were overwhelmed with handling reports and responding to outside inquiries, including those from the Head Office, that the situation did not allow them to concentrate on their duties.

(4) Summary of Reflections on Major Turning Points at Each Unit

In sections (1) through (3) above, we reflected on significant turning points in progression of the accidents at each unit, and their common conditions can be arranged as follows:

- Alternative means for times when all power sources were lost had not been sufficiently prepared.
- Due to factors such as the debris from the tsunami and hydrogen explosions at the reactor buildings (R/B), just responding to the accident itself was extremely difficult.
- Preparations were not in place for nuclear power division personnel to carry out on their own the work necessary for restoration in the event of an emergency, so time was required for each separate response.
- We were not able to call upon personnel to effectively collect the necessary information from each location in order to estimate condition of the reactor cores, nor were we able to make good use of fragmented information available to make accurate predictions of the situation.
- At the Power Station Emergency Response Headquarters, there were organizational impossibilities in handling a severe accident and simultaneous disasters at multiple units (e.g., beyond the limit over which control could be exercised).
- Information concerning the status of important equipment, such as the isolation condenser system (IC), could not be shared. In addition, regardless of the information's level of importance, all sorts of information were brought to the Power Station Emergency Response Headquarters in the sharing of information, which resulted in hindering prompt and appropriate decision-making and confusing instructions and orders.

When the analyses of sections (1) through (3) are summarized, the root cause is as follows.

Root cause: Not believing that a severe accident or simultaneous disasters could occur at multiple units, we were not amply prepared in terms of training, equipment and materials for responding to such an accident on site. Consequently, information sharing of critical plant conditions as well as quick and appropriate depressurization operations could not be performed.

Based on the analysis results, the items identified as problem areas have been arranged as follows from the perspectives of "safety awareness," "technological capabilities" and "communication skill."

[Problems pertaining to Safety Awareness]

- Since it was assumed that a severe accident would not occur, training plans were not ample and training had become a formality.
- Likewise, preparation of the necessary materials and equipment was not ample.

[Problems pertaining to Technological Capabilities]

- Because of a failure to configure the techniques which we should have had to perform operations necessary in the event of an emergency, those necessary operations were not quickly implemented by us (Unit 2 problem (Accident –v) "It took some time to start cooling water injection," etc.).

- Because we assumed that even during a severe accident it would be possible to obtain information about plant conditions using instruments, we were not able to estimate the plant condition and quickly formulate countermeasures based on such estimates in a state where no information was available. (Unit 1 problem (Accident –i.) "Misunderstanding the cooling water injection situation," etc.)
- With preparation and training for an information sharing structure not being ample, the sharing of information did not go smoothly.
- The Head Office could not coordinate external inquiries and instructions, and this confused the command system at the power station.
- The Head Office could not provide adequate support through quick preparation, transportation and delivery of materials.

[Problems pertaining to Dialogue Skills]

- We could not quickly and appropriately communicate the status of accident progression to the relevant institutions or local communities.

(5) Public Relations Response during the Accident

We examined the content of announcements that were made concerning the status after the Fukushima Daiichi NPS accident (reactor conditions, environmental impact, accident response status, etc.). At that time, we did not have ample quickness and precision in disclosure of information, taking into consideration that public relations work was overwhelmed due to handling non-nuclear incident matters also, and, as for the nuclear incident, the available plant data was limited due to a total loss of power. We have taken these PR failures very gravely and reflected seriously on them. Reasons for a promptness and appropriateness not being ample in our PR activities were as follows:

a. We misunderstood the situation
b. We fell short of a proactive inclination toward promptly disclosing information
c. We required some time for coordinating with external entities.

Below, we cite examples of the content reported immediately after the incident as classified according to each of these causes (see Attachment 1-3).

- With regard to the core meltdown at Unit 1, since we had the mistaken notion that the IC had continued to operate even after the tsunami arrived, we believed the water level indication at the time water level monitoring was restored. As a result, we misunderstood that the core was being cooled and publicly announced this information, which differed from the facts. <Cause A>
- Regarding the public announcement of radiation levels observed at Unit 1, on March 11 at 21:51, it was confirmed that the radiation level inside the reactor building (R/B) was rising, and entry into the R/B was prohibited. However, despite TEPCO having been aware of this matter, we neither issued reports or press releases. <Cause B>
- Concerning public announcements on estimates on the status of core meltdowns, although TEPCO had been making preparations to announce such with a target date of around September 2011, it took until November 30 of the same year for the actual announcement due to time required to explain to the Nuclear and Industrial Safety Agency the details concerning estimates of the status of core meltdowns. <Cause C>

The problems which have come to light in this consolidation can broadly be categorized into the following three points:

a. We only publicized and provided explanations of matters that we can clearly determine as being fact, out of excessive consideration towards the information recipient’s grave response to the situation of the accident. (This mentality can be found in all areas, including when issuing external explanations, and not just in public statements. This was especially apparent concerning the core meltdowns and hydrogen explosions.)

b. We prioritized responding and giving information to the Prime Minister’s Official Residence and NISA over the public and local residents, who rightfully should have been conveyed information about the incident (information that we reported but did not include in press releases, the President’s instructions after being warned by the Prime Minister’s Official Residence, etc.).

c. (In connection with a. and b.) Even though there were inconsistencies and discrepancies in the content of descriptions and public statements, our checking function did not work, and external announcements were made with the erroneous information unchanged. (Examples of some of the erroneous information include an announcement in which it seemed that all units were being cooled, which was in the initial announcement after reporting Article 15 of the Act on Special Measures Concerning Nuclear Emergency Preparedness (hereinafter, "Nuclear Emergency Act”), and an announcement made in the early morning on the 12th, in which it seemed as though Unit 1 was more stable than it actually was.)

As a result of a. through c., not all information was revealed to local residents or the public. Furthermore, with some of the publicized information having been incorrect, the incident progressed and escalated from one event to another, raising questions about the content of TEPCO’s announcements and giving rise to a sense of distrust towards TEPCO.

In addition, concerning the information provided to the local governments concerned, we were not able to respond adequately in the first instance due to reasons such as the malfunctioning of communication tools due to the earthquake and its aftereffects, the limited information which could be obtained in the midst of confusion arising from the incident and difficult situation in which to even ascertain the plant status, as well as TEPCO employees not going out to accompany some local governments immediately after the accident at the power station. We seriously reflect on these PR failures which caused great inconvenience to the local governments concerned, and we plan to adopt measures, such as utilizing communication tools with greater reliability which employ satellite channels or other circuits so that we do not cause such a situation again.

(6) Additional Issues Concerning the Response during the Accident

So far, we taken a retrospective look at situations involved in the accident response at each unit that actually led to a significant turning point. Here, we have deduced issues concerning other matters.

- Matters which, although not causes in this accident response, gave rise to problems such as delays in processing and require improvement:
    - Transportation of equipment, materials and personnel tended to be delayed.
    - Noteworthy parameters were not check in a timely manner and were not able to be processed quickly.
    - While wearing a full-face mask, personnel found it difficult to use communication equipment such as transceivers.
- Matters which, although not problems in this accident response, could possibly have made the accident response more difficult depending on the situation:
    - The accident occurred on a weekday afternoon and the initial personnel were secured.

- A power source for the seismic isolated building (only one system with no backup system) was secured.
- A teleconferencing system, internal LAN and internal telephone lines (except for between the seismic isolated building and MCRs) were secured.

The problems and countermeasures that have been deduced are shown in Attachment 2-4-4. In any case, the countermeasures for solving problems have already been implemented or plans for their execution have already been decided.

2.3.2 Lessons Learned from the Accident Response at Fukushima Daini NPS

(1) Changes in Plant Status

a) During rated thermal power output, Units 1-4 automatically shut down due to the March 11th earthquake and were subcritical.

b) The off-site power facility at Fukushima Daini had four incoming power lines, but after the earthquake, power continued to be received over only one line. (One line was shut down for inspection and two lines shut down after the earthquake.)

c) As for Unit 3, since the emergency component cooling system (B) in the seawater heat exchanger building on the south side was usable, the residual heat removal system (B) was in usable conditions. Therefore, it was used to inject cooling water into and cool the reactor, and the reactor achieved a cold shutdown on March 12.

d) At Units 1, 2 and 4, the impact of the tsunami rendered all of the emergency component cooling systems in the heat exchanger buildings unusable, resulting in the loss of reactor heat removal function (event corresponding to Article 10 of the Nuclear Emergency Act). However, the reactor core isolation cooling system (RCIC) continued to maintain the reactor water level and reactor pressure was able to be controlled by the safety relief valve (SRV). After reducing pressure in the reactor, the injection of cooling water into the reactor was switched from the RCIC to an alternative water injection means using the make-up water condensate system (MUWC). However, the residual heat removal function was not restored after it was lost, causing the water temperature in the suppression chamber (S/C) to rise (over 100°C), which was determined to be an event corresponding to Article 15 of the Nuclear Emergency Act. Subsequently, the station personnel and some of the contractors' workers, who had remained behind, worked and were able to put some of the emergency component cooling system in usable condition on March 14. As a result, the reactor residual heat removal function, which had been lost, was restored, leading ultimately to cold shutdown of the reactors on March 15.

(2) Accident Response History

a) Walkdowns[18] conducted to confirm post-tsunami damage

With much of the equipment damaged, an examination was conducted to determine whether or not the residual heat removal function could be effectively restored in a short time, and an order of priority was established for equipment restoration.

- Walkdown conducted to confirm the state of damage to the facility
- Personnel gathered and shared the walkdown results in the Emergency Response Headquarters
- Order of priority determined for restoration efforts (replacement of the motor for the emergency component cooling system (B) and restoration of function by supplying power from a power supply car via a temporary cable)

b) Emergency procurement of machinery and materials for restoration

[18] Series of operations conducted on site whereby a certain procedure is followed to observe and inspect equipment and to evaluate those results.

- Emergency procurement of replacement motors, power cables, power supply cars, light oil, and portable transformers (liaison was effective between Head Office and power station)
- Motors were airlifted from manufacturers' factories and transported by truck from Kashiwazaki-Kariwa NPS

c) Supply of temporary power and replacement of motors

- Temporary power cables were laid from the rad-waste building power panels to the heat exchanger buildings of Unit 1 and Unit 2, and also laid between heat exchanger building at all units, and power was supplied
- Most of the temporary power cable, which had a total length of approximately 9km, was laid in one day by about 200 workers
- Power supply cars and transformers were set up, and power was supplied to the emergency diesel generator facility cooling system motors (Units 1 and 4)

d) Cold shutdown of reactors through restoration of cooling systems

- In order to cool reactors more effectively, emergency cooling procedures were established and a new loop path was formed
  (Suppression chamber >> RHR cooling system pumps >> same heat exchanger >> reactor cooling water injection >> SRV >> suppression chamber).

(3) Differences from the Disaster at Fukushima Daiichi NPS

a) External power was able to be received from a single line, and power could be supplied to all units via high-voltage start-up transformers. Therefore, some equipment and power sources were usable, and accident response operations could be performed based on existing procedures. Also, instruments (parameters) could be monitored and information ascertained (utilization of the safety parameter display system[19]), and communication tools (pagers, safety telephones) and lighting were available with the exception of some areas. Therefore, it was possible to maintain means of communication between the Emergency Response Headquarters, main control rooms, and the field. In the Emergency Response Headquarters, information about plant status could be shared with the field and the subsequent response to the accident was able to proceed relatively smoothly.

b) There was relatively little damage to the seawater cooling system pumps and motors, which serve as the ultimate heat sink, and there were only three motors that urgently required replacement (emergency diesel generator facility cooling system (Unit 1), residual heat removal cooling systems (Units 1 and 4)), and cold shutdowns were achieved for all reactors comparatively early.

c) Damage to the main administrative building was relatively slight, so it could continue to be used. As a result, searching for the necessary documents was relatively easy, and office space and rest areas for workers could be secured. Meanwhile, because the power facility for the seismic isolated building had been struck by tsunami, power was restored using temporary power cables.

(4) Success Factors in the Accident Response

Unlike at the Fukushima Daiichi NPS, some of the remaining power sources and cooling function were utilized, and station workers came together to launch the recovery effort under

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[19] Proprietary system of Tokyo Electric Power Company (common known as the Safety Parameter Display System (SPDS)). Other emergency systems include the Emergency Response Support System (commonly called ERSS) maintained by the Nuclear and Industrial Safety Agency and the System for Prediction of Environmental Emergency Dose Information (commonly called SPEEDI) operated by the Ministry of Education, Culture, Sports, Science and Technology.

the leadership of the Fukushima Daini site superintendent. The main success factors are compiled below.

a) Progression of the accident mitigated through utilization and application of Emergency Operating Procedures for warning sign basis accidents and accident management measures.
   - Submergence of reactor cores maintained through alternate water injection using MUWC
   - Injection of cooling water into suppression pool via the cooler drainage line of the flammability control system, and mitigation of the rise in temperature and pressure in the primary containment vessel by means of PCV spraying employing the MUWC.

b) Prioritization restoration strategy based on ascertained condition of on-site damage
   - While the tsunami alarm continued to sound, walkdowns were conducted after safety measures had been adopted, including readying for emergency evacuation of station personnel, to identify damage in preparation for additional tsunami
   - With much equipment damaged, an examination was conducted to determine what should be prioritized for recovery in order to be able to effectively restore the residual heat removal function in a short time

c) Solid organizational management (leadership, communication, professionalism)
   - The power station executives and leaders of the functional teams exercised leadership by presenting clear goals, conveying specific instructions, as well as ascertaining and addressing facility and organizational situations
   - Workers with operational experience were dispatched to the main control rooms as contact personnel, and communication was maintained with the Emergency Response Headquarters all from the shift supervisor down to subordinate personnel could devote themselves to operations and monitoring
   - Even while families were being affected by the disaster and the situation worsened at Fukushima Daiichi NPS, the majority of personnel remained at the power station to engage in restoration activities, and station workers, who had been outside the site on leave or business when the disaster struck, traveled along roads made impassable by the earthquake and tsunami to assemble at the power station

d) Mobilized recovery due to successful emergency procurement and transport of materials and equipment for restoration
   - Emergency procurement of replacement motors, power cables, power supply cars, and portable transformers (liaison was effective between Head Office and power station)
   - Motors were airlifted by Self-Defense Force helicopters from manufacturers' factories and transported by truck from the Kashiwazaki-Kariwa NPS
   - With a shortage of machinery and materials for laying power cables, a force of approximately 200 workers laid a temporary power cable extending approximately 9 km in one day
   - Strong support from the Distribution Division

e) Logistical support activities enabled disaster response effort to continue
   - Although there were only provisions and equipment to support activities for the first few days, the welfare team coordinated efforts to deploy logistic support immediately after the disaster struck, supplying ground water, showers, food, and bedding.
   - Because transport of recovery machinery and materials was in disorder (impassable national highways, imperfect guidance about detours, mobile telephone service

interruptions) and assistance from transport workers could not be obtained, TEPCO directly managed transport within the evacuation zone

(5) Issues in Light of the Experience of this Accident

As for the accident response at Fukushima Daini NPS, the initial disaster situation differed greatly, as described in "(3) Differences from the Disaster at Fukushima Daiichi NPS" The fact that the accident at Fukushima Daini NPS could be resolved was not necessarily because the workers at Fukushima Daini NPS had special qualities. In other words, even if the plant workers at Fukushima Daini NPS were hypothetically switched with those at Fukushima Daiichi NPS, the accident at Fukushima Daiichi NPS probably would not have improved and the situation at Fukushima Daini NPS probably would have been resolved in the same way, insofar as it was in its initial state.

However, in the accident response at Fukushima Daini NPS, even though cold shutdown had been achieved, it is a fact that similar challenges as the Fukushima Nuclear Accident had been present, so we will reexamine this case here.

a) Issues in facility design

In the buildings where critical safety facilities were located, facilities were physically separated into safety zones from the standpoint of protection against internal flooding or fire. However, the tsunami damaged multiple safety functions simultaneously when it exceeded the design standard conditions, making response efforts difficult. The lesson in this instance is that external events can damage much of the facilities simultaneously when the assumed design conditions are exceeded, and it is necessary to ensure diversity not just multiplexing of safety facilities and physical separation, taking account of external events.

b) Issues with the accident response

As described below, it is necessary to specify beforehand the following measures for handling situations in which special equipment and skills are urgently required. In the future, direct management of operations and practical training need to be undertaken during normal times to maintain and improve techniques and skills so that it is possible to directly manage the response required in an emergency and not rely on contractors.

- Deployment and operation of heavy machinery required for debris removal and work.
- Centering adjustment and cable terminal treatment during replacement of pumps and motors
- Deployment, operation, and connection of power supply cars
- Deployment, operation, and connection of fire engines for alternate water injection
- Deployment of auxiliary pumps, motors, power panels, power cables, batteries, etc. on high ground
- Power sources for measurement equipment and replacement with auxiliary instruments
- Ensuring radiation measurement techniques for checking the work environment
- Ensuring restoration and response techniques for times when the communication infrastructure is damaged.

Also, when responding to emergencies, it is not possible to respond using only station workers, contractors' workers, equipment, materials and stockpiles, so ensuring transportation of supplies to the power station and securing replacement personnel are necessary. As such, relay locations for the transportation of personnel and materials to the power station must be selected. As for the initial response, it is assumed that there will be confusion about how to enter closed areas, grasping information concerning the evacuation of local citizens, as well as collecting and summarizing plant information from the power station in addition to other matters. Therefore, it is necessary to coordinate in advance with the police, local municipalities and others concerned.

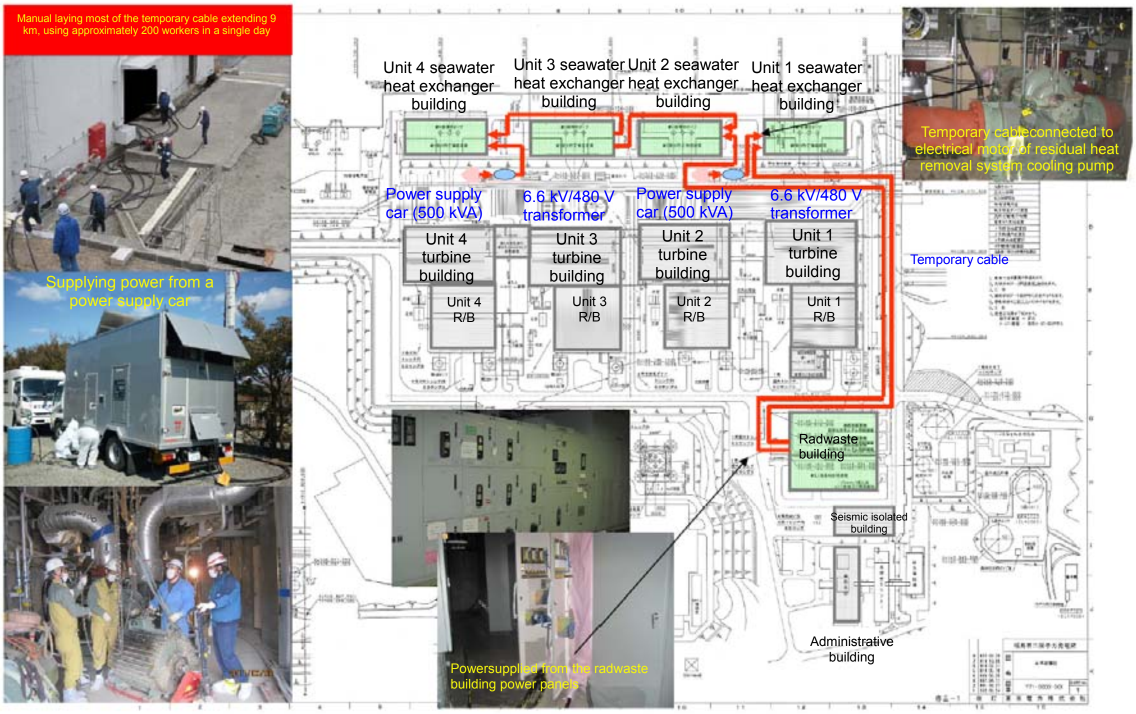

Figure 2-1: Temporary power supply and motor replacement

2.4 Previous Organizational Issues and Initiatives

Although TEPCO's past organizational issues concerning nuclear power did not directly cause the Fukushima Nuclear Accident, we will analyze here whether the Nuclear power departments had any underlying factors pertaining to its organization that caused the incident.

(1) Main developments in the Nuclear Power Departments

a) Up through completion of Fukushima Daiichi NPS (to March 1971)

The history of TEPCO's Nuclear power departments dates back to November 1955, when the Nuclear Power Generation Section was established in the President's Office with the aim of "promoting basic research and study of nuclear power generation." With our experience of constructing and operating thermal power stations as well as that of the Japan Atomic Power Company and other institutions, we absorbed light-water reactor technology from the United States and commenced construction on Unit 1 at the Fukushima Daiichi NPS in January 1967. Despite the suffering of numerous initial problems, operation was commenced in March 1971. Although this project was delivered as a turnkey system by GE (blanket order: GE bearing full responsibility from designs until commencement of commercial operation), the vendors, Toshiba and Hitachi, had the responsibility for machinery and electric-related construction. Following this, a technical assistance agreement, which included know-how about reactor core design technology and relevant mechanical, was concluded, and the way was paved for domestic production of Unit 2 and later construction.

b) Improved standardization plan (1975- 1986)

In addition to TEPCO's Fukushima Daiichi NPS, commercial light water nuclear power stations in the early days in Japan were constructed through the introduction of technology from the United States. Over the approximately 10 years after the technology was introduced, experience in construction and operation was gained and led to diligent domestic production. However, until around 1975, the emphasis was on assimilating the introduced technology.

While experience was being accumulated in Japan through manufacturing, construction, operation, and maintenance of equipment for light water nuclear power stations, problems and flaws in operation and maintenance, such as stress corrosion cracking (SCC) in boiling water reactors (BWR) and damage to steam generator tubes of pressurized water reactors (PWR) also attracted attention, and the initial capacity utilization rates were not achieved. In order for light water reactors to fulfil their role as a stable, economical, and long-term source of energy, it was believed that improvements in "equipment automation," "radiation exposure reduction measures" and other such areas should be made, and the technology for light water reactors should be established in a way that was uniquely suited to Japan. By implementing these improvements and promoting standardization with these, it was expected that reliability and economic efficiency would be improved, along with more efficient licensing and approval procedures. Thus, the public and private sectors came together to start the "First Improvement and Standardization Program of Light Water Reactors" in the 1975, and the "Second Improvement and Standardization Program of Light Water Reactors" in 1978. The plan was promoted for 800,000 kW class and 1,100,000kW class BWR. TEPCO sequentially incorporated the results of improved standardization into Unit 2 and later units in Fukushima Daini NPS.

Although efforts were made to reduce radiation levels as well as improve reliability and workability through improved standardization, the work was basically limited because it fell within the scope of GE's basic designs, and it was felt that there was a limit as to how much improvement could be made. In parallel with the improved standardization being promoted, from the late 1970s, TEPCO gathered creative ideas from manufacturers around the world. We determined that it was necessary to develop technologies with the aim of having the best conceivable BWR plants at that time, and we began joint research with these manufacturers. Through a series of studies implemented since, technology development has been promoted by focusing once again on the development of a plant concept which, among other things, reduces the probability of a core meltdown. This result was incorporated into the Third Improvement and Standardization Program (1981 to 1986).

c) Development of passively safe reactors (latter half of 1980s and after)

Meanwhile, in light of the lessons learned from the accident at the Three Mile Island (TMI) Nuclear Power Station, there was an increased interest in reactors which were highly safe as well as easy to operate and maintain. GE designed and developed a simplified boiling water reactor (SBWR) with a 670MW class plant. Moreover, partly due to the Chernobyl accident in 1986, safety had been improved through the simplification of facilities, equipment and structures, including the complete adoption of passively safe designs and the employment of a natural circulation core. In Japan, using the American design as a basis, studies were carried out with a view toward increasing capacity, but these did not lead to implementation in actual plant designs or construction.

d) ABWR development and construction (latter half of 1980s to July 1997)

With the results of the Third Improvement and Standardization Program (1981 to 1986), TEPCO decided in 1987 to adopt the ABWR for Units 6 and 7 at the Kashiwazaki-Kariwa NPS. After the licensing and approval process for the initial unit, construction on Unit 6 began in 1991. While initially experiencing problems, we commenced commercial operation of Unit 6 in 1996 and Unit 7 in 1997. Later, despite several setbacks, the company achieved improved reliability and economic efficiency, achieving a good track record by the 2000s.

e) Efforts to develop next-generation reactors (latter half of 1990s to first half of 2000s)

Since the latter half of the 1990s when the prospects for ABWR construction had started to materialize, the development of next-generation reactors was initiated with the aim of achieving further improvements. TEPCO also participated in research and development of the ABWR-II. Based on the ABWR technology which was nearing completion, research and development proceeded on what would follow the ABWR as a large capacity light water reactor for the future. Incorporating passive safety designs such as a core-catcher and passive containment cooling system (PCCS), the aim was to improve safety to a level equivalent to or better than that of the ABWR, but the foremost goal of the development was to increase economic efficiency. The focus was mainly on increasing plant output while, at the same time, aiming to reduce material volume by making fuel assemblies and control rods larger, introducing a functional control rode drive mechanism, and reducing the number of valves through increased size of the safety relief valve (SRV). Hardly any consideration was given to backfitting existing reactors in regard to safety design.

f) Stagnation in development of technology after ABWR construction (from latter half of 1990s)

The construction projects of new plants after Units 6 and 7 at Kashiwazaki-Kariwa NPS adhered to the design of Unit 6 and 7 of Kashiwazaki-Kariwa NPS, and projects moved forward for Units 7 and 8 at Fukushima Daiichi NPS and Units 1 and 2 at Higashidori NPS (construction has only begun on Unit 1 at Higashidori NPS). However, factors such as "strong demands to reduce cost" and "design changes based on external requests," in addition to "project delays due to the external environment," created an environment in which technological consideration for further improvement in safety could not be enhanced, as explained below:

- Period devoted to cost reductions

  In the mid-1990s, instructions were even issued to the extent that "construction cannot be undertaken unless the cost of constructing the next nuclear power station is more competitive than advanced combined cycle (ACC) thermal power." The entire Nuclear Power Construction Department worked to decrease costs. Design changes, such as "design standardization and previous reactor copying," were avoided and procurement methods, such as "competitive ordering" and "separate ordering," were devised. As a result, although ensuring safety was a prerequisite, reducing costs became the pillar for technological reviews and the central focus was on reducing material quantities. During this period, we failed to actively and thoroughly pursue on our own the reinforcement of facilities to improve safety.

- Loss of flexibility in design due to a protracted licensing and approval process

  In 2000, the environmental impact scoping document was submitted to the central government from the Higashidori NPS. At this time, the site configuration, ground leveling height, reactor core position, major building arrangement, water intake and discharge positions, and port configuration had been determined. Later, due to the external environment, it took 11 more years until construction began in January 2011, requiring great effort and a long time to gain licensing and approval. As a result, our mentality was that "the design cannot be changed here because it is subject to licensing and approval" or "requesting for a design change here would take many years until for approval." Thus, we did not actively try to incorporate new knowledge.

Despite this situation, there have been instances of "learning from experience," such as changing the structure of the reactor building to "incorporate lessons learned from the Niigata-Chuetsu-Oki Earthquake" and changing the design of the Higashidori NPS to one in which the seismic tolerance exceeded approved levels.

g) Implementation of large improvement works

During the period before and after completion of plant construction, efforts such as "construction of a concentrated environment facility, "shroud[20] replacement," "augmentation of emergency diesel generators," and "expansion of the spent fuel pool (SPF)" were implemented mainly at Fukushima Daiichi NPS. However, with the exception of "shroud replacement" (the world's first such project was completed at Fukushima Daiichi NPS Unit 3 in 1998, and later performed at Fukushima Daiichi NPS Units 2, 5 and 1), these were one-item work projects that had little effect on "improving TEPCO's technological capabilities" compared to other construction work. Also, efforts to address technical research issues included the following, and involved the "extrapolating of precedents from other countries" and "additional assessments to improve the nature of explanations." Any contribution to the "improvement of technological capabilities" was limited.

- Introduction of plutonium thermal technology (first introduced at Fukushima Daiichi NPS Unit 3 in 2010)
- Introduction of rated thermal power output (first operation at Kashiwazaki-Kariwa NPS Units 2 and 5 in May 2002)
- Long-term cycle operation (not yet introduced but intended for introduction at the Fukushima Daini NPS)
- Introduction of plant life management (PLM) (mandatory beginning in 1999)
- Implementation of periodic safety reviews (PSR) (conducted since 1994 in accordance with a request from the Agency for Natural Resources and Energy)

However, it can be concluded that, depending on the management, these initiatives could have been viewed as opportunities to "set forth issues and solve them," and could have actively contributed to "improvement of technological capabilities."

h) Main problems experienced after the start of operations (until the cover-ups in 2002)

In addition to the "plant construction" mentioned above, much of the technological capability and dialogue skills of TEPCO's nuclear power departments have been affected by "responses to problems," which were experienced during operation. The main problems (including those of other companies) are as follows:

i. Stress corrosion cracking (SCC)

Stress corrosion cracking (SCC) was confirmed in the United States in 1974, and many cases have also been verified in Japan. Because it was thought that SCC was caused by a combination of the three conditions of material, stress and environment, our understanding at the time was that responding with a change of material would be a sufficient countermeasure. Thus, we adopted a policy of sequentially replacing SUS304 type material with the SUS316L type material. As the reactor internal structure and primary loop recirculation system piping (PLR piping) were the main targets of this change in material, the measure required large-scale work and a long-term shutdown of plant operations. As a result, the facility utilization ratio of TEPCO's nuclear power stations for fiscal 1975 fell to approximately 19%.

However, SCC was later confirmed in SUS316L type material as well, confirming the importance of reconsidering SCC measures not only from a materials aspect, but also from the aspects of stress and environment. Consequently, numerous efforts were made in research directed towards elucidating the mechanism behind SCC and developing technology to serve as a countermeasure. Currently, by simultaneously advancing countermeasures for material, stress and environment, reports of cases, in which damage has been due to SCC, have decreased significantly. In addition, when problems involving SCC were found, regulatory authorities always demanded measures to maintain design performance, and we had no option

[20] A reactor core support structures that separate the flow of water going from the bottom to the top of the reactor core and the flow of water that goes from the top to bottom outside the core.

but to shut down plant operations for a long period each time these countermeasures were be implemented. This was one of the underlying reasons which led to the cover-ups revealed in 2002. After this, maintenance guidelines which reflected knowledge of fracture mechanics and took into account aging were approved in 2003. Although this led to reasonable maintenance activities later on, the reduction in the capacity utilization rate on account of the implementation of SCC measures continued to be perceived as a significant management challenge.

ii. Accident at Three Mile Island (TMI) Nuclear Power Plant (1979, INES level 5)

This was an accident in which operator error and design flaws caused a reduction in primary coolant, exposing the reactor core and damaging the fuel. Following this accident, general inspections were implemented at nuclear power stations in Japan, and it was confirmed that there was no possibility of a similar accident occurring in Japan. However, to ensure safety to an even greater degree, operator education, training, and other measures were further enhanced. Also, a special investigation committee established by the Nuclear Safety Commission (NSC) identified items to be reflected in safety assurance measures, and these items were later reflected in safety standards, safety reviews, safety designs, operator management, and other areas.

iii. Chernobyl accident (1986, INES level 7)

Design defects and multiple operating rule violations led to a sudden increase in output, which caused fuel failure, hydrogen explosions, black smoke fires, and the release of a large quantity of radioactive material into the atmosphere. Unlike in Japan, the design of the Chernobyl power plant differed greatly from that of Japan's reactors in that the nuclear reactor itself did not have positive self-regulating capability (fission reactions were controlled in due course when output increased), there was no containment vessel as well as other disparities. However, this accident not only spurred much debate about the importance of "safety culture" in various aspects including design, construction and operation of reactors, but it also led to the formation of the World Association of Nuclear Operators (WANO) in order to promote the widespread adoption of a safety culture.

iv. Damage to the PLR pump submerged bearing of Unit 3 at Fukushima Daini Nuclear Power Station (1989, INES level 2)

The submerged bearing ring failed during operation as were multiple other components, and damaged components and metal powder flowed into the reactor. The fact that the reactor had been operating for six days following the event was also a problem. Countermeasures were implemented, such as "improvements to the bearing structure," "reassessment of the operating manual," "strengthening of response to indications of abnormalities," and "safety management enhancement." The unit was restarted in November 1990.

v. Leakage of seawater into building at Fukushima Daiichi NPS Unit 1 due to seawater system piping rupture (reactor manual shutdown) (1991, INES level 0)

Seawater bubbled up through the floor in the motor-driven feed water pump room on basement level 1 of the turbine building (T/B), and seawater seeped from the conduit tube pit through a conduit tube to infiltrate a broad area, including the heat exchanger area of the auxiliary cooling system in the T/B, the shower drain receiving tank area, the triangular sink tidy in the reactor building (R/B), and the common emergency diesel power generator room for Units 1 and 2. The diesel generator stopped functioning due to the water inundation, and needed to be taken to the factory for repair. The cause was leakage from a penetration whose thickness had been reduced due to corrosion in the auxiliary cooling water system seawater pipe laid under the floor of the motor-driven feed water pump room. Two months were required until the reactor could be restarted. Although internal and external events differ, the accident, which was similar to the Fukushima Nuclear Accident where facilities were damaged by flooding, had actually occurred.

vi. Automatic scram caused by low reactor water level in Unit 2 at Fukushima Daiichi NPS (1992, INES level 1)

When inspecting the high pressure condensate pump power panel on standby while the reactor was in operation, workers forgot to remove the temporary testing fixtures when performing recovery operations, resulting in all high-pressure condensate pumps shutting down and a loss of all feed water. This resulted in a decrease in the reactor water level which triggered an automatic scram of the reactor, and one of the emergency core standby cooling systems (i.e., HPCI) was activated. Because these human errors, including workers conducting operations without any procedures on hand and an imperfect handover between personnel, started the emergency core standby cooling systems, this event invoked considerable social concern.

vii. Criticality accident at JCO Uranium Fuel Processing Facility Plant (1999, INES Level 4)

When processing fuel for a fast experimental reactor, an illegal procedure for handling uranium nitrate was used in order to decrease work time, resulting in a criticality that left two employees dead and the issuance of a temporary evacuation advisory for residents in the area surrounding the facility. Possible reasons for the accident included "imperfect awareness of criticality" and "worker management problems, such as problems in human resource allocation and training." This accident became the impetus for formation of the Nuclear Safety Network (NS Net), a group of 36 companies in the nuclear power industry, assumed a role in conducting peer reviews, engaging in activities to disseminate a culture of safety, and communicating information about safety as well as other efforts from the standpoint of "sharing a culture and climate of safety.” Later, in March 2005, as the environment surrounding nuclear power was undergoing considerable change including progression in liberalization of electric power, introduction of new safety regulations for nuclear power, and the wavering of society’s confidence due to TEPCO’s concealment of problems, the entire nuclear power industry assembled all of its strength to work to further improve voluntary safety activities, ensure safe and stable operation, and restore society’s trust in nuclear power, so the Japan Nuclear Technology Institute (JANTI) was established, which absorbed NS Net. In addition to the peer reviews conducted by NS Net, JANTI also assumed the role of developing commercial standards.

viii. TEPCO’s cover-ups

On August 29, 2002, TEPCO disclosed that problems had been covered up. In September of that same year, an investigation report was released which stated that 29 items concerning voluntary inspection work records were investigated based on 2 matters reported by GE. Although there were no problems with facility safety, 16 items had been inappropriately handled and 13 items could not be confirmed as having been handled inappropriately. That aside, in October of the same year, we also published a report related to the impropriety of PCV leak rate inspections in the 15th and 16 periodic inspections of Unit 1 at Fukushima Daiichi NPS. In light of the fact that an impropriety had actually been committed in a national inspection, the Nuclear and Industrial Safety Agency ordered that operation of Unit 1 be suspended for one year. Later, plants were gradually shut down so that inspections could be conducted once again at all TEPCO units to check for PCV leaks, and all units were in a state of shutdown on April 15, 2003.

As a result of this, a general inspection was conducted of voluntary inspection work records to check for any inconsistencies with contractor report records in TEPCO's records over the past 10 years for reactor pressure vessels (RPV) and reactor internal structures as well as in records of recent full-scale inspections for other items. This inspection took approximately 5 months, mobilizing a total of approximately 14,800 people. The final report on the general inspection was released at the end of February 2003. In response to this cover-up, the president and five executives resigned and there was a loss of trust from society and, particularly, the siting communities. At each nuclear power station, visits were made to each household in the siting community to apologize. Later, reactors were gradually restarted beginning in May 2003, but the community response continued to be severe, and the plans to plutonium thermal technology for Unit 3 at Fukushima Daiichi NPS and Unit 3 at Kashiwazaki-Kariwa NPS ended up having to be rescinded.

Also, three years later in November 2006, it was announced that data on seawater temperature for Units 1 and 4 at Kashiwazaki-Kariwa NPS had been falsified. At the time, a thorough investigation was conducted to reveal whether or not there were any similar instances throughout the entire company. In April 2007, disclosure was made of the investigation into inappropriate actions, the reasons why they had not come to light during the 2002 general inspection, and measures to prevent any recurrence of such issues. The recurrence prevention measures included having a "culture of no misconduct" and "mechanisms to prevent misconduct," which were measures implemented in response to the 2002 concealment of problems, but also the addition of a "mechanism for speaking out" as a new countermeasure. Although these measures aimed at strengthening compliance with laws and regulations, corporate ethics activities, and ensuring transparency, they promoted a climate of placing manuals above anything else, and did not encourage the initiative for proactive reform through drastic changes to the status quo.

i) Safety design of Fukushima Daiichi NPS

Comparing the accident countermeasures in the application for an establishment permit for the Fukushima Daiichi NPS with the Fukushima Nuclear Accident, the safety facilities, which it was explained would operate during an accident, lost almost all function after the tsunami because ample consideration had not been given to preventing common factor failures attributable to external events, which gave rise to a severe accident in which there was core meltdown and the release of a large amount of radioactive materials over a wide area.

On the other hand, after the construction of Unit 1 at Fukushima Daiichi NPS, various successive improvements were made to the subsequent units, but updating (backfitting) of facilities and other equipment to conform to the most recent guidelines was almost never implemented. For example, an emergency system power facility had been separately and independently established in each category of safety system from Unit 6 and later at Fukushima Daiichi NPS. However, the earlier units were left as they were without separating the location where the facility was placed. The reason for this is inferred to be the view held by many of the personnel involved in the facility formation and maintenance that there was no space, which is resistant to an earthquake, for separating the installment location inside the building, and that a conversion work, in which a new building would be constructed and cables laid, would cost a tremendous amount of money, and such an extent of effort for construction was unnecessary.

j) Changes in organization of the nuclear power departments

Organization of the nuclear power departments has undergone the following transitions in response to changes in the environment and the cover-up of problems.

<Head Office organization>

December 1965 Nuclear Power Development Division established (comprised of the

	Nuclear Power Department and Nuclear Power Development Laboratory)
June 1974	Nuclear Power Dept. reorganized into three Depts.: Nuclear Safety Dept., Nuclear Construction Dept., and Nuclear Management Dept.
June 1981	Three Depts. reorganized into the Nuclear Affairs Dept., Nuclear Management Dept., Nuclear Construction Dept., Nuclear Fuel Dept., and Health & Safety Center
June 1985	Reorganization into the Nuclear Power Division (comprised of the Nuclear Affairs Dept., Nuclear Power Generation Dept., Nuclear Construction Dept., Nuclear Fuel Dept., and Health and Safety Center)
June 1996	Discontinued the Health and Safety Center and reorganized it into the Nuclear Planning Dept., Nuclear Management Dept., Nuclear Engineering Dept., Nuclear Fuel Dept., and Nuclear Engineering Center
October 2002	Established the Nuclear Quality Management Dept. (monitoring division independent of the Nuclear Power Division)
June 2004	Reorganized into the Nuclear and Plant Siting Division (comprised of the Nuclear Power & Plant Siting Administrative Dept., Nuclear Engineering Quality & Safety Dept., Plant Siting and Regional Relations Dept., Nuclear Power Plant Management Dept., and Nuclear Fuel Cycle Dept.)
April 2007	Nuclear Engineering Quality & Safety Dept. reorganized into the Nuclear Quality & Safety Management Dept. and the Nuclear Asset Management Dept.

<Power station organization>

January 1995	Introduced training shift to shift operators and divided into six teams
March 1995	Established (former) Maintenance Dept. that monitors and inspects work with periodic inspections of each facility and system, and, within Operations Dept., set up unit management groups to conduct daily maintenance and procurement-related work for each unit. In addition, Safety group reorganized into Radiation Control group and Environmental Chemistry group according to each unit.
January 2004	Established Quality & Safety Management Dept., and reorganized (Former) Maintenance Dept. (unit management functions consolidated in the Maintenance Dept.); Splitted Maintenance Dept. into First Maintenance Dept. and Second Maintenance Dept. (Fukushima Daiichi NPS and Kashiwazaki - Kariwa NPS) ; Duties related to safety in Engineering Dept. transferred to Quality & Safety Management Dept.
July 2004	Established the position of unit superintendent. Engineering duties including fuel, security, plant status monitoring as well as operation and maintenance transferred to under control of the unit superintendent. Splitted Operation Dept. into First Operation Dept. and Second Operation Dept. (Fukushima Daiichi NPS and Kashiwazaki-Kariwa NPS)
January 2008	Operators Shifts are changed from three rotations to two rotations, and Work Management Groups are established

Although it cannot be said that such organizational changes were factors in this accident, despite the augmented organization and personnel which was traces its origin to the 2002 cover-up, there was no relief from the work pressure, and those changes did not lead to improve motivation nor stimulate any improvement activities. Also, a new issue emerged in that there were no clear Head Office counterparts for these organizational changes from the view of the power stations.

k) Summary from a technological perspective

As stated, the technological capabilities of the TEPCO's nuclear power departments have been developed mainly through plant construction [a) through d)], research and development [e) & f)], g) large-scale improvement work, h) responding to accidents and problems, i) safety design and j) organizational transitions in the nuclear power departments. But there have been the following sorts of problems.

Problem (Organizational -i): It has been surmised that efforts at TEPCO to improve safety, namely the reflection in Fukushima Daiichi NPS of the safety measures (for example, physical isolation of emergency power generation apparatuses) adopted at Fukushima Daini NPS and Kashiwazaki-Kariwa NPS which have superior safety designs, were not implemented as a large number of nuclear power division personnel believed that "such efforts would be enormously costly to realize."

Problem (Organizational -ii): Plant construction ceased after Unit 7 was constructed at the Kashiwazaki-Kariwa NPS, and, despite the concern about a decline in technological capability, effective measures were not adopted.

Example: In regard to the acquisition of skills for ABWR construction, although TEPCO welcomed and stationed personnel from other electric utility companies at its power stations, almost no TEPCO personnel were dispatched to construction sites of other electric utility companies (only the short-term stationing of personnel during the construction at Chugoku Electric Power Company's Shimane Unit 3). In addition, after becoming aware of this problem, TEPCO instituted core skills including the acquisition of skills for facility diagnostics and direct management of maintenance operations, but reviews have taken time and have not reached a point where sufficient results have been achieved.

Problem (Organizational -iii): In responding to accidents and problems, TEPCO has committed huge resources for "overall inspections," "recurrence prevention measures," and "horizontal development," yet priority has been on preventing the recurrence of accident and problems, which has not led to improvements in safety such as the accumulation of defense in depth, but just an increase in work load.

Problem (Organizational -iv): It has been pointed out that for large-scale improvement work as well as addressing accidents and problems, TEPCO consulted with manufacturers and had little desire to attempt to create a design on our own. Supervisors would also instruct subordinates to confirm matters with the manufacturer, which increased our dependence on manufacturers.

Problem (Organizational -v): The organization was reformed in response to cover-ups and changes in the environment, but the demerits of reorganization were more prominent than the merits. In particular, as operations under the charge of the Head Office organization expanded, the expansion into a six department system resulted conversely in demerits arising such as delays in efforts to address cross-organizational issues, and uncertainties about Head Office counterparts as viewed from the standpoint of the power station.

(2) OSART, WANO and JANTI Peer Reviews and Nuclear Power Quality Audit Efforts

External reviews of nuclear power stations include OSART conducted by the IAEA, peer reviews by WANO, and peer reviews by JANTI. Prior to this accident, TEPCO's nuclear power stations underwent the peer reviews listed below (excluding follow-ups).

Fukushima Daiichi NPS	IAEA: 0, WANO: 2, JANTI: 2
Fukushima Daini NPS	IAEA: 1, WANO: 1, JANTI: 2
Kashiwazaki-Kariwa NPS	IAEA: 1, WANO: 2, JANTI: 0
Head Office	WANO: 1 (corporate peer review)

In these external reviews, TEPCO obtained a number of different items for improvement mainly pertaining to operations, maintenance and radiation control, and has since implemented measures for improvement for each of those items. However, if there were improvements related to radiation control, such were limited to personnel involved with radiation control and there was no shared awareness throughout the nuclear power-related sections toward learning independently to make improvements, such as exploring processes for improvement, inquiring into the underlying factors of problems and recognizing such improvements as successful practices.

In addition, the Nuclear Quality Management Department was established, which is an internal audit organization independent of the nuclear power departments and created in the remorse over the 2002 cover-up, which was the "issue of misconduct related to TEPCO's voluntary inspection records (falsification of shroud inspection records, etc.)," and the department conducted internal audits in connection with safety and quality. These internal audits involved inspecting operational quality, and themes were decided on and audits conducted which cut to the crux of the matter (degree to which Nuclear Safety Senior Engineer can accomplish their duties and the status of organizational revisions [establishment of unit superintendant]). During these audits, checks were performed from the standpoint of ensuring quality and safety during periodic inspections and operation in accordance with manuals and other guidelines, and the audits going back to the design and prior preparations for dealing with a severe accident were not carried out. In the audit results, there was nothing that got to the heart of the intrinsic management problems so that problems with the former nuclear power management would be brought to light, such as "why such a situation would arise?" or "why the situation was left without a solution being found?"

On the other hand, for the Nuclear Power & Plant Siting Division which was being audited, it became a situation where there was always some sort of review or audit being carried out. Consequently, doubts remain about just how seriously the division took the results of the outside reviews and the results of audits by the Nuclear Quality Management Department, and whether it even tried to make improvements. Also, employees felt that follow-up inspections in connection with the indicated items were putting pressure on their normal operations, so instead they seemed to focus on not getting any indicated items to deal with in the first place, rather than trying to make improvements by using the indicated items. In cases where an item was actually indicated, personnel would appear to neatly deal with the matter in some manner or other. Consequently, the initiative toward seriously engaging in safety related discussions through review and audits, or taking seriously matters indicated by those outside the company was not ample.

Problem (Organizational -vi): There was an insufficient attitude toward wanting to actively learn on our own and make improvements through reviews, audits and other checks by outside organizations.

(3) Previous Efforts Connected with Reform Activities

a) Reforming the corporate culture

Given the background of a series of problems that include the falsification of nuclear power plant pipe welding data (1997) and the falsification of spent fuel transport container data (1998), TEPCO established in 1998 the Cultural Reform Review Committee, comprising executives and general managers of the relevant sections and headed by a managing director as chairman. The committee investigated in depth the corporate context and culture to ascertain problem areas and reviewed background analyses and countermeasures. In April 1999, it came up with a four-point company-wide action plan for reforming corporate culture that called for “improving openness,” “listening to the voice of society,” “shaping up our own house,” and “getting all employees to participate.” Furthermore, in April 1999 and May 2000, cultural reform campaigns were implemented to set about developing an environment in which management and employees could have a direct dialogue, conducting training to thoroughly instill morality and manners of each and every employee, as well as other activities. From the standpoint that "continual reform of awareness is needed” for reforming our corporate culture, in March 2001, this cultural reform progressively incorporated the “action principles (feel, think and practice)” of the “management vision” (announced on March 29, 2001), which was enacted to indicate the direction that TEPCO should aim toward.

Despite such efforts, the cover-up was exposed in 2002, and the following comments regarding this situation were noted in an internal report that was released in September 2002.

> "Company-wide, TEPCO has achieved a certain level of effectiveness, and, in the nuclear power departments as well, we can also say we were effective in that we were motivated in our decision to make public the day to day existence of things that we had kept quiet about and to fix those matters as in the case concerning the Fukushima Daiichi NPS Unit 1 reactor core spray sparger (the decision had been made to replace the shroud during the next periodic inspection, which would not have been announced before with our previous mindset), but, on the other hand, we did not go as far as to make public every single detail from the past.”

Consequently, though it produced some results, the corporate cultural reform of 1998 was thought to be nothing more than a rallying cry which did not lead to fundamental reform. There was a tempering of just how bad the situation and not enough soul-searching into fundamental causes, so improvement measures were to be widely applied to everything in general and come to be taken for granted. Therefore, it is presumed that these efforts at corporate cultural reform merely imposed idealism and did not lead to actual reform.

b) Nuclear renaissance activities

At the time of the 2002 cover-up which was the “issue of misconduct related to TEPCO’s voluntary inspection records (falsification of shroud inspection records, etc.),” nuclear renaissance activities were launched having as their purpose making recurrence prevention measures more widespread and becoming an outstanding world-class nuclear operator. Those efforts proceeded mainly on two fronts: the Leadership Development Exchange (LDE), which promoted the reform of individual awareness which would serve as the foundation for change, and “operation process improvement activities (peer activities),” which were cross-organizational activities aimed at building common processes for the three nuclear power stations.

The LDE was implemented as off-JT training in which the employee was away from his or her regular duties for one to two weeks for the purpose of raising the awareness of trainees by providing the skills necessary to accomplish reforms (communication skills and problem-solving techniques). This training was carried out continuously until March 11, and the degree of satisfaction of students surveyed was high according to questionnaires completed by the students. Thus, the quality of the training itself is thought to have been high. Moreover, the communication skills, requisites for leadership and other things that the students learned in the training are thought to have possible use as tools for reform by encouraging their reuse, e.g., creating opportunities for employees to refresh the content of what they learned even now after a certain time had passed since training. In that alone, those skills can be rated as having had a high value. Nevertheless, even though the LDE resulted in a very good training program, as the years went by hardly anybody from the former nuclear power management came to observe the sessions. The LDE did not get strong support, and actual specific use of the skills by the students was not sufficient.

Next, there are the peer activities. These activities were aimed at reassessing the work processes concerning maintenance, operations and other duties that are common to the three nuclear power stations while using examples for each type of job from other countries and then raising the standard of each to a world-class level. Those activities enabled systematic preparation for periodic inspections, such as scheduling periodic inspections and planning safety measures, and left a certain level of results that included reduced exposure to radiation by means of prioritized work management of jobs and work sites where there were high levels of radiation, and fewer non-conformities through analyses of human error. However, the actual state of those reviews was such that most cases required a great deal of time to be spent coordinating matters among the nuclear power stations, divisions, and groups. That has resulted in the redefinition of world-class level work processes and difficulty with the gap between that and the goal of executing the particular processes. We can look back and say that it would have been better if there had been more priority placed on the standardization and implementation of the process and a greater emphasis on the concept that each power station actively adopt other power stations' processes, rather than sticking only to its own process. In addition to that, there have been comments such as "we could not get approval for our plans to implement improvement activities, so we did not move into executing those plans"; "we did get approval, but later it was left entirely up to the improvement activities study group"; "along the way, nuclear management personnel did not show up." Also cited as problems were that former nuclear management-level personnel did not fully share in the basic plan to standardize processes, and that there was no visible sponsorship or commitment.

In addition, while these efforts were proceeding, in conjunction with the vision of nuclear renaissance activities which was set as "aim to be a trusted nuclear power station having the world's highest standard for safety and quality," TEPCO specified targets to be intensively addressed in line with the management vision (risk management, systematic operation execution, appropriate management of non-conformities, and good relations with local communities). The specific operations for each of the targets were incorporated into the operation plans in nuclear power departments and it was clarified which operation should aim for what. Furthermore, activities were undertaken to bring about continual improvements by presenting goals to be aimed at for the respective targets, setting indices to measure the results of each and periodically verifying the progress. The performance review meetings, which were held on a continuing monthly basis at each power station, were the implementing entity, and the evaluation was that a certain level of results had been achieved.

Thus, by raising individual awareness about reform through nuclear renaissance activities (LDE), improving work processes (peer activities), and constructing a framework for management which monitors progress and strives for overall optimization (performance review council), a certain level of results were achieved, but problems were found in "utilizing LDE students" and "how nuclear power management should participate in LDE and peer activities."

Furthermore, these activities turned into long-term efforts, but in the background behind these efforts was the fact that workloads had increased because of tightened regulations for central government-led safety management reviews and safety inspections on account of the cover-ups and other problems which had been the origin of the nuclear renaissance activities. Whereas, there had been no progress in discussions as to how to rationally proceed with the work in question, scrapping other work duties, and so forth, which resulted in shifting the burden to the improvement activities and a commitment of resources that was not ample.

Problem (Organizational -vii): Management was imperfect in actively utilizing LDE trainees and others having a strong desire for reform nor did it accelerate the speed of improvements to address issues, which cut across the organization, by breaking down organizational barriers.

Problem (Organizational -viii): The Head Office departments for the Nuclear Power Division and the nuclear power stations were unorganized, unable to indicate a specific direction, nor could they forcefully promote improvement activities. In addition, no one took responsibility if the schedule for improvement activities, results of those activities, or other matters did not proceed as laid out in goals.

c) Introduction and reinforcement of the quality management system

In 2002, the cover-ups were exposed, which were the "issue of misconduct related to TEPCO's voluntary inspection records (falsification of shroud inspection records, etc.)," came to light, and as recurrence prevention measures based on this series of issues, regulations were revised concerning the installation, operation and other aspects of commercial power-generation reactors, and safety activities grounded in Quality Management System (QMS) became mandatory. Building upon this, TEPCO rearranged work processes into operations, maintenance, radiation control and other processes, and, in accordance with JEAC4111 (Quality Assurance Rules for Safety at Nuclear Power Stations), prepared manuals that would enable determinations to be made about meeting requirements by referring to the manual.

From the viewpoint of not only satisfying quality assurance requirements but also being more rigorous about work after the cover-ups, a thick manual specifying everything from detail processes to evidence was created at this time. As a concrete example, in the manual concerning management of non-conformities, TEPCO constructed same-level management processes which did not depend on the severity of an accident. For example, no matter how many times a particular non-conformity occurred or was discovered, it would be managed and announced. As a result, there was an over commitment of resources to insufficient non-conformities that were only stopgap measures and not safety issues.

On the other hand, because QMS was incorporated into the technical specifications, nuclear power stations were subject to four safety inspections annually which emphasized QMS validation. The safety inspections involved examining the documentation of each individual manual and evaluating the state of safety at the nuclear power station based on the state of that performance. Because any mention of JEAC4111, which provides for QMS, in those evaluations was qualitative in nature, guidelines for evaluating QMS were not clear. Along with that, on the discretion of the safety inspector, comments and instructions were received that were thought to be cases where a low level of importance was attached to safety as viewed from the standpoint of the operator. By working to improve each individual quality assurance issue, there was not ample discussion with regulatory authorities concerning approaches to preventing even bigger safety problems, and the situation was not one in which there was sufficient understanding on the operator side nor an effective commitment of resources.

Despite the situations described above, we had to raise the level of our technological capabilities and improve safety. However, because the directives and instructions given in the safety regulations were directly related to legal requirements, we came to deal with the situation by concentrating on manual preparation and evidence creation as a way of handling quality assurance. Furthermore, QMS in nuclear industry defines "people" and "nuclear safety regulations who is mandated by people" as "customer", resulting in a tendency to think that it was sufficient to follow the directives of the safety inspectors, or, in other words, to just satisfy regulatory requirements.

Problem (Organizational -ix): The introduction of QMS efforts was motivated by the cover-ups and other problems, and the emphasis of those QMS efforts was to restore trust. In particular, TEPCO tried to improve safety by rigorously implementing measures to deal with each individual non-conformity, but many resources were diverted to such work, and the efforts did not lead to the kind of safety improvements that would have prevented or mitigated the Fukushima Nuclear Accident.

Problem (Organizational -x): Because of technological capability not being ample to be able to conduct a dialogue with regulatory authorities, TEPCO avoided serious discussions with regulatory authorities and, while aware of the problem of just how important QMS was (the corresponding degree of improvement in work quality was low, despite the many rules and large amount of evidence), effective improvements were not implemented. On the other hand, it is possible that a climate was created in which it was all right to perform an operation according to the stipulations specified in the manual

d) Personnel exchanges among departments

Since the soul searching over the 2002 cover-ups, personnel exchanges between the nuclear power departments and other departments have been actively carried out for the purpose of ensuring transparency. The public announcement given at the time was as follows.

Personnel exchanges will be actively conducted to develop balanced personnel who are not biased toward only nuclear power (2002 -) - Along the career path to managerial positions in the Nuclear Power Division, it will be mandatory for all personnel to have operational experience outside of the division (Initially, over a period of three years, the aim is to have 50% of newly appointed managers with experience in other sections, and to raise that percentage to 100% in the future.). - Between the Nuclear Power Division and thermal power & engineering divisions, personnel exchanges and transfers of engineering personnel will be implemented for personnel in mid-level up to managerial positions. - Personnel exchange will be implemented between the Nuclear Power Plant Management Department and Nuclear Power Engineering Department at the Head Office for all positions, as well as among maintenance, operations, engineering and other nuclear power station groups. - Within three years after joining the company, younger nuclear engineers must undergo training in front line sales or other operations which are a point of contact with customers.

As a result, the percentage of new management positions occupied by people with experience outside of the division was an average 15.3% between 2002 and 2004, and an average 39.8% between 2002 and 2010 (maximum 62.9% in 2008). In addition, evaluating the results of exchanges with other sections by the number of personnel exchanged showed that up to just before the Fukushima Nuclear Accident, the number had risen to a total of 207 people over the period 2002-2010.

- Nuclear division >> other divisions: 94 people
  (engineering, 35; distribution, 25; thermal power, 25, other divisions, 9)
- Other divisions >> nuclear division: 113 people
  (engineering, 48; distribution, 35; thermal power, 30)

The aim has been to develop well-balanced personnel at each level who are not biased toward only nuclear power, and thereby break down the closed nature of the nuclear power departments and build a more open atmosphere in the company culture. Table 2-1 below gives the impressions of those who participated in the exchange as regards work and company organization.

Table 2-1 Impressions from Inter-Departmental Exchanges

Impressions of allocated division (nuclear division >> other divisions)	Impressions of nuclear division (other divisions >> nuclear division)
(-)There were few operating procedures	(-)Awareness about reducing costs is low.
(-)There was a rough-and-ready feeling.	(-)The orientation is directed toward coordination rather than technological capability.
(+)They thoroughly manage costs.	(+)Everything is left to the manufacturer.
(+)There were many opportunities to go to the field.	(+)Manuals are detailed.
(+)There is a lot of direct management, so technological capabilities are solid.	(+)There are two levels, the Head Office and the power station, so communication is clear.

Thus, it can be said that the inter-departmental exchange was effective for the participants, who made comments such as, "My knowledge about things outside of the division increased, and my perspective broadened" and, "By having people from other divisions come in, nuclear division employees had more opportunities to be interested in other divisions." Nevertheless, it was difficult for participants at the individual level to break down the closed nature of the nuclear division and to change the corporate culture. No matter how many general manager level executives participated, they become aware of the limits to which they can issue appropriate commands for organizations outside of their area of specialization. Incidentally, in regard to ensuring transparency, which was the initial objective of the inter-departmental exchange, at the present point in time the climate of concealing things that was inherent to the nuclear division is thought to have been eradicated, but it is thought that the newly adopted non-conformity management system contributed more to that than the effects of the inter-departmental exchange.

Based on interviews with those who participated in the inter-departmental exchange, no particular instructions were provided by their superiors about their mission at the time the reassignment orders were given, nor was there any follow-up during the exchange period. Nevertheless, each individual endeavored to learn the new work and make the most of his or her work experience from their original departments so as to respond to the encouragement from their original department that they would "do their very best in the other department to which they were assigned." On the other hand, since exchange personnel at the accepting organization did not have ample experience, each operation implemented OJT so as to possibly make them acquire practical work. However, there were also examples of employees who were assigned from the nuclear division to other divisions who did not fully absorb the significance of the inter-departmental exchange, saying that "being separated for 2 to 3 years from the nuclear power departments will be a loss for my career as a nuclear engineer," and "I worry about my documentation preparation skills declining."

In the wake of the 2002 cover-up, if the main aim of taking in staff from other departments was to raise awareness in the nuclear power departments, then it is to be expected that a small exchange with only certain members will have a limited effect on the organization overall. Additionally, as shown by impressions noted in Table 2-1, the impressions were drawn from within the nuclear power departments mainly at power stations, but no particular measures has been taken in response to these. On the other hand, in situations where individuals from each group were assigned unfamiliar work in areas outside of their own specialties, they had a weaker voice and less power to make their ideas known.

<u>Problem (Organizational -xi): While on one hand the initial objective of ensuring transparency was realized as a result of the establishment of a non-conformity management system, personnel exchange was vaguely carried out or without ample thoroughness such that it did not lead to any improvements in the nuclear power departments, and, as an organization, TEPCO was not able to address the situation (make improvements).</u>

In July 2003, a competent special manager, who had been working in other department, was appointed as the former General Manager of the Engineering Department, a key post at the power station, in an effort to ensure transparency. The former General Manager of the Engineering Department managed approximately 200 people in total including those in the Fuel Engineering Group and Radiation Control Group as well as the Plant Engineering Group responsible for reactor safety, trouble-shooting and overseas information. At the time when the there was no full-time Nuclear Safety Senior engineer, the former General Manager of the Engineering Department was an important post, which was the cornerstone of reactor safety. When selecting someone to fill this post, such consideration should be given first priority. In this context, it is difficult to believe that an inter-section exchange from another section, while being a competent special manager, would be able to issue appropriate commands about nuclear power safety, which is of a different dimension in terms of personnel and work safety. In fact, in an interview with a person who experienced serving in this position, he confided "I didn't think that I would be able to manage the department" prior to the organizational revision, which will be described later.

The following year in July 2004, the position of unit superintendant was established, and organizational reform was carried out that concentrates authority for plant's operation and maintenance in the position At this time, some of the functions related to reactor safety in the Plant Engineering Group were transferred to the Safety Management Group in the Quality & Safety Management Department, the functions related to troubleshooting to the Plant Operation Assessment Group in the Operation Management Department, and the Plant Engineering Group took over the other operations. With this, the name of the former Engineering Department was changed to the Engineering Management Department with a total force of 80 personnel, and the breadth of management by inter-departmental exchanges was reduced. Although this revision took into account organizational revision of each operational process, it is frequently said within the nuclear power departments that "vital functions directly bearing on plant management and reactor safety were taken out of the Engineering Management Department so that a general manager of that Department can be installed as an inter-departmental exchange post from other sections with the intent of ensuring transparency" despite there not being ample documentation or other evidence. With this, functions related to reactor safety and those for handling large projects were scattered about and lost, and the functions for commanding an overall view of reactor safety within a power station may have been made more vulnerable.

Problem (Organizational-xii): Because the initial objective of ensuring transparency was realized through the establishment of a non-conformity management system, implementing inter-departmental personnel exchange became a goal in itself, and that served to weaken functions governing safety.

e) Improvement activities for maintenance operation processes

With regard to maintenance work process, along with nuclear renaissance activities which originated out of the 2002 cover-ups, improvement activities had been carried out to realize maintenance mainly in the field as the foundation for power station operation. The three important points for improvement, which were raised at that time, are as follows.

i) Strengthening engineering functions oriented toward reliability centered maintenance (RCM)

The aim was for TEPCO's maintenance policy, which was centered on the traditional scheduled maintenance (periodic overhauls), to be converted to the reliability centered maintenance (RCM) policy in which the optimal maintenance system is selected from among scheduled maintenance (including changes in inspection intervals), condition-based maintenance, breakdown maintenance and other schemes in accordance with the degree of importance determined based on assessments of impact on the plant from a facility or equipment failure or other such reason.

First, an expert engineering team was set up at the power station to introduce and assess condition-based maintenance techniques, and an expert engineering team was established at the Head Office to formulate guidelines stipulating the requirements for maintaining reliability of facilities and equipment. Assessments were conducted based on the results obtained from monitoring facility and equipment operating condition and as-found-data on inspections. A process constructed through which those results will be continually reflected in maintenance plans, and such assessments are currently being conducted.

ii) System of field-centered administration

The aim was for TEPCO's maintenance organization to be divided into one team which would conduct operations mainly for inspection, planning and procurement, and another work monitoring team. The work monitoring team would be a combination of TEPCO and contractors (conventionally, the prime contractor) so that the monitoring work during periodic inspections, of which a high percentage was previously desk work, would be improved through a system of field-centered administration. The work monitoring team was permanently stationed at the Outage Control Center (OCC), which was located in the service building, and inspection-related information was consolidated here in an integrated manner to make improvements by directly monitoring and ascertaining the condition of equipment in the field and the progress of work in the field as well as by reliably collecting information on the performance processes, records of work performance, records about quality and so on.

iii) Introduction of IT for operational support

In order to reliably implement RCM, it is important to efficiently collect an enormous amount of data on condition-based maintenance and evaluate it. So, the aim was to maintain an equipment master database, which would serve as the foundation, as well as to construct and maintain an inspection history database, which would coordinate with the master database.

With regard to a), although monitoring results and as-found-data on inspections pertaining to the operating condition of facilities and equipment were accumulated, this did not lead to specific results, such as the implementation of a change from scheduled maintenance to a more appropriate maintenance scheme which would have reduced inspection resources. One of the causes cited was that the initial plan called for work to reduce inspection resources while conducting RCM evaluations to optimize the maintenance specifics for equipment with low maintenance priority. However, following the central government's revision of the inspection system, the specifics for maintenance of equipment having a high maintenance priority had to be consolidated. With regard to b) and c), because there was a broad range of comments from the former nuclear power management in regard to proceeding with the project, the project itself continued for a long period of time

Also, along with the passage of time, assessments about its success or failure were ambiguous, and the locus of responsibility became unclear following the transfer of project leaders and the personnel promoting the project, so it was limited to the trial of work monitoring combined with contractors and partial introduction of the system. Close to 10 years have passed since the review commenced, and the current situation is very far removed from the future vision aimed at initially, and it cannot be said that progress has been made on improvements.

Problem (Organization-xiii): With regard to the activities for improving maintenance processes, not only were the times for achievement of goals and the setting of milestones done in a leisurely manner, but responsibility tended to be ambiguous in cross-organizational project management, and, moreover, management for achieving goals was not perfect, so these factors brought about delays in planning, and the results initially planned for have not been sufficiently achieved.

Problem (Organization-xiv): The Head Office departments for the Nuclear Power Division and the nuclear power stations were unorganized and unable to indicate a specific direction, so no discussions materialized. Various ideas were indicated for a) through c) to help improvement proceed incrementally, so rather than moving forward with step-by-step improvements, much time and labor were required just to get started and it was not possible to strongly promote improvement activities.

f) Activities for disseminating a safety culture throughout the organization

The activities for spreading a safety culture throughout the entire organization had their origin in the comment received in the September 2008 WANO corporate peer review that "There is margin for improvement in disseminating a culture of safety throughout the entire organization." Subsequently, in 2009, TEPCO's basic philosophy on safety culture was stipulated (Seven Principles of Safety Culture[21]) and an organizational effort made to make this safety culture more widespread. Illustrations of efforts are given below.

- Activities to explain the Seven Principles of Safety Culture and Code of Conduct (examples of how one is to behave)
- Activities to chant slogans of the Seven Principles of Safety Culture at morning meetings and meetings for exchanging opinions
- Feedback and evaluation of the work related to disseminating a safety culture, etc.

[21] Principle 1: All personnel will be aware of their involvement in nuclear safety
Principle 2: Leaders will take the initiative in setting examples of safety culture principles
Principle 3: Mutual trust will be promoted among all concerned parties inside and outside TEPCO
Principle 4: Decisions will be made with nuclear safety as the first priority
Principle 5: Be keenly aware of the inherent risks of nuclear power generation
Principle 6: A questioning attitude will always be maintained
Principle 7: Learn systematically on a daily basis

In addition, in accordance with Technical Specification, report on evaluation of activities for creating a safety culture was made and reported to the president once every year. A confirmation of the status of reports prior to the Fukushima Nuclear Accident showed that safety activities at power stations were evaluated in light of the Seven Principles of Safety Culture and that if an event actualized even though it might be insignificant, it was addressed. However, the deterioration of a safety culture throughout the entire organization, which underlay the occurrence of events which posed an issue, was limited to the assessment that "there was no inclination toward a decline in the safety culture." It did not result in an effort to deduce issues to be addressed based on how the whole operation proceeded. Based on this situation, past efforts to create a culture of safety were confined to so-called campaign-style content, and it is believed that measures did not go deep enough to the heart of measures which should have been addressed and evaluated.

"Degree of Decline in Safety Culture" in the INSAG 13 and 15 reports by the IAEA's International Nuclear Safety Advisory Group (INSAG) is shown in Table 2-2. This table estimates the degree of deterioration in a safety culture viewed according to phenomena. Although it was originally believed that deterioration proceeded in stages, this table is a measurement of the relationship between phenomena and indications, at the most. It is not necessarily a quantitative assessment of actual conditions. Once again, when compared with the aforementioned conditions as well as a retrospective look back on past accidents, there is the following progression.

- Stage 1 (over-confidence) >> Assumption that safety has already been established
- Stage 2 (complacency) >> Minor events come to light, such as unsafe behavior or an imperfect understanding of the background behind rules
- Stage 3 (denial) >> After the HERP's long-term evaluation was released (2002), it took six years to perform a tentative calculation of tsunami height.
- Stage 4 (danger) >>Counterarguments made against the creation of regulations for severe accident measures
- Stage 5 (collapse) →Scandals related to nuclear power came to light in 2002 and 2006

Phenomena indicating signs of decline had surfaced previously, and, despite the fact that TEPCO's safety culture was definitely not in a good state, this fact was overlooked in previous self-assessments with such comments as "There was no inclination toward a decline in the safety culture," Consequently, it is believed that opportunities were missed to improve and enhance safety culture efforts.

Table 2-2 Degrees of Deterioration in Safety Culture (From INSAG 13 & 15)

Symptoms of deterioration		Phenomena
Stage 1	Over-confidence	Brought about as a result of previous good performance, praise from independent evaluations, and unjustified self-satisfaction.
Stage 2	Complacency	Minor events begin to occur. "Oversight" functions weaken, and self-satisfaction leads to delay or missed chances.
Stage 3	Denial	A number of minor events and more significant events begin to occur. However, they are treated as isolated special events, and comments from internal audits are ignored. Also, improvement programs end before improvements are completed.
Stage 4	Danger	Even though a few potential severe events occur, the organization as a whole does not respond as criticisms from internal audits, regulators or other external organizations are considered "unjust."
Stage 5	Collapse (occurrence of organizational accident)	A special inspection by regulatory authorities or other external organization is necessary. Resignations of management or other such measures emerge. Tremendous cost is required for repairs and improvements.

A safety culture is a natural feature of an organization and indicates how management is performing. Also, messages and other statements issued by the INPO, WANO and other overseas organizations advocating a safety culture have repeatedly stated that the foundation for making a safety culture widespread is top leadership and have emphasized the importance of such a foundation. The decline of our safety culture went unnoticed with there not being ample activities for improving the situation. This situation is thought to have had its origin in the fact that nuclear power management was not able to exercise leadership.

(4) Status of the Nuclear Power Public Relations

Looking back on the results of this accident, we believe that the risk of a tsunami strike exceeding assumptions should have been announced, and we should have communicated that the possibility of a severe accident occurring even with various safety measures in place was not zero. Also, we should have explained the necessity of measures for mitigating the effects of an accident. We believe that there were problems underlying our not having been able to provide explanations of these risks.

- Management and nuclear power leaders were not aware of the existence of risks, or, if they were, they left any announcements about such risks to personnel in the field. There was no policy which clearly indicated how to communicate such risks to communities and society.
- We were concerned that, if the risk of a tsunami strike exceeding assumptions had been announced, then there would have been demands for absolutely safe countermeasures to perfectly protect against any impact resulting from a tsunami. Operations would have been unavoidably shut down until such measures had been completed.
- We did not have an ample resolve to responsibly explain to siting communities the fact that "there is no zero risk," nor did we possess the ability to hold such a dialogue or the technological capability to explain such risk. On this point, cooperation between personnel in charge at the sites and nuclear power engineers was deficient.
- Furthermore, even though our corporate culture regarding compliance with laws and regulations improved somewhat on account of our past efforts involving a "culture of no misconduct," "mechanisms to prevent misconduct" and "mechanisms for speaking out," our corporate culture did not reach the level of carrying out activities from the viewpoint of people in society. In other words, there was not ample sensitivity towards the feeling of residents in siting communities and society, not only in the nuclear power departments but throughout the entire company. The initiative to sincerely face society was not ample. Furthermore, management did not sufficiently urge the nuclear power departments and other divisions to act based on society's viewpoint.

  Below, we take a look back on the state of public relations concerning nuclear power at the time for each area.

a) Situation in the nuclear power departments

When looking back at past public relations activities concerning nuclear power, particularly after the 2002 cover-ups, all non-conformities (that occurred) were announced in accordance with public relations guidelines, but, on the other hand, with regard to the necessity of announcing things that did not happen, for example, the necessity of announcing information about nuclear risks, contemplation of such issues by the nuclear power departments per se was not ample.

Also, as for examples of announcements of events other than problems which previously occurred, there is the example of the reassessment of active faults in sea areas around the Kashiwazaki-Kariwa NPS (2003). Below, looking back in retrospect along with recurrence prevention measures, there was an event where, at the time, TEPCO assessed that "there is the possibility of an active fault" in regard to seven faults in the sea area and reported this information to NISA, but no explanation was given to local municipalities or residents in the siting communities, which bred enormous mistrust in the siting community and society. The perception inside TEPCO was that we had determined there were no safety issues with regard to this fault (F-B fault), which was the hypocenter of the Niigata-Chuetsu-Oki Earthquake, so no announcements were made outside the company other than the report to NISA. With regard to instances where it was determined that "there is no problem," there was no awareness that such information must be announced, and determinations about such announcements were not able to be considered from the point of view or standpoint of people in the community.

From the example of the F-B fault, we became aware that it was necessary to announce information about risks from the point of view of local residents. In December 2007, a measure was identified to further strengthen the role and authority of the Engineering & Public Relations Coordinator, which was established to act from the perspective of the community. However, in June 2008 when deliberations were held internally about the results of a tentative calculation concerning a tsunami strike exceeding assumptions at 15.7m, said risk was not announced despite the Engineering & Public Relations Coordinator attending such deliberations at the direction of the then general manager.

While the nuclear power departments were aware that no announcement would be made if it had not been determined that "a risk existed" or that even information about risk information would not be announced if nothing had occurred, as such it was very difficult for such departments to communicate risk information. Also, as for the framework for "offering opinions about risk awareness and policy formulation on behalf of the company from the point of view of people in the community," the system did not function adequately due to the fact that the authority of the Engineering & Public Relations Coordinator was ambiguous and a system for supervision was not ample, among other reasons. Furthermore, one major factor underlying the absence of such announcements is considered to have been that at their root was the former nuclear power management's perception of risk, which was a fear that announcing information about uncertain risks would create anxiety among people in the siting communities and result in a decline in capacity utilization rates.

It is a simple prerequisite for risk communication to recognize the importance of communicating safety risks from the viewpoint of the community and then to make the announcement and provide an explanation. Looking back at past incidents of losing trust from local communities and society, there seems to have been a problem in which our action itself was deviating from the standards of society before even discussing whether to make a public announcement or not. This deviation was not detected or corrected because of our attitude, within the nuclear power departments and throughout TEPCO, of leaving the technical matters to the nuclear division, using the highly specialized nature as an excuse. As a result, insincere actions were taken with respect to society. A problem[22] came to light in which a false explanation was possibly provided to the National Diet Nuclear Accident Independent Investigation Commission (NAIIC) regarding a report on surveying the surrounding area of the isolation condenser system (IC) located on the fourth floor of Fukushima Daiichi Unit 1 reactor building. We think that our deviation from the standards of society was an underlying factor, which is "to take the stance of showing the site proactively on our own initiative" to "the committee appointed by the National Diet, which is the nation's highest authority." With respect to this issue, we received the following three improvement requests from the "Third Party

[22] See "Report of Verified Results" issued by Third-Party Investigation Committee on TEPCO's Response to the National Diet Nuclear Accident Independent Investigation Commission (March 13, 2013)

Investigation Committee on TEPCO's Response to the National Diet Nuclear Accident Independent Investigation Commission" (so-called "Third Party Investigation Committee"):

a) Enhance employee education in regard to negotiations with external organizations
b) Organize a cooperative system and a support system among employees
c) In regard to the need for showing the attitude of TEPCO as a whole to the external organizations, establish an organizational structure in which directives from upper management are disseminated to all employees, and the employees can consult with the upper management at an early stage.

As reported in the verification report, the Nuclear Reform Special Task Force sincerely accepts the fact that "this problem has not simply originated the disposition of individual employees" and that the reason for having this improvement request concerns the issue of organizational character of the entire company, in which the company did not realize the deviation from way of thinking and judgment standard of society, and therefore it could not make corrections.

Also, during the power-outage accident of Fukushima Daiichi which occurred on March 18, 2013, the communication, reporting and public announcement on the interruption in the cooling of the spent fuel pool were delayed because there was no anomaly with cooling water injection for the reactor; there was some margin of time before the water temperature of the spent fuel pool would reach the limit specified by Technical Specification. Recovery from the power outage and the restoration of pool cooling took two more days. This also shows that we were extremely insensitive to the feelings of people in society, especially in the siting communities, in regard to a situation in which the spent fuel pool could not be cooled. Our company's thinking and judgment thus deviated from the standard of society.

b) Status of Nuclear Power Public Acceptance (PA) Activities

In nuclear power public acceptance (PA) activities, Corporate Communications and Plant Siting & Regional Relations Department principally formulate PA policy. In addition to these departments, the Sales Division has been launching activities grounded in the policy by inviting the public to nuclear power related facilities such as nuclear power stations. The policy made it clear that "because nuclear power is dangerous, we have to control (implement safety measures) so that it is not dangerous," and a script[23] was prepared. On the other hand, because our stance was not to proactively disclose specific risks to the public as company policy, only information that "a series of safety measures have been implemented, and therefore it is on the whole safe" was passed on to the public, and it can be surmised that this gradually created the myth of safety.

Many employees from other departments began to accept a responsibility of the nuclear power PA due to an increase in opportunities for inviting the public to a power station as part of the "visiting campaign (campaign to invite 1,000,000 people to nuclear power stations in 2001 by the Federation of Electric Power Companies and each of the electric power companies)." Since this accident, we have heard from employees who were involved in these activities that "they regret having said it was absolutely safe." As described, it is also a challenge as to how to maintain a proper explanation policy when the number of employees who accept such a responsibility increases. From now on, it will be necessary to reinforce management to reassess the framework and methods by understanding the degree to which the policy has been disseminated and the actual state at specific points in order to perform activities where it is presumed that risks will be announced.

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[23] A script to make the response of each person in charge the same when communicating with the customer. The accurate information for the answer to the customer is described in the script in the form of spoken word by assuming the customer's response.

c) Framework issues for information disclosure during emergencies

As described in "2.3.1 (5) Public Relations Response during the Accident," examples can be seen in which the content presented per se does not have promptness and accuracy. However, there are also issues in terms of the framework for public relations. Based on a review conducted of our response during the Niigata-Chuetsu-Oki Earthquake, spokespersons have been posted at each station to provide information quickly and accurately in liaison with Corporate Communications when an accident or problem occurs significantly affecting society. The reasons why this system did not work during this accident are as follows.

- The spokespersons were not appointed exclusively to that post. Therefore, no spokesperson was available in some cases to handle public relations because the work in the department to which the spokesperson was assigned took priority during the accident.
- Because each spokesperson was assigned to a power station, the route along which instructions were issued was complex, and these instructions were not relayed quickly.
- Given the difficulty in responding during the accident, it was necessary for a spokesperson to gain experience in dealing with the media on a daily basis.

In addition, because of the division of roles and the command system comprising Corporate Communications at the Head Office and each power station and the Plant Siting & Regional Relations Department, and the role of the spokesperson as described above had not been clarified, there were situations during this accident in which communication for obtaining information was not based on unified instructions, but each department scrambled to contact the others to obtain information, becoming an obstacle for restoration activities which was the key issue. Moreover, at the time when an accident occurs which has a substantial impact on society as in this case, sincere responses to inquiries from customers in our service area were demanded in addition to responding to site communities and the media. However, the needed support was not obtained from the nuclear power departments in a timely manner, and there were instances in which we lost our customers' trust.

Problem 5-xv: The nuclear power departments had not released outside the company any nuclear disaster risk information (which had not occurred) other than information about problems, which had been set forth in public relations guidelines.

Problem 5-xvi: The framework for "offering opinions about policy formulation and risk recognition as a company" in accordance with community residents' viewpoints did not function properly because such authority was not clear, the monitoring system was imperfect, and other factors.

Problem 5-xvii: While responding to the accident, the site superintendent at the power station headquarters and various group leaders had their time taken up handling outside press requests, thus creating a situation which hindered restoration activities.

Problem 5-xviii: The division of roles for each Corporate Communications section and that for the public relations coordinators (how to function during an emergency) were unclear, and the command system for public relations was not unified.

(5) Summary

When previous nuclear power scandals occurred, top management took responsibility and resigned or employees from other departments were promoted to head the nuclear power departments. Also, many activities were implemented to reorganize the nuclear power departments, and there were attempts which resulted in a certain level of accomplishment. However, the Nuclear Reform Special Task Force summarized as follows the reasons why the Fukushima Nuclear Accident could not be prevented.

a) There was recognition that nuclear power safety had already been sufficiently achieved, and the nuclear power scandals were not considered to be an indication of the deterioration of the safety culture, but due to there not being ample communication skills and problem-solving techniques. Therefore, the measures were not ample to methodically improve safety awareness.

b) With regard to “safety awareness,” there was no specific reform plan for the former nuclear power management due to the recognition that cause of scandals was a problem pertaining to middle management and field organization, despite the fact that the former nuclear power management should have taken the initiative to improve "safety awareness” throughout the organization with unwavering resolve.

c) Organizational authority and responsibility during an emergency were unclear. However, there was ambiguity regarding managerial authority and responsibility even during normal operation.

2.5 Negative Spiral of the Shortfall in Accident Preparation

A more in-depth analysis was performed to clarify the relation and structure of problems regarding "safety awareness,” "technological capabilities,” and the "dialogue skills” that were summarized by the root cause analysis in sections 2.1 through 2.3, and the problem discussed in section 2.4. The reason for this is that the essence of the problem is found in the question "why an organization, whose stated vision of safety as the top priority, could not prevent the Fukushima Nuclear Accident,” even though there was not a single executive in the former nuclear power management who did not consider "safety to be the top priority.”

The business environment surrounding the electric utility industry has changed greatly over the last decade or so. In the case of TEPCO, a series of scandals and the 2007 Niigata-Chuetsu-Oki Earthquake had a major impact on our capacity utilization rate, so management made strong demands on the nuclear power departments to increase the capacity utilization rate. On the other hand, even while presenting "safety is our top priority” as part of our vision, we had to spare resources for safety issues involving fires and personal accidents, which actually happened often. We assumed that safety was established after certain measures for severe accidents had been implemented and capacity utilization rate and other such standards were considered to be an important management challenges. On account of this, avoiding prolonged reactor shutdown (increasing the capacity utilization rate) was made into one axis of the risk map that determines work priority. Measures whose effect was difficult to assess, such as severe accident measures, were postponed. For example, while the discovery of a shroud crack could mandate a long-term shutdown, necessitating a cost on the order of tens of billions of yen despite the fact that this does not contribute to improved safety, measures to make the battery rooms watertight, which do not directly contribute to improving the capacity utilization rate, and the like were not adopted.

In such a situation, measures such as SCC and the earthquake countermeasures were performed in order to secure, maintain and improve the capacity utilization rate even at an excessive cost, thinking that such expenditures could be recovered as long as the capacity utilization rate was improved, and thus our dependence upon manufacturers increased. This resulted in a decrease in our technological capabilities and a high-cost structure. Moreover, the nature of nuclear power in which somewhat higher costs can be recovered as long as the capacity utilization rate is increased is thought to have contributed to this spiral. The decrease in technological capabilities became one factor in our decreasing ability to debate purely technological arguments with regulatory authorities and the ability to disclose the residual risks of nuclear power. The deterioration of communication skills was accelerated by a hesitation to engage in risk communication.

In addition, in response to the 2002 cover-ups, QMS was introduced, and the work quality was positively improved by preparing manuals and other such documentation along with safety inspections by NISA. However, the reduction in small non-conformities contributed to the improvement of quality, but did not lead to the establishment of a strong safety awareness (in particular, defense in depth), which is necessary for a nuclear power operator handling the unique risks of nuclear power, and maintained it only in respect to a high awareness of quality improvement, that is a reduction in nonconformities.

The correlation of structural problems in the nuclear power departments has been summarized, and the negative spiral of the shortfall in accident preparation is shown in Figure 2-2. With this, a structural outline surfaced in which each of the "negative" items flows in a series and where overall "safety was assumed to have been already established, and as a result of considering the capacity utilization rate and other such benchmarks to be an important management challenges, the preparation for an accident was not ample." Because a vicious spiral that enhanced the structural problem of the nuclear power departments was firmly established in the organization, it was difficult to resolve.

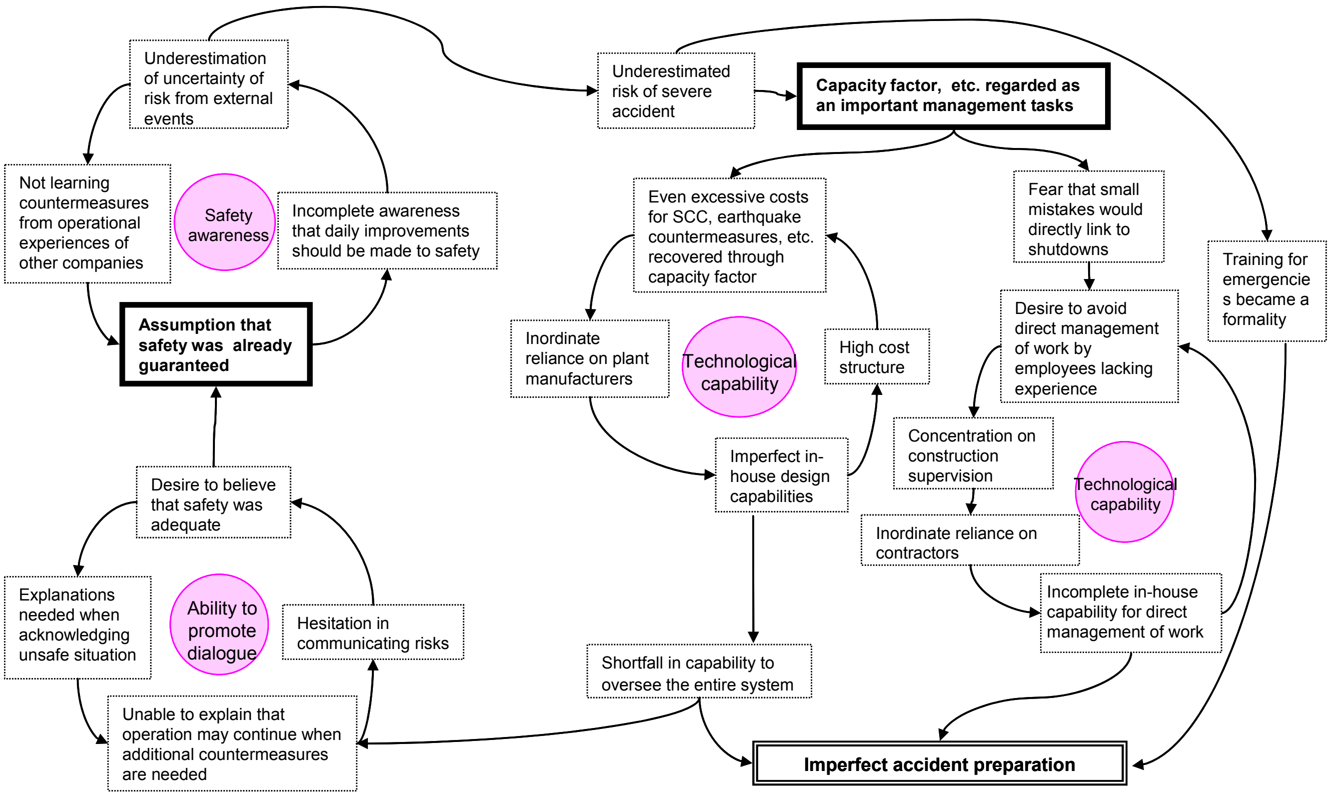

Figure 2-2: Negative Spiral of Shortfall in Accident Preparation

On the other hand, the Fukushima Nuclear Accident was not only caused by the problem of a negative spiral in the nuclear power departments. It is considered that the risk management conducted by the entire management was too optimistic for a company handling a unique risk of nuclear power generation.

The necessity and importance of company-wide risk management once again began to be recognized because of TEPCO’s nuclear power scandals in 2002 and the occurrence of inappropriate risk instances of risk management at other companies before and after the scandals. In July 2004, a Risk Management Committee was established in order to general oversight across the entire company for appropriate damage control (prevention the progression of damage) when a "violation of the law or corporate ethics,” "fatal accident,” and some other event occurred which would have a significant impact on management of the company. Subsequently, while the risks which TEPCO had to address became more diverse, including increased competition due to expanded electricity liberalization, diversification of company activities, increase in environmental problems (PCB, asbestos, etc.), and reinforced privacy protection, the maintenance of internal controls (framework for ensuring the appropriateness of operations) was made mandatory by the revised Companies Act in 2006. In order to provide blanket recognition and control of risk throughout the entire TEPCO group under normal operations by considering such a state of affairs, the basic policy for company-wide risk management was laid out, and a risk management framework for the entire group was established. Also, in the nuclear power departments, the Nuclear Power Risk Management Committee was established in June 2007 as a committee to centrally oversee the status of risk management under normal operations in the departments, in addition to reinforcing the risk management framework for the entire company.

Within the risk management framework for the entire company, the following risk scenario was proposed in a meeting of the Nuclear Power Risk Management Committee (November 2010) in relation to a "severe accident that exceeds design guideline events.”

"There is a movement within the Nuclear Safety Commission and the NISA to make severe accidents exceeding design guideline events subject to regulation. Depending on the substance of the regulations, a significant response will be unavoidably necessary in various aspects, such as demands for costly facilities, backfitting of existing reactors, and reheating a lawsuit seeking a cancellation of the establishment permit.”

As described above, a risk scenario was not actually submitted for the case of a severe accident occurring that exceeds design guideline events, as the risk of a such an accident occurring was understood as a regulatory risk.

Furthermore, also in the "Risk Management Committee (February 2011)” which accepted the aforementioned risk scenario from the nuclear power departments, an examination and reassessment of the risk scenario, which the nuclear power departments had reviewed, from other viewpoints was not ample. A risk scenario could not be drawn up which led to a nuclear disaster resulting from a "severe accident exceeding a design guideline event.” There was no discussion of the validity of a response to an important risk such as a nuclear disaster.

In the future, specialized knowledge of third parties independent of the nuclear power departments will be effectively applied. The inspection and supervision over the managerial status of the nuclear power safety risks (such as a nuclear disaster) by the nuclear power departments will be improved and reinforced throughout the entire management of the company.

3. Nuclear Safety Reform Plan [Facility and Operational Safety Measures]

3.1 Problems with Response to Fukushima Nuclear Accident

Based on "2.3 Lessons to be Learned from the Accident Response," the problems with the accident response on the facility side and operation side have been summarized as follows.

(1) Problems on the Facility Side

- Protection against a tsunami exceeding assumptions (A) was weak.
- Sufficient preparations were not made for the case of complete loss of electric power (B) and ensuring high-pressure cooling water injection (C), depressurization (D), low pressure water injection, heat removal, cooling water injection for the fuel pool and water sources as subsequent measures after the loss of electric power.
- Means were not prepared to mitigate the impact after reactor core damage (E) (prevention of PCV damage, hydrogen control, countermeasures for melt-through, prevention of a large release of radioactive material into the environment, etc.)
- Lighting and communication tools were limited, and in addition, means for monitoring and measurement were lost so that the plant status could not be ascertained.
- Factors such as the fear of large aftershocks and tsunami accompanying an aftershock decreased accessibility and ability to work in the field due to scattered debris and other rubble as well as a marked deterioration in the work environment made responding to the accident difficult.

(2) Problems on the Operation Side

- Training and preparation of equipment and materials against a tsunami exceeding assumptions was not ample.
- Confusion in preparations occurred as a result of being struck by compound disasters, or multiple plants being simultaneously struck.
- Due to the fact that, with power outages and the like, means for communication were limited, and it was difficult to share information about the situation, and thus the status of the plant could not be ascertained or shared smoothly.
- Due to the damage inside and outside of the power station by the earthquake and tsunami, equipment and materials for bring the accident to a resolution could not transported and delivered quickly.
- The spread of contamination and an imperfect radiation control system made responding to the accident difficult.
- Official announcements and dissemination of information at the time of the accident were scant.

3.2 Basic Approach to Safety Design

(1) Facts and Lessons Learned When Reassessing the Approach to Ensuring Safety

Among the problems indicated in 3.1, particularly those which are important and the lessons learned have been summarized for reassessing the approach to ensuring the safety of TEPCO's nuclear power stations.

1) Reinforcement of defense in depth against external events (corresponds to Problem A in previous section)

In the Fukushima Nuclear Accident, despite the fact that knowledge about tsunami was scant, we judge the possibility of a tsunami exceeding assumptions to be low and did not implement preparations based concept of defense in depth (preparation for tsunami exceeding assumptions). As a result, the strike of tsunami exceeding assumptions caused the simultaneous loss of safety functions (including the means for achieving a stable cooling of the reactors using normal systems) excluding the function for shutting down the reactors. As a result, we could not do anything but respond on the spot to the disaster immediately after the tsunami, and faced many difficulties. Even prior to the Fukushima Nuclear Accident, we had worked on ensuring the safety of reactors based on the approach of the defense in depth. However, the events, which are assumed by this approach, were in reality limited to events (so-called internal events) originating in failures which randomly occur inside plants. If the probability of a random failure occurring is low, the possibility becomes even smaller that a simultaneous failure may arise, so defense in depth has been reinforced by preparing multiple facilities which are highly reliable.[24]

In this accident, the defense in depth, which had been provided to counter internal events, did not function in response to the external event. Based on our reconsideration of this accident, we will take into account the characteristics of external events acting simultaneously on multiple facilities and reinforce the functions of each layer of defense in depth mainly through diversification of the means for response so that, for example even if a situation results which exceeds design assumptions, it will not be allowed to easily move on to the next layer.

2) Reinforcement of high pressure cooling water injection and depressurization functions on the assumption of station blackout (SBO) (corresponds to Problems B, C, and D in previous section)

In the Fukushima Nuclear Accident, the isolation condenser system (IC) at Unit 1 did not function as expected, and function of the high pressure coolant injection system was lost. Units 2 and 3 had to rely only on the reactor core insulation cooling system (RCIC) for an extended period of time, and depressurization of the reactor, which is necessary to switch to a cold shutdown, was very difficult.

Such a situation occurs when all AC power sources are lost (SBO). However, conventional perception was that there was only a small possibility a SBO would occur due to the high reliability of power sources from outside the plant (off-site power), emergency diesel generators, and storage batteries (DC power). Also, certain measures had been adopted to counter a station blackout, such as preparing facilities and procedures for interchanging high and low voltage AC power from adjacent units using the advantage of having multiple units on site and the fact that a reactor can be cooled for about 30 minutes by means of the safety relief valve (SRV) and RCIC even AC power source is lost.

However, in this accident, this understanding and certain countermeasures did not function in response to the SBO. Based on this experience, we will assume the loss of all AC power sources, and further augment power sources so that such a loss does not occur, and we will adopt measures so that important safety functions are not lost even if an SBO occurs. Further, we will devise measures in a prioritized manner for high pressure cooling water injection function, which is necessary at the initial stage of an accident, and for maintaining function of safety relief valves for an extended period of time, which is necessary to transition to a cold shutdown.

3) Clarification of PCV design requirements for mitigating impact after reactor core damage (corresponds to Problem E in previous section)

In the Fukushima Nuclear Accident, as a result of the PCV being damaged due to an

[24] The reliability of a facility in the design stage is enhanced by the selection of materials, design, construction, inspection and other means based on the configuration of conservative conditions, high quality controls, etc., and in the operation stage by a periodic confirmation of functions, thorough maintenance, and other such means. by installing multiple facilities, the simultaneous occurrence of a random failure is hindered.

excessively high temperature after reactor core damage, radioactive materials were released in an uncontrolled manner into the environment. The PCV and incidental facilities were designed using requirements based on a loss of coolant accident. Although spraying functions and those for injecting cooling water into the pedestal were strengthened as part of the AM measures previously prepared, the countermeasures assuming reactor core damage were devised only within the scope of effectively utilizing existing facilities, and did not go so far as to consider specific requirements to address functions for mitigating the effects of reactor core damage.

Out of remorse for the uncontrolled release of radioactive materials into the environment, we will adopt the necessary measures after clarifying the requirements needed for functions to mitigate any impact after reactor core damage for the PCV and any incidental facilities.

(2) Basic Policy Taking into Account Problems for Ensuring Reactor Safety

Based on the lessons learned as indicated section (1), the basic policy for ensuring reactor safety is described below.

1) Reinforcement of the defense in depth

The defense in depth will be reinforced by devising countermeasures that emphasize diversity and positional dispersion on the assumption that multiple failures will occur.

In order to prevent the critical safety functions in each layer of defense in depth ("abnormality prevention," "shutting down," "cooling," and "sealing") from loss due to a conspicuous common cause resulting from an external event, we will shift from the conventional securing of reliability through redundancy to ensuring reliability with an emphasis on diversity and positional dispersion to reinforce defense in depth. We will assure multiple options of diverse response means by separating the grade of measures into those having a design basis which confers additional requirements to some design guidelines and those whose classification exceeds the design basis to further improve the reliability within the same layer (Design Extension Condition (DEC)). The framework of TEPCO's defense in depth is shown in Table 3-1.

Table 3-1: Reconstruction of TEPCO's Defense in Depth

Layer	Objective (Critical function)	Design Basis Requirement	DEC Requirement (selection of countermeasures based on phased approach as described later)
First Layer	Prevention of Abnormality (Abnormality Prevention)	Example of tsunami: The occurrence of an SBO is prevented for a design tsunami, and the loss of safety function of each of subsequent layer is prevented.	Example of tsunami: Abnormalities of facilities for protection against tsunami are taken into account and the function of facilities in critical areas is not lost even though building interiors are inundated to a certain extent. Water can be drained from important areas.
Second Layer	Prevention of Accident Progression (Shutting down)	No changes (Subcriticality of the reactor is achieved even when one control rod with a maximum reaction value is not inserted. The reactor is able to be cooled using normal systems.)	No changes (Subcriticality of the reactor can be achieved by equipments other than control rods. Reliability of the shutdown function is improved by control rods.)
Third Layer	Prevention of Reactor Core Damage (Cooling)	Cooling: The reactor is able to be cooled by cooling water injection even assuming a single failure of an active component in response to an SBO.	Cooling: The reactor can be cooled by cooling water injection and by a heat sink by using diverse or multiplexed facilities in response to an extended SBO.
		Depressurization: The reactor is able to be depressurized even assuming a single failure of an active component in response to an SBO.	Depressurization: The reactor can be depressurized by using diverse or multiplexed equipments in response to an extended SBO.
Fourth Layer	Mitigation of Reactor Damage, Discharge Control (Sealing)	The contamination of the land over an extended period of time is prevented with a combination of the functions of the PCV and incidental facilities. Uncontrolled release of radioactive material is prevented.	

Newly added region for DEC

Conventional DEC region in Europe

2) Adoption of phased approach

The measures will be selected by considering that the selection of measures and the required reliability change depending on the margin of time.

In the Fukushima Nuclear Accident, a response employing portable facilities such as fire engines and power supply cars was necessary as the function of most facilities on site had been lost. However, portable facilities, which allow for a flexible response in keeping with progression of an accident, have significant utility value, if proper coordination, including procedures, is in place before the event. On the other hand, permanently installed facilities have the advantage over portable facilities in that no time is necessary for transportation or installation and such facilities will automatically start up when there is no margin of time to respond. It is extremely important to make the selection of what measures are to be adopted from the standpoint of the margin of time for response and whether other alternative means may be taken (Phased Approach[25]). The concept of phased approach is shown in Figure 3-1. For strengthening each safety function, the reinforcement of defense in depth can be made more effective by applying a phased approach and adopting diverse measures.

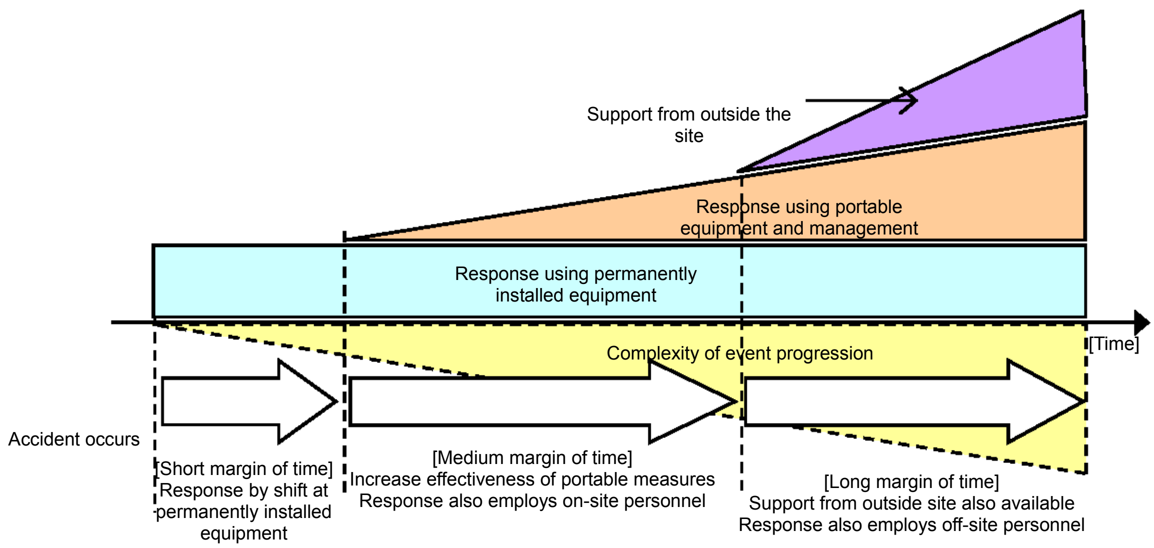

Figure 3-1: Concept of Phased Approach

3) Design requirements for PCV to mitigate impact after reactor core damage and to suppress release of radioactive materials

The measures will be adopted by clarifying the requirements expected of the PCV and incidental facilities after reactor core damage.

25 In the initial stages of an accident, the response is made using permanently installed facilities because there are limits on the amount of time and personnel; and in the latter stages of an accident, the response is made by using diverse means including portable facilities which also allow a flexible response in keeping with progression of an event, and, furthermore, when support from outside the site can be expected, it is possible to take even more diverse means to respond including restoration of facilities.

Also in the design guideline as well, the PCV comprises the reactor storage facility along with the PCV spray system, flammability control system and other facilities, and it is not assumed that the PCV is to seal itself as a single unit.[26] The requirements for the PCV to mitigate the impact after reactor core damage and to suppress the release of radioactive materials are also configured by considering inter-relationship with incidental facilities (alternate spray, pedestal cooling water injection system, wet well vent, filter vent, etc.), and the performance targets are set based on the evaluation.

(3) Approach to improve safety in existing reactors

We will adopt measures based on the reinforcement of defense in depth as shown in section (2) and phased approach. However, for existing reactors, the fuel has already been loaded, and it is very necessary that safety be effectively improved immediately. Therefore, an approach that differs from a new reactor may necessarily be taken. Several options may be considered for strengthening safety improvement measures ranging from the addition of new facilities to permanently installed ones to the improvement of procedures. However, for existing reactors, we will select measures by taking into account the interaction with present facilities and the unique conditions of the site, which may become particularly prominent in the case of an external event.

In addition, even when various guidelines are not completely met, measures that emphasize diversity and positional dispersion will be expeditiously adopted because safety will certainly be improved by employing diverse measures particularly in regard to an external event. Furthermore, we will continue to improve with the aim of achieving even greater safety without being satisfied with the level of safety which is achieved through measures adopted. Safety measures arranged based on this approach (ex.: Kashiwazaki-Kariwa Units 1 and 7) are shown in Attachment 3-1.

3.3 Concrete Measures Underway at Each Power Station

(1) Fukushima Daiichi NPS

In accordance with the implementation plan[27] based on the “items required for measures on the designated Specified Nuclear Facility installed at Fukushima Daiichi NPS, TEPCO” we will specify the matters to be adopted as the operator of a specified nuclear reactor facility and are sequentially proceeding with safety measures based on that concerning the completion of decommissioning as early as possible, including ensuring safety of the process for decommissioning as well as the removal and storage of molten fuel (fuel debris) for Units 1-4, and safely maintaining and continuing the cold shutdown of Units 5 and 6 (see Attachment 3-2).

(2) Fukushima Daini NPS

In accordance with the restoration plan formulated based on the nuclear operator disaster prevention business plan, we are proceeding with restoration of Fukushima Daini, including facilities involved in maintaining a cold shutdown of the plant. At Fukushima

[26] The pressure and temperature inside the BWR PCV rise due to steam flowing out of the primary system during a design guideline LOCA. However, increase in pressure and temperature is suppressed by suppressing a pressure by means of the suppression pool over the short term, and by removing heat to the ultimate heat sink through a PCV spray cooling system over the long term. Also, the generation of hydrogen and oxygen can be assumed due to oxidation of fuel cladding and radiolysis of water. However, the combustion of hydrogen can be prevented by deactivating the PCV atmosphere and operating the flammability control system at the time of an accident.

[27] Implementation Plan of Measures for Ensuring Security and Protecting the Specified Nuclear Fuel at Fukushima Daiichi Nuclear Power Station Designated as a Specified Reactor Facility (December 2012, TEPCO) http://www.tepco.co.jp/en/press/corp-com/release/2012/1223529_1870.html

Daini, we have taken safety measures with the objective of a tentative stable cold shutdown, having learned lessons from the Fukushima Nuclear Accident as well as those from other experiences of disasters at our own power stations (see Attachment 3-3).

(3) Kashiwazaki-Kariwa NPS

The measures have been adopted to improve safety at Kashiwazaki-Kariwa (see Attachment 3-4).

In the response to the Fukushima Nuclear Accident, TEPCO has undergone experiences at an unprecedented level. There are many matters which are still unconfirmed and unknown regarding damage locations, degree of damage, causes, and such associated with progression of the accident following the Tohoku-Chihou-Taiheiyo-Oki Earthquake. So, we are striving to understand the behavior and other characteristics of the nuclear reactors at the time of the accident by continuously conducting systematic field investigations and simulation analyses. Also, in consideration of our international responsibility as concerns this accident, we will contribute by actively communicating and sharing these experiences with other countries.

4. Nuclear Safety Reform Plan [Managerial Safety Measures]

In implementing the Nuclear Safety Reform Plan, TEPCO's management itself will focus on:

- Exercising leadership
- Examining the suitability of specific measures for each plan
- Ascertaining progress and guiding improvement
- Continually examining internal control system in the implementation processes

As stated in Chapter 2, the underlying factor, which allowed the Fukushima Nuclear Accident to happen, was that a negative spiral of the shortfall in accident preparation became firmly rooted within our organization, and, in order to resolve this situation, we will implement measures to severe this chain at multiple points simultaneously. For the illustration of the negative spiral as shown in Figure 2-2, six measures to severe that are shown as "scissors" in Figure 4-1, and an overview is provided in Table 4-1.

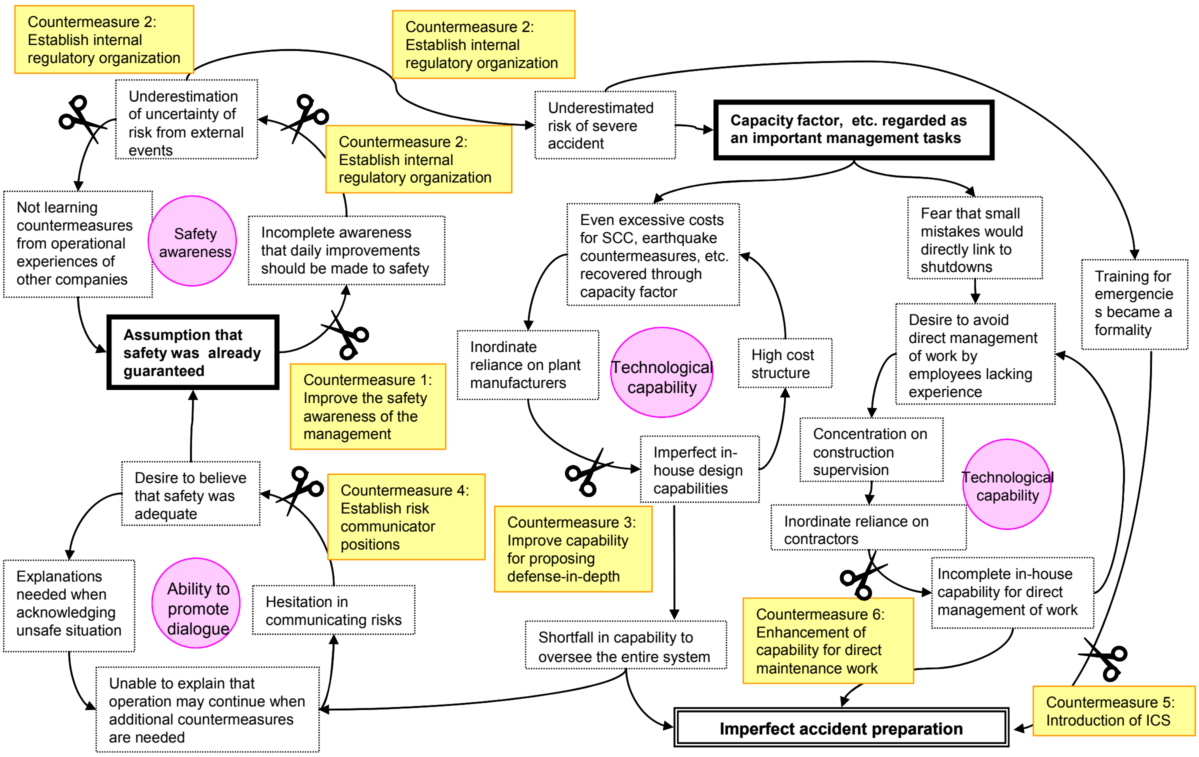

Figure 4-1: Severing the Negative Spiral

Table 4-1 Summary of Safety Measures on Management Side

	Action Plan	Points of Action Plan
Measure 1 Reform starting from Management	Measure 1-1 Improvement of safety awareness by management	Training programs will be prepared and implement to improve the awareness of nuclear power safety as a starting point for cultivating a safety culture.
	Measure 1-2 Development of nuclear power leaders	In training nuclear leaders, the behavioral indicators concerning safety will be formulated, and evaluations and feedback given of the extent such is manifested. In addition, programs for such training will be enhanced.
	Measure 1-3 Dissemination of safety culture throughout the entire organization	Disseminating the safety culture will be the mission of management, and it will be promoted with the leadership of top management. Discussion of a safety culture is important for its permeation, and a framework will be constructed in which such discussions will be continuously carried out continuously and in a multitiered manner, and are to include discussions on individual levels and between organizations
Measure 2 Enhancement of oversight and support for management	Measure 2-1 Establishment of an internal regulatory organization	Executives will reliably ensure safety under supervision of the Nuclear Safety Oversight Office, an internal regulatory organization independent of corporate executives.
	Measure 2-2 Improving the role of middle management	Portions of the present training curriculum will be revised, and the extent to which behavioral indicators are manifested will be evaluated in performance evaluations for middle management in nuclear power departments.
	Measure 2-3 Reassessment of the status of chief reactor engineers	The activities will be carried out in liaison with employees assigned to power stations in the Nuclear Safety Oversight Office to be established in the future, and the reactor chief engineer will be selected from personnel in the top management level.
Measure 3 Enhancement of ability to propose defense in depth	Measure 3-1 Construction of work processes enabling layering of defense in depth	The proposals that promptly improve safety will be actively encouraged, and a framework for realizing such proposals will be constructed.
	Measure 3-2 Construction of processes for utilizing safety information	In view of the weakness of reflecting the lessons learned from external events, a framework will be constructed that appropriately extracts the knowledge from safety information, including that form other industries and countries, from a standpoint of improving safety.
	Measure 3-3 Construction of improvement process using hazard analysis	For measures regarding hazards with extensive cliff edge characteristics, problems will be shared among concerned groups through hazard analysis, and a system for prompt improvement will be constructed.
	Measure 3-4 Improvement of process for periodic safety evaluations	This system will be built so that the results of the activities related to nuclear safety will be reviewed very frequently, weaknesses related to nuclear safety will be ascertained, improved, and followed up on.
	Measure 3-5 Improvement in the overstressing of operational evidence	By ameliorating excessive QMS, the volume of work will be reduced to device the time necessary for safety improvement.

	Action Plan	Points of Action Plan
	Measure 3-6 Uniform management of work evaluations related to nuclear safety	Appropriate evaluation will be conducted by overseeing the efforts and results for improving safety. Also, from the standpoint of human resource development, the appropriateness of personnel placement will be overseen.
	Measure 3-7 Improvement in ability to solve problems seamlessly across organizational lines	By clarifying the responsibility and the authority of projects from the top level of the organization, the early resolution of technological challenges will be sought. Also, responsibility will be evaluated by linking it to the assessment of an employee’s performance.
	Measure 3-8 Reassessment of personnel transfers between departments	The objective will be clarified to be "awareness of work reform,” and the placement of employees will be reassessed.
Measure 4 Enhancement of risk communication activities	Measure 4-1 Posting of risk communicators	From the viewpoint of society, proposal will be made concerning "recognition of risks and formulation of a policy for explain risks” as a company, and, based on that policy, a specialist position (risk communicator) who will undertake the work of communicating risks will be installed.
	Measure 4-2 Implementation of risk communication	Risks will be announced, and explanations provided and a dialogue conducted concerning the strengthening of measures to improve safety to counter such risks, and communication will be promoted to obtain the formation of a certain level of agreement.
	Measure 4-3 Establishment of Social Communication Office	Establishing the Social Communication Office to fill in gaps in awareness of risks between society and nuclear power departments and to undertake activities to promote awareness about society’s benchmarks and point of view through exhaustive risk management.
	Measure 4-4 Improvement of skills for conducting a dialogue with regulatory authorities	Response guidelines will be prepared to for responding with an emphasis on safety on behalf of the company, and responses to regulatory authorities will be handled with a consistent attitude.
Measure 5 Reform of Emergency Response Organization at the Power Station and Headquarters	Measure 5-1 Reform the emergency response organization (introduction of ICS)	An emergency organization will be introduced which incorporates information sharing, managerial limits and other characteristics under a unified command system.
	Measure 5-2 Reinforcement of the operational side of the emergency response	Education and training will be enhanced and bolstered based on the new emergency organization.
Measure 6 Reassessment of non- emergency power station organization and enhancement of capability for direct maintenance work	Measure 6-1 Reassessment of power station organization during normal operations	The organization will be reassessed so that the oversight functions related to reactor safety at the power station are reinforced, and the system engineers are able to be trained. In addition, a personnel rotation plan will be created for career enhancement.
	Measure 6-2 Expansion of direct maintenance work for emergency response	A framework will be put in place so that emergency work can be implemented by TEPCO personnel on the assumption that outside support is not available for the first 72 hours after an accident occurs.

4.1 Reform Starting from Management

(1) Improvement of Safety Awareness by Management

Before the Fukushima Nuclear Accident, we assumed that safety had already been established and understood decreases of the capacity utilization rate to be a risk. However, we will consistently establish "safety first" as our foundation and we need to change our attitude toward risk. The starting point for "reform from management" is the "reform of management itself." Management must have a high level of safety awareness in regard to nuclear power, such that it has "a vivid awareness of the unique risks of nuclear power, and a deep awareness that it bears this responsibility." Further, it is also the responsibility of management to construct an organization and develop human resources in order to increase safety awareness.

In keeping with these points, training for improving the awareness of nuclear power safety will be carried out for management.

- Fukushima Nuclear Accident causes and countermeasures
  This is to understand how the Fukushima Nuclear Accident progressed and what responses were taken by our company, and, in addition, to understand safety measures available in terms of facilities and operations based on this, and to what extent they have been put in place.
- Basic principles of safety design and the safety culture of nuclear power
  This is to understand approaches (examples: establishment permit, safety design review guideline) to safety design that are the foundation for nuclear power. Furthermore, this is to understand the concept of nuclear safety and the approaches on the basis of safety culture, etc.
- Learning from examples of other companies, etc.
  Discussions will be held using actual examples of risk communication and fostering a safety culture from other companies as well as other industries.

Training courses for executives in the US as shown in Table 4-2 is used as a reference for constructing the training program, which will be sequentially implemented, and course content will continue to be improved and enhanced.

Table 4-2: Examples of US Executive-Oriented Training Courses

Course Name	Oriented toward	Length	Overview
Goizueta Director Institute	Outside directors without a background in nuclear power	2 Days	Conducted by Emory University. Includes the basics of power generation technology and panel discussions regarding current issues within the industry.
Reactor Technology Course	Management level staff without backgrounds in nuclear power who may become CEOs.	3 Weeks	Conducted by the Massachusetts Institute of Technology. Deepens understanding of topics such as the basics of power generation technology and the need for conservative and cautious decision making based on past lessons learned.
Senior Executive Leadership Seminar	Chief Nuclear Officer (CNO)	1 Week	Conducted by the U.S. Nuclear Energy Institute (NEI). Also includes discussions regarding politics with banks and analysts.
Senior Nuclear Executive Seminar	Site superintendent level personnel	2 Days	Conducted by INPO twice annually. Topics such as the most recent issues in the nuclear power business are discussed.
Senior Nuclear Plant Management Course	Unit superintendent and power station general manager level	5 Weeks	Conducted by INPO. Includes safety culture and meetings with regulatory authorities and law offices, etc.

(2) Development of Nuclear Power Leaders

1) Establishment of behavioral indicators

Like management, nuclear power leaders[28] should have a strong awareness of the unique risks of nuclear power and a deep awareness that they bear such responsibility, and the following behavioral indicators have been established for them.

1. Rank continuous improvement of safety as their highest-priority management challenge.
2. Promote the preparation of defense in depth on the assumption that designs will not go as planned.
3. Face the risk of natural phenomena with humility and do not underestimate them.
4. Strive to improve technological abilities in order to improve safety and evaluate new things that they have tried even when they fail.
5. Honestly communicate residual risks of nuclear power to society and do not try to easily impose peace of mind.

Nuclear power leaders must act to embody these 5 behavioral indicators, and there needs to be an organizational structure to develop and recruit this kind of person and sustain and maintain this consciousness.

2) Reassessment of evaluation axes for nuclear power leaders

Aiming for the optimal allocation of management resources as well as the stability and improvement of company performance are the evaluation axes for management. Because of this, due to the major effect that severe accidents have on management, management personnel who are capable of being nuclear power leaders must undergo periodic evaluations that look at whether they are executing in accordance with the behavioral indicators shown above.

For this reason, nuclear power leaders undergo quarterly trend evaluations for the items below and are provided feedback to make them aware of gaps between the behavioral indicators and their self-awareness.

a) Implementation of safety-improvement measures, including defense in depth
b) 360-degree evaluations (evaluations from superiors, colleagues and subordinates as well as opinions from contractors and residents in the siting communities)

As one of the activities for fostering a culture of safety, a location will be established for periodic discussions based on facts learned from 360-degree evaluations and organizational trends, points for improvement will be extracted from the review, and related to the subsequent responses.

3) Enhancement of development programs for nuclear power leaders

In the future, in order to make it possible to more effectively select nuclear power leaders who can embody these behavioral indicators, we will provide the necessary education and development before the promotion to nuclear power leader, in addition to improving capabilities through actual duties. With regard to development, nuclear power leader candidates are to be persons who have mastered the actual duties of a power station, and several persons are to be selected from among those who have work experience as chief reactor engineers (or in the Nuclear Safety Oversight Office) or as a risk communicator described below and given training in the 5 subjects listed below as well as the current training for management positions. The following are to be provided based on the job level.

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[28] A "nuclear power leader" in the Nuclear Safety Reform Plan refers to executive officers, corporate officers and general managers of the nuclear power division, nuclear power station and construction office site superintendent, and anyone at equal or above these ranks.

a) Fukushima Nuclear Accident causes and countermeasures
This is the same training program as for management.

b) Basic principles of safety design and the safety culture of nuclear power
This is the same training program as for management.

c) Basic knowledge of plant operations, including the Operation Training Center's advanced course
- Candidates are to be reinforced on the starting point of nuclear power generation by experiencing what sort of behavior a plant shows in response to various situations through means such as simulators for use in operator training.

d) Severe accident progression and countermeasures
- Candidates are to understand under what conditions severe accidents may occur and how they would progress, as well as what preparations should be made to respond to them at each level.

e) Acquisition of up-to-date knowledge
- Candidates are to constantly incorporate new information, such as changes in regulations and guidelines, case studies of nuclear operators, including those in other countries and the latest trends in academic associations and technological developments (including those in other industries).

f) Walkdown
- Candidates are to have a thorough knowledge of power station circumstances (for example, what is located where on site).

As an immediate response, this educational program is to be gradually applied to current nuclear power leaders.

(3) Dissemination of Safety Culture throughout the Entire Organization

TEPCO will turn back to fundamental principles in order to severe the negative spiral affecting safety consciousness and rebuild a culture of safety. Additionally, efforts to foster and disseminate a culture of safety will be improved from the previous efforts, which took the form of campaigns, to turn back the spiral of the safety culture that moves between discussion, recognition, implementation and action.

The efforts shown in Table 4-3 will be put into place in order to create an organization in which the culture of safety reaches every employee who is involved in nuclear power generation and trust is regained from everyone in society. The fundamental philosophy of efforts such as these has as its starting point the "deepening of each and every person’s understanding of safety culture through thorough discussions of safety culture," followed by the process of embodying the 7 principles of safety culture in actual work operations. Additionally, organization is to be created through the achievement of an "attitude of mutual questioning (challenging) in which superiors ask subordinates, "Is this all right?" and subordinates ask superiors, "Do you think this is all right?"; as a result, nuclear safety is assured through daily tasks.

Table 4-3: How to Lead Discussions for Disseminating a Safety Culture

Step1	The transmission of a culture of safety is to be established as management's mission and promoted through leadership by top management. - As long as nuclear power stations exist, nuclear power leaders are to thoroughly discuss the Fukushima Nuclear Accident as a whole and to continuously sever the "negative spiral of the shortfall in accident preparation" without evasion by any person. - Nuclear power leaders are to read the reports of all accident investigations and this Nuclear Safety Reform Plan and state their own thoughts in intranet - Nuclear power leaders will reconfirm and reunify their recognition and the philosophy of the 7 principles of safety culture by getting on the same page, establishing this transmission as their mission and promote it by displaying leadership. - Nuclear power leaders will make use of safety culture assessments and other reviews by external organizations, work to gain an objective grasp of the status of the dissemination of safety culture on a periodic basis and carry out self-checks by nuclear power leaders and discussions among leaders.
Step2	Discussions of nuclear safety are to be multitiered and continuous, and are to include discussions on individual levels and between organizations. (See Figure 4-2) - Individual levels are to ensure that they are on the same page (nuclear power leaders > management levels > member levels), unifying recognition and philosophies of the 7 principles of safety culture. - <Our resolution> (discussed below) is to be thoroughly discussed by all individuals. - The results of surveys on safety culture, OE information, good examples of approaches taken by inside or outside of the company, etc. are to be used as input information and combined with self-assessments and discussions to find points for improvement and be brought to bear on actual duties. For example, group managers (GM) are to carry out multiple discussions within levels and between organizations, such as - self assessments - intra-group discussions - discussions among persons with the same positions in the same department, power station, etc. - discussions among management organizations within the same department (or organization) below the general manager level. - discussions among GMs of organizations corresponding to headquarters counterparts. -Opportunities for discussion should not just be those whose theme is safety culture, but all sorts of opportunities are to be availed of daily including committee meetings and group meetings in the mornings and evenings. On such occasions, the "attitude of mutual questioning (challenging) in which superiors ask subordinates, "Is this all right?" and subordinates ask superiors, "Do you think this is all right?" is to be put into practice. -By challenging each other, these discussions will surely produce output including the sharing of each other’s recognition of the current situation and decisions on improvement measures, then lead to the next discussion and will not be allowed to end just with a discussion.

Step3	Construction of mechanisms to activate efforts (See Figure 4-3) - In order to make active use of the discussions in 1 and 2 above and ensure that they are meaningful, it will be necessary to prepare materials for discussion, provide intangible skills, have mechanisms of making use of the results of discussions and carry out reviews by organizations such as INPO, WANO, the Nuclear Safety Oversight Office and the nuclear quality management department. - Materials for discussion are to include indices that are thought to have a comparatively large effect on safety culture, such as the results of various opinion surveys, the extent of trends and changes in quantitative and qualitative information regarding defect events, problems and proposals for improvement and analyses of the results of previous reviews. What is important is not to discuss whether the value obtained is high or low but to analyze what organizations and individuals have done based on the extent of the increasing or decreasing trend or change when compared to previous occasions. - With regards to imparting intangible skills in discussions, things like exhibiting leadership for the purpose of ensuring nuclear safety and holding discussions in ways that elicit honest opinions and give participants a sense of satisfaction are not to be attributed to individual characteristics (such as personality) but are to be the subject of organizational initiatives to impart abilities. Examples of initiatives that have improved results and training, etc. which have been well-evaluated are to be used as references when creating programs that have specific safety aims and repeating the cycle of implementation and improvement. These initiatives are to be put into place as necessary for purposes such as facilitating the implementation of meaningful meetings (discussions). The opinions, knowledge, and approaches obtained from this effort and their implementation status will be shared not only within the division but also with people in and out of the company in order to further improve this effort.

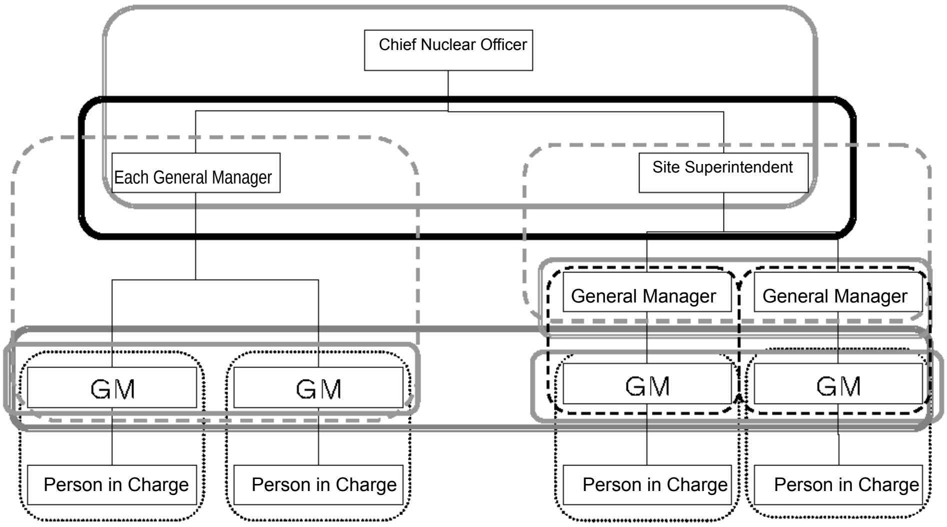


Figure 4-2: Units Carrying out Discussions (Illustration)

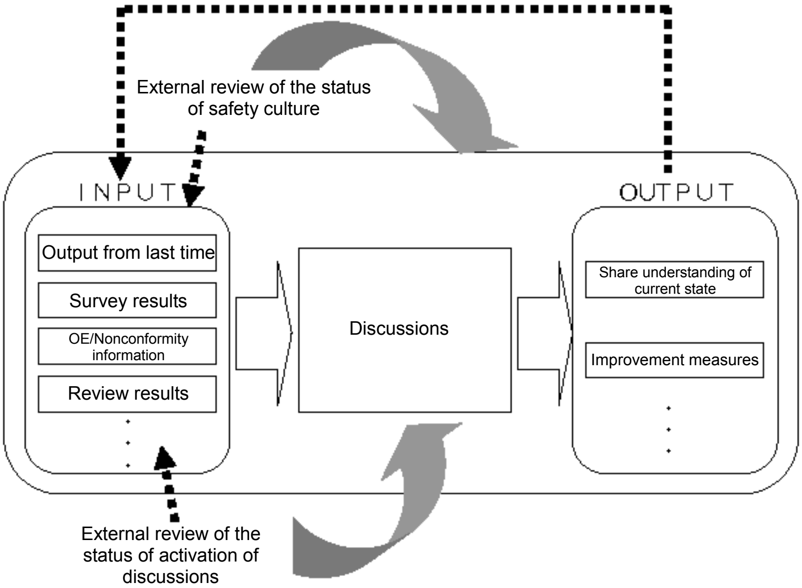


Figure 4-3: Illustration of Initiatives

The safety culture to be achieved by the nuclear power department includes "assuring the safety of facilities and people involved in the work," which applies to the entire company, and "assuring the safety of people in the communities and society." This means that the safety culture must satisfy two objectives of "operating the nuclear power station stably and not allowing the emission of radioactive materials." Thus, the "7 principles of safety culture" consists of items common to all divisions and items that are unique to the nuclear division. Therefore, in order to disseminate a safety culture within the nuclear power departments, the effort will begin by having multilayered discussions among levels and organizations related to aforementioned nuclear safety, but the following effort will also be carried out in response to the nature of safety culture (See Table 4-3, Figure 4-2, and Figure 4-3).

For the common items, such as example by leadership, building trust, an inquiring attitude, and a learning organization, each person will improve his/her own efforts by proactively referencing the safety measures for personnel and facilities and the improvement plans for knowledge and awareness, which are carried on throughout the company, or by referencing various efforts carried out by other departments of the company or other companies (both the same business or different businesses alike). Also, for items unique to the nuclear division or items that are significantly influenced by unique conditions, improvement will be made by referencing the efforts of domestic or overseas nuclear-related organizations.

4.2 Enhancement of Oversight and Support for Management

(1) Establishment of an Internal Regulatory Organization

As this is a company that handles the unique risks of nuclear power generation, for the purpose of strengthening the risk management related to nuclear safety by the Board of Directors, which is the highest-ranking body responsible for management, the Nuclear Safety Oversight Office will be established as the internal regulatory organization reporting directly to the Board of Directors. While making effective use of the opinions of third-party specialists who are independent of the executive, the Nuclear Safety Oversight Office will carry out independent, direct evaluations of the executive's management of nuclear power and report to the Board of Directors. The executives will be monitored and provided advice regarding nuclear safety from the Nuclear Safety Oversight Office (see Figure 4-4).

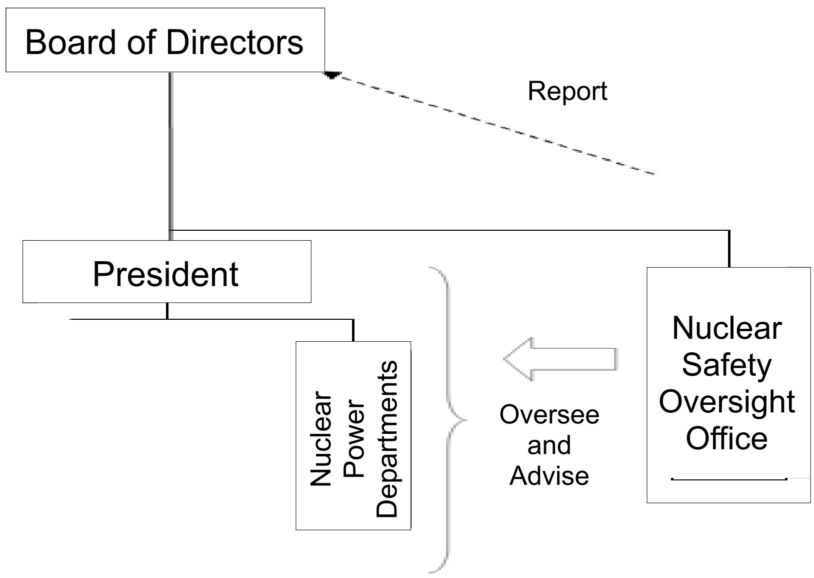


Figure 4-4: Illustration of the Nuclear Safety Oversight Office

The executive side of the nuclear power departments will be monitored and be provided with advice on a daily basis, and the president will be provided with such periodically and when emergency nuclear power safety countermeasures are necessary. The Nuclear Safety Oversight Office is to report to the Board of Directors periodically and when nuclear power safety countermeasures are necessary.

The functions and composition of the Nuclear Safety Oversight Office are as described below, and the Office will have the right to freely access internal information, meetings and other matters relating to nuclear power safety.

1) Monitoring and advice for the president and nuclear power leaders

- Safety consciousness of the president and nuclear power leaders
- Message transmission and dissemination status
- Management reviews and performance reviews
- Convocation of nuclear power safety review committees (provisional name; to be newly established)

2) Monitoring and advice for work processes and their results

- Work processes that contribute to improvement of nuclear safety and their results
    - Design reviews, non-conformity management, management reviews
    - Risk management, periodic safety reviews, stress tests
- Work processes which make use of management observation

3) Monitoring and advice for activities that promote a culture of safety

- Status of the dissemination of the safety culture
- Status of safety culture self-assessments
- Measures for increasing the effectiveness of discussions on safety culture

4) Analysis of information necessary for the implementation of 1) through 3)

- Collection and analysis of up-to-date information which is the cornerstone of nuclear power safety monitoring and advice activities
    - Status of nuclear power safety initiatives by nuclear operators and organizations in Japan and other countries
    - Trends in regulation of nuclear power in Japan and other countries
    - Information released by research organizations related to nuclear power in Japan and other countries
    - Information about problems from other industries and operational experiences (OE) in Japan and other countries

The director of the Nuclear Safety Oversight Office is to be brought in from outside of company (including someone from another country). In order to carry out the functions described above, there will be approximately 20 persons working under the director (1/4 from outside the company, 3/4 from within the company), with roughly 2 in residence at each power station. These persons will work in liaison with the chief reactor engineers.

(2) Improving the Role of Middle Management

Although reform is promoted to instill an awareness of responsibility in nuclear power leaders and enable them to carry out that responsibility as described in 4.1, middle management personnel (general manager and manager levels) also need to be a sufficient awareness of their own responsibility for safety, and they must have the awareness and skills to completely fulfill their responsibilities in regard to nuclear power leaders.

If a nuclear power leader underemphasize safety or appears to take an attitude toward excessively delaying a conclusion, middle management must speak up. They must understand the situation and provide the materials necessary for making a determination to management at an appropriate time without having excessive trust in the intentions of superiors or remaining silent out of fear of making waves. There are cases in which middle management of a company sounded the alarm regarding the need for investment in facilities for earthquake countermeasures for safety purposes for four years before succeeding. Rather than repeating the same explanations, advice that constantly incorporated the most up-to-date information and aimed to minimize risks can be considered to have properly guided management in making decisions and is said to have minimized damage from the recent Tohoku-Chihou-Taiheiyo-Oki Earthquake. Additionally, at TEPCO, there is the example of repeated proposals to change the design for the reactor building of the Higashidori nuclear power station to one that would provide a greater level of seismic tolerance than that required in licensing and approval, which was based on lessons learned from the Niigata-Chuetsu-Oki Earthquake.

It is important that middle management should not underestimate their line responsibilities (division of duties and authority) and actively put forth their opinions, and their fundamental role is to show such an attitude to their subordinates, which bears responsibility for the next generation. Points that will make it possible for middle management to do this are given below.

1) Highly sensitive, highly stable:
   Be aware of problems at all times and sensitive to external information. Additionally, increasing one's specialized knowledge and experience while understanding processes that precede and follow your own duties will increase the stability of management.
2) Daily self-discipline:
   Rather than aiming to obtain a management position, employees should continuously engage in learning themselves in order to make some progress every day.
3) Beneficial effect on one's surroundings:
   Actively engage in communication both inside and outside the company and continuously work to convey a good influence at all times in order to ensure the safety of one's surroundings.

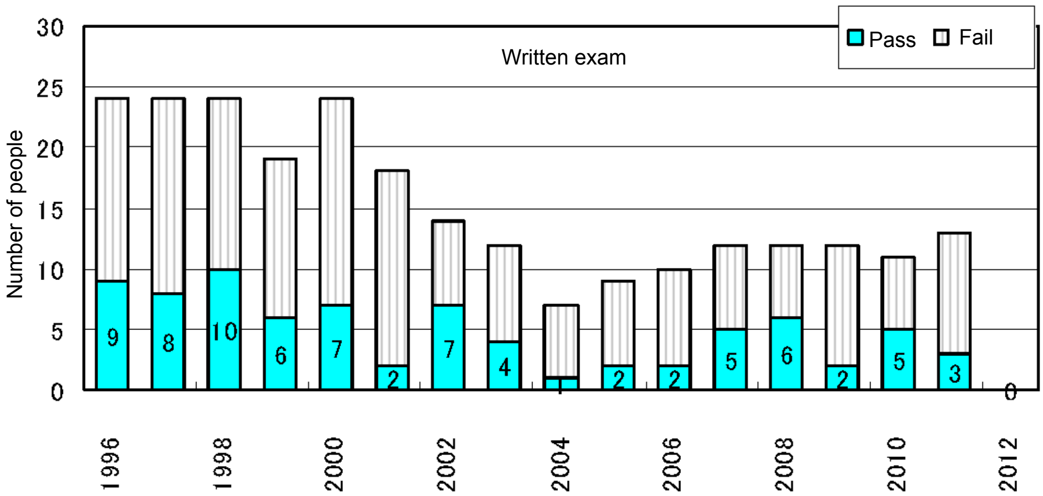
Persons who become more likely to "see more than other people, see things which are farther away than other people can, and see things before other people do" as a result of doing these things will be suitable candidates to become nuclear power leaders.

In addition, middle management also has a role to play in issuing commands to subordinates and following up on those orders. In particular, when it comes to safety, attention must be paid to looking at the nuclear power system as a whole and not being limited to a conception of work that aims at partial optimization of only one's own department. When it comes to one's own role in a severe accident (reactor meltdown), for example, it is useful to voraciously obtain new information and experiences while also referencing past failures, and periodically establish opportunities for reports that provide a big-picture view and hold discussions with superiors and subordinates. Additionally, in order to achieve these, efforts contributing to improved safety consciousness and technological capabilities by properly weighting challenges and resolving them on one's own will be evaluated so that proactively setting challenges and the process of addressing those are emphasized and we do not fall into the doctrine of attaching too much importance to results. Concretely, the 5 behavioral indicators will be evaluated in the same manner as corporate ethics, and, in addition, a 360-degree evaluation of how well one embodies the 5 behavioral indicators will be carried out by superiors, subordinates and colleagues.

(3) Reassessment of Status of Nuclear Safety Senior Engineers

As a result of the administrative order following the 2006 data falsification problem (Order Changing Technical Specifications, Minister of Economy, Trade and Industry (METI), May 7, 2007), a framework was adopted in which nuclear safety senior engineers were given the full-time role of responsibility for reactor safety and were able to report to the president independently of site superintendents. Up to that point, nuclear safety senior engineers were selected by giving a dual role to a qualified member of the leadership, such as the general manager of the department of engineering, operation and quality and safety, or the deputy superintendent. Also a person from the group level, mainly an engineering group manager or fuel group manager, might be named to the dual role only when there was a shortage of qualified personnel. When this position was a dual role, a single person was responsible for 1 or 2 plants, but since it has become a full-time position, a single person is responsible for 2 to 4 plants. Although appointment of a person at the line general manager level to a dual role had the disadvantages of increased busyness compared to full-time responsibility for nuclear safety and the inability to completely guarantee independence from the plant manager, appointment of a person at the line general manager level had the advantage of putting the reactor safety engineer in a strong position to speak out.

On the other hand, making the responsibility for reactor safety full-time means that the position has no subordinates or budget, making it more difficult for that person to have their voice heard within the power station when compared with prior to creation of the full-time position. Although a system for appointment of a nuclear safety senior engineer is legally mandated, because the desired function of the post is extremely important in terms of reactor safety as it monitors the safety of the reactor facility, the recruitment and appointment reflects the nuclear power leaders' awareness of reactor safety, and this is keenly felt by the power station personnel. Furthermore, a view of the status of recent nuclear safety senior engineer examinations (including internal screening tests, see Fig. 4-5) shows that the number of persons within TEPCO who are taking and passing the test is decreasing, suggesting that the position does not have ample appeal to encourage younger workers.



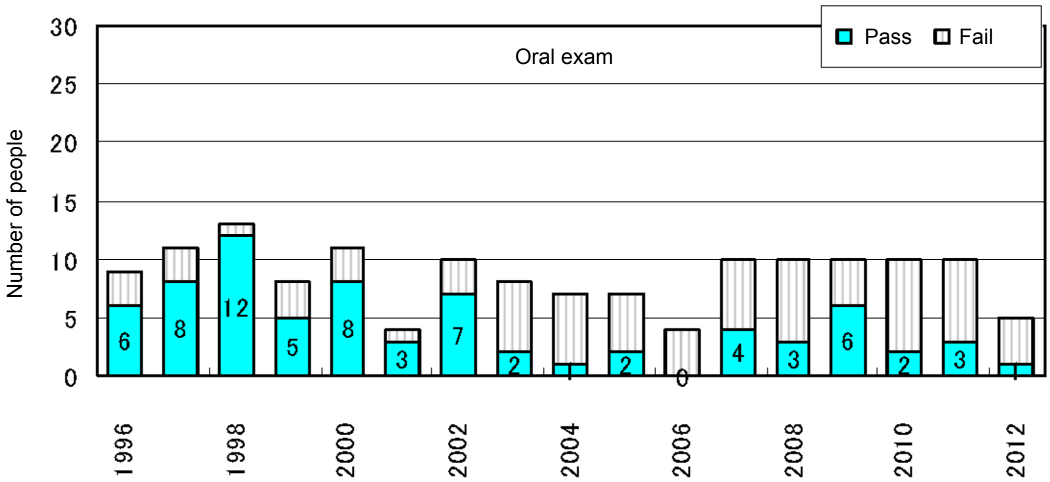


Figure 4-5: Number of Persons Taking and Passing the Qualification Test for Nuclear Safety Senior Engineer within TEPCO

Based on the above, from the standpoint of strengthening this position’s functions in assisting management and voice, the chief reactor engineer will work in liaison with the Nuclear Safety Oversight Office personnel who are in residence at the power station, and the persons, who hold that position, should clearly be selected from leadership level personnel (as a general rule, personnel with experience as unit superintendents, deputy general managers, or those who are candidates to hold those positions (general manager level).

4.3 Enhancement of Ability to Propose Defense in Depth

(1) Construction of Work Processes Enabling Build up of Defense in Depth

In addition to management leadership and safety culture dissemination activities leading day-to-day enhancement of measures to improve safety in nuclear power departments, “safety improvement competitions" will be held in order to strengthen technological abilities to consider safety measures from a wide range of viewpoints and then propose and implement those which are highly cost-effective. The goal of doing so is to encourage proposals that cross organizational lines while making the proposal and implementation of safety measures a part of daily work duties, with the experience of success that is gained from the certain implementation of excellent proposals for improvement providing the entire nuclear power division with a continuing consciousness of safety improvement.

[The Safety Improvement Competition Process]

1) Proposal of measures strengthening defense in depth

Proposals for expeditious increases in safety, separate from the ordinary budgets, will be actively solicited. Proposals for improvement will be made based on the results of various reviews for the improvement of safety (periodic safety assessments), OE information and various other sources of inspiration. The proposals are to concern measures for events which exceed design standards (such as measures to prevent or mitigate damage to the reactor core and improvements to emergency response), with the goals for the length and cost of the improvements to focus primarily on accumulation of successful experiences. The major focus of proposals is to be on AM measures (level 4 of defense in depth), but as they may also involve the emergency response that is included in level 5 of defense in depth, proposals may be made not only by engineering personnel, but open to all members of nuclear power departments. Proposals will even be solicited from departments not related to nuclear power.

2) Selection of superior proposals

Superior proposals will be selected from those described above by means of a competition (no limits on the number to be selected), which will be commended and publicized. Competitions will be held roughly twice a year, with the goal being continuous improvement of safety. Competitions are to be carried out based on accounting periods, and no prior budget appropriations are to be made in order to avoid giving the erroneous impression that there is an upper limit to the budget for the improvement of safety.

3) Implementation of detailed design

Detailed design of proposals which are adopted will be implemented under direct management in cooperation with relevant personnel in the nuclear power departments, research laboratories and group companies (project team or other such groups will be formed).

4) Implementation of work

The work implementation partners will be selected from group companies and contractors to carry out the work.

(2) Construction of Processes for Utilizing Safety Information

Making use of safety information such as internal and external OE information, regulatory information, scholarly trends and safety information from other industries is a particularly important part of the activities aimed at preventing accidents before they happen. The procedures by which OE information and other matters were investigated turned into processes that it was difficult to single out the lessons to be learned, so information regarding problems at Le Blayais, Maanshan and Madras nuclear power stations that may have been able to decrease the severity of the Fukushima Nuclear Accident, however slightly, was overlooked. A process for the utilization of safety information will be constructed based on awareness that things that happen anywhere in the world can occur at TEPCO's power stations (see Fig. 4-6).

[Process for Utilization of Safety Information]

1) Collection of information for input

- As can be seen in Fig. 4-6, there is a massive amount of information to serve as inputs. The responsibility and scope of authority for each piece of information was not necessarily clarified when the current work processes were investigated, so the information that is to be input is to be organized and the responsibility and scope of authority clarified.
- Because of the diversity of the departments that will deal with OE information, a framework through which it is possible to efficiently update, search and download information will be constructed by means such as making use of the non-conformity management system.

2) Screening

- The Head Office and various groups (including shifts) from power stations, who design and operate facilities, will conduct screening to extract matters for which some sort of countermeasure is necessary from the safety information that has been input into the database.
- The Nuclear Quality & Safety Management Department, which supervises all power stations, will conduct screening to extract matters for which some sort of countermeasure is necessary from the safety information that has been input into the database.
- Roughly once every 2 weeks, screening meetings will be held in order to mutually confirm that there are no gaps in the results of screening. Screening is to consider not only the cause and the prevention of events but also the possibility of an effect occurring which is similar to those resulting from the cause. Additionally, screening meetings will be carried out in a multiple-level fashion with group managers and general manager class personnel.
- Audits of the status and effectiveness of the screening activities of the Head Office, various groups (including shifts) from power stations and the Nuclear Quality & Safety Management Department will be conducted.

3) Preparation of impact assessments and consideration of countermeasures

- For items found as the result of screening, the Nuclear Quality & Safety Management Department will examine the likelihood of occurrence, cliff edge proximity, available options for countermeasures, scenarios in the event that no countermeasures are adopted, and the locus of authority, and prepare an impact assessment statement (see "(3) Construction of a Process for Improvement using Hazard Analysis" below).
- The issue in question will be described in a nuclear safety risk map (or hazard map) based on the prepared impact assessment statement, and risk management will be

carried out by the nuclear power departments.

- The status (in particular, the amount of time from screening to preparation of the impact assessment statement and from the preparation of the impact assessment statement to completion of the countermeasures) and the effectiveness of the nuclear power division's activities in relation to the impact assessment statement are to be audited.

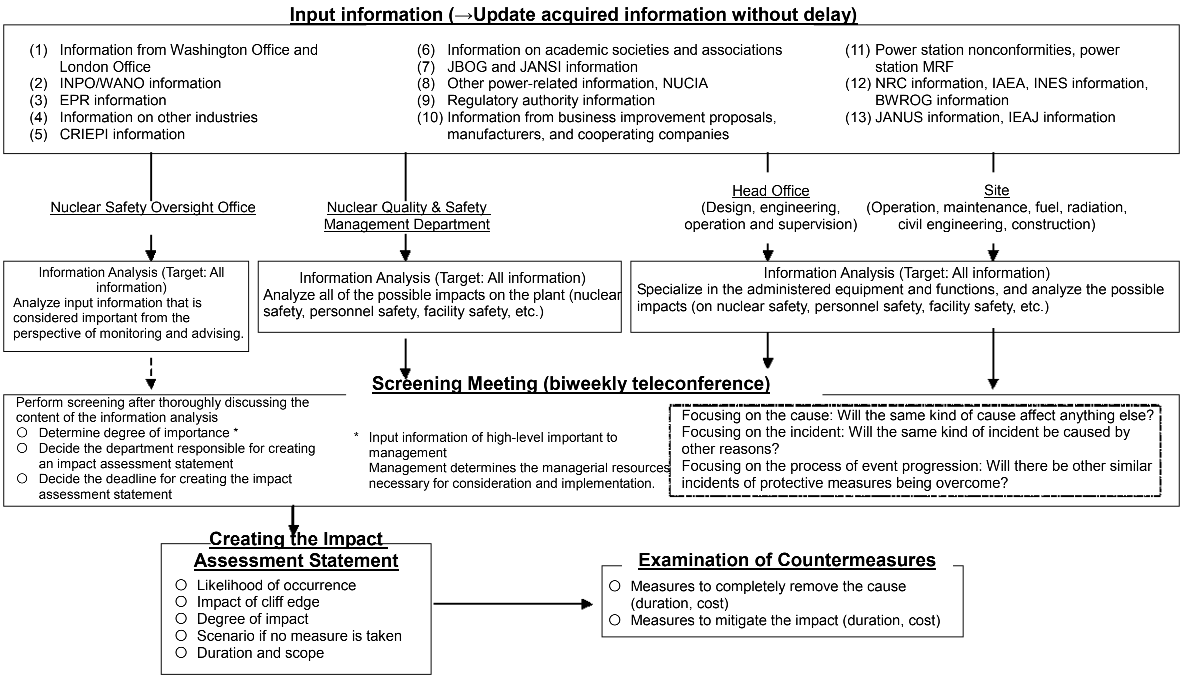


Figure 4-6 Process for Utilizing Safety Information (Illustration)

(3) Construction of Improvement Process using Hazard Analysis

It is clear from the root cause analyses in "2.1 Severe Accident Assumptions and Countermeasures" and "2.2. Tsunami Height Assumptions and Countermeasures" that approach and arrangements were not ample in preparation for events, such as a major tsunami which are subject to a high degree of uncertainty with regards to frequency of occurrence and have a high likelihood of going over the cliff's edge (external events having a major impact). Because of this, for measures against external events having a major impact, we will share problems in conjunction with even more concerned groups through hazard analyses, and will construct processes for making expeditious and feasible improvements, including countermeasures assuming the occurrence of such events.

[Hazard Analysis Process]

1) Confirmation of cliff edge risks

The Nuclear Quality & Safety Management Department will consolidate current evaluation methods, design guidelines, and other procedures for various external events on the basis of information from various groups at the Head Office and power stations and then use this data to sort out the treatment of uncertainties regarding the frequency of occurrence in the methods of evaluation, design tolerances in design techniques, and strength of events that will cause safety facilities and other equipment to lose function as well as other such matters. The Department will analyze and identify hazards that have high cliff edge risks based on discussions of safety with the various groups.

2) Examination of countermeasures

Groups at the Head Office and power stations will formulate and carry out improvement plans which take into consideration:

a) That there are limits on predictions based on scientific and technological knowledge

b) That it is important to promptly put feasible countermeasures assuming the occurrence of an event, even if quantitative assessments have not all been fully completed.

c) That it is possible to take countermeasures that do not involve expanding design guidelines (e.g., raising flooding embankments in the case of a tsunami), etc.

(4) Improvement of Process for Periodic Safety Evaluations

Previous activities carried out by nuclear power departments to improve nuclear safety include:

- Non-conformity management
- Utilization of OE information
- Feedback from the results of reviews by external organizations (OSART by IAEA, reviews and nuclear power quality audits by WANO and JANTI)

Their implementation status is confirmed during periodic safety reviews (PSR), but the perspective and frequency of reviews is not sufficient from the standpoint of nuclear power safety (PSR are conducted once every 10 years), and there are no reviews of proactive and continuous self-improvement activities for nuclear power safety.

In the future, reviews of nuclear power safety-related activities will be carried out with high frequency not only from the perspective of whether or not the pending issues or indicated matters are appropriately processed, but also to ascertain organizational weak points in the process of such disposition and to improve and follow up on those points. Specifically, in addition to non-conformity management, utilization of OE information and responses to external reviews, the results of activities relating to the improvement of nuclear power safety, such as plant walkdowns, will be reviewed comprehensively once yearly from the standpoint of improving nuclear safety (safety reviews), weaknesses relating to nuclear safety will be deduced and ascertained. An improvement policy, the persons responsible and response deadlines and other such matters will be specified and put into effect.

(5) Improvement in the Overstressing of Operational Evidence

With regard to construction of the quality management system (QMS), there was a tendency to perceive it as something that we were forced to do, and due to the circumstances of its introduction (see 2.4 (3) c)), it was difficult for us to come to the awareness that we should make improvements on our own initiative. Moreover, we became mired in a way of doing things where QMS was for meeting the demands of regulatory authorities.

The main issue with TEPCO's QMS is that despite the large quantity of rules and evidence, the increase in the quality of work is low in comparison. As for the large quantity of rules, such initiatives are in progress such to limit requirements in the manual itself so far and to put the procedures necessary for achieving them into guide form (for example, establishing standard methods). In the future, such work will continue to achieve the rationalization of processes and reduction in workloads. As for the large quantity of evidence, as same as manual, efforts for rationalization will be made with consideration being given to whether or not the required level is satisfied from the standpoint of legal requirements.

With regard to the implementation of these improvement measures, activity aimed at decreasing workloads are already underway as part of the reform and improvement activity for Kashiwazaki-Kariwa, and the effective and prompt implementation of the current main goal has been effective. Additionally, while power stations independently take action in this way, the Head Office, which is responsible for basic rules, will take action according to its role (e.g., conducting reviews to minimize the quantity of records and the workload involved in preparing them while satisfying legal requirements). Based on the current situation, a standardization of work was already carried out based on coordination with three power stations, but in the future work will be optimized with a focus on Kashiwazaki-Kariwa, with the results being applied to Fukushima Daiichi and Fukushima Daini (due to differences in the characteristics of work at Fukushima Daiichi, application will depend on the content). The role of the Head Office will be to support the optimization of work that is carried out by Kashiwazaki-Kariwa.

Up to now, rather than guidelines and demands regarding safety, regulatory authorities, including safety inspectors stationed at power stations, have made specific demands regarding the preparation of evidence and rules, but, based on the current aim, the approach of TEPCO will be to make the degree of contribution to safety as our main pillar, make determinations based on technical aspects and rationality, and undertake the appropriate response and explanation.

(6) Uniform Management of Work Evaluations Related to Nuclear Safety

In order to build up a defense in depth, the motivation to encourage improvements in work that contribute to the improvement of safety is important, and it is necessary to proactively evaluate attempts at improvement and the outcome (see 4. 2 (2)). Particularly important for this is that management charged with human resource development in the Nuclear Power & Plant Siting Division provide uniform management of personnel rotations and performance evaluations for all including the Head Office and power stations and implement personnel rotations which take the education of human resource development into consideration and construct a system for evaluations so that individuals who produce excellent initiatives and results that contribute to improvements in safety are not buried within a large organization.

There is a limit to the number of people that one person can supervise (see 4. 5 (1)), and this can also be said for performance evaluations. In other words, it is difficult to say that the current situation in which general managers and group managers evaluate dozens of subordinates is properly observing and evaluating those subject to evaluation. Accordingly, for future performance evaluations, the persons doing the assessment and the persons being assessed will be set in consideration of the limits to the number of people that the evaluator can supervise (authority to conduct the evaluation being given to the person who is well aware of the actual work, and higher-ranking personnel checking the results). Moreover, also when a project tackling a problem which crosses organizational lines has been launched, appropriate evaluators and evaluatees will be set, making it possible to properly observe the subjects even when the actual organizational affiliations and project framework differ.

(7) Improvement in Ability to Solve Problems Seamlessly across Organizational Lines

Up to this point, when various problems crossing organizational lines have arisen within the nuclear power departments, project frameworks have been established and efforts to resolve the issues carried out, but as described in 2. 4 (3), this approach cannot be said to have achieved its desired result in all cases. This is thought to be due to insufficiencies in aspects such as establishment of the project framework, assignment of work duties to project leaders and the configuration of project deadlines. Accordingly, the following policies will be followed in the future.

- When there is a problem that crosses organizational lines, nuclear power leaders will construct the project framework (including forming feasible groups under the authority of a

Head Office general manager or site superintendent), designate the project leader (general manager or group manager), and clarify responsibility and authority, goals, expected results, deadlines and other specifics utilizing the intranet or other such means.

- As a general rule, project leaders are to be full-time, and the organizational director of the project himself will apportion the necessary resources.
- Project leaders are to solve problems as representatives of the organizational director and are responsible for goal attainment. There have been cases where goals have not been achieved due accidents, troubles, or other such problems in the past, but, because the occurrence of accidents and trouble is a real possibility, they are not to be used as a reason for failure.
- Project progress is to be periodically reported to the organizational director and also shared with the organization in question, with support from other groups being requested if necessary. If the progress of the project is not satisfactory, the organizational director may redeploy resources.

Projects carried out according to this policy are to be determined based on the judgment of the organizational director, but the “introduction of IT for support of work duties (maximo phase II),” which must be carried out laterally between the maintenance and systems departments and the Head Office and power stations is the most important task for promoting the rationalization of work, and it is to be tackled as the first example.

(8) Reassessment of Personnel Transfers between Departments

As discussed in 2. 4 (3), although divisional exchanges achieved results at the individual level, organizational results were difficult to observe, and the objective was also ambiguous. Because of this, the goal for future divisional exchanges will be specified as "awareness of work improvements" and "learning viewpoints of outside the company.” The following will also be addressed in addition to the exchanges that have taken place so far. Also, site superintendents and other high ranking personnel are to proactively gather opinions and suggestions from exchange participants, judge whether or not to adopt them or make improvements, and then will promote organizational reforms.

<Persons dispatched from the nuclear power departments to other divisions>

1) Personnel will be dispatched to divisions that have direct contact with customers such as the Customer Consultation Office or Customer Center where an external view of the company can be acquired while providing appropriate responses to inquiries, etc.
2) Personnel will be assigned to positions of responsibility in other divisions or facilities departments with backgrounds other than nuclear power, broadening horizons with regards to facilities management and risk management, issues which are to be reflected in the nuclear power departments.

<Persons dispatched to the nuclear power departments from other divisions>

1) Groups or teams that require generalized knowledge of electrical and communications systems rather than an extensive specialized knowledge of nuclear power are to be established, and engineering and communications employees are to be assigned in a certain number according to each work unit. Doing so will make maximal use of specialized practical abilities within the field of expertise and can also be expected to improve work arrangements for the duties in question and have a ripple effect on other groups within the power station through organizational efforts.

2) Filling posts such as work planning and human resource development that the nuclear power division is responsible for while taking care not to weaken functions that

directly oversee nuclear power safety as a whole will be lead the initiatives and management of other departments to be reflected by in nuclear power departments.

Other personnel education exchanges for young engineers will continue to be carried out according to current company-wide policies in parallel with personnel exchanges that focus on leadership candidates.

4.4 Enhancement of Risk Communication Activities

To reduce residual risks to a social acceptable level, we aim to realize the redundancy of defense in depth. However, if revealing risks leads regulatory authorities and siting communities to demand excessive countermeasures and "thinking grinds to a halt due to fixed notions" that forces the shutdown of nuclear reactors. Then, in order to end this delusion, risk communication will be promoted based on the idea that the beliefs held by nuclear leaders themselves that "nuclear power is not absolutely safe (zero risk)" and which gives siting communities and society an understanding of the safety measures to counter those risks.

Furthermore, as an operator who has caused an accident, we have a duty to announce risks and convey the countermeasures to society. We must accurately communicate the risks of a nuclear disaster, share and accurately face the doubts and anxieties that people in society have. Through such communication, we believe that we will be able to obtain beneficial information about risks which we have not noticed, and, although there may be an extremely low probability of such risk, we will be able to share the countermeasures which ought to be taken against risks[29] whose impact would be extensive if they occur and the socially acceptable level of risk.

In addition, risk communication is not limited to the field of nuclear safety, but is applied for the all business operations, especially those of nuclear power departments, to continuously check and correct gaps in the ways of thinking and benchmarks between society and us. It is also carried out to enlighten groups and individuals through the check and correction processes. For this purpose, the Social Communication Office, which will comprise outside experts, is to be established to collect and analyze risk information in a broad and integrated manner to provide systematic consultation services and to give necessary instructions and responses. The Office will make use of risk communicators to initially provide daily cooperation and support to employees and organizations in nuclear power departments so that they not only is compliance legally, but also in conformity with social benchmarks.

Basic Policies

- Communicate risks relating to nuclear power safety. Management and nuclear power leaders are to take the initiative in supporting the announcement of risks and work to ensure that its purpose and necessity are transmitted throughout the entire division.

- The circumstances encompassing TEPCO will be properly understood, and the corporate culture will steadily be improved so that gaps do not arise with society in the benchmarks for making decisions or our approach.

[29] However, even with regard to risks which are considered extreme, we will also take into consideration closing the power station if the unanimous request of all of society is that such a countermeasures should be taken.

(1) Posting of Risk Communicators

In order to achieve the basic policy described above, risk communicators, a specialist position which will implement risk communication, are to be instituted in a position close to management and nuclear power leaders. Risk communicators are to propose measures and policies for explanations based on society viewpoints regarding risk awareness, formulation of countermeasures accompanying announcements and the limits thereof to the management and nuclear power leaders, and conduct risk communication according to those policies. Management and nuclear power leaders are to request the opinions of risk communicators when making major management decisions, and are to be certain to respond on the opinions which risk communicators put forth having drawn upon the requests of siting communities, society and regulatory authorities (such as by approaching concerned parties inside the company).

Risk communicators will always have an understanding of these requests mainly for information related to the nuclear power departments, will promote risk communication from the viewpoint of local citizens and all of society, and will have a role in making suggestions to the management as to which risks the company should be aware of and announce. Therefore, the following types of characteristics are to be found and selected when appointing risk communicators.

- Persons who have experience with numerous engineering type operations in the nuclear power departments [30] and have an extensive personal network.
- Persons who have a high ability to gather information and who have minds that learn constantly by talking with people inside and outside of the company.
- Persons who can provide justified and sensible advice to management and nuclear power leaders.

With regard to specific assignments, of the 24 positions that have been announced as risk communicators and belonging to the team directly reporting to the president as described later, 10 will be assigned to the Fukushima region (Fukushima Revitalization Headquarters, Stabilization Center, Fukushima Daiichi, Fukushima Daini), 10 to the Niigata region (Kashiwazaki-Kariwa, Niigata office) and 4 to the Head Office (Plant Siting & Regional Relations Department).

Because risk communicators must have a broad knowledge and experience in various fields related to nuclear power, planned personnel rotations will be carried out for future risk communicator candidates for periodic assignments in the future. Nuclear power leaders will have responsibilities such as training and evaluating risk communicator candidates and appointing them to power station management positions after their assignments as risk communicators have come to an end. Additionally, in Corporate Communications at their assigned location, they will learn skill for responding externally and promoting the acquisition of the viewpoint of society, and these skills will be evaluated periodically by individuals outside of the company. Also, periodically naming engineers from the nuclear power division as risk communicators will increase the number of people with high-level communications skills, and will allow considerations on the entire nuclear power division from perspectives of the community and society.

(2) Implementation of Risk Communication

Risk communicators will perform all facets of nuclear power communications in relation to all stakeholders. An appropriate work rotation will be implemented so they can gain experience

[30] Not limited to personnel in the nuclear power departments; technical and clerical employees from other divisions who are considered suitable can be asked to purposefully obtain work experience related to nuclear technology.

dealing with all stakeholders. In particular, within Fukushima Prefecture, the risk communicator provides explanations regarding circumstances of Fukushima Daiichi in fields concerning restoration, decontamination and compensation activities in liaison with persons in charge of public relations and plant siting. Also, at each power station, the risk communicator carries out technical communication with the workers of contractors, and asks for an accurate understanding of the relevant facts.

The purpose of risk communication is to "disclose risks, to explain and conduct a dialog about the reinforcement of the safety improvement measures at nuclear power station to counter the risks, and to obtain a certain level of understanding about the substance of the measures." However, in order to undertake these duties, it is vital that trust be fostered between TEPCO and the siting communities as well as society. Consequently, the basic process for risk communication will be carried out as per the following procedures.

i. Disclosing information
   Face the other party. Listen to what they are saying, identify with and understand their questions and concerns.
   ↓
ii. Providing explanations
   Provide an accurate and courteous explanation taking into account the other party's living environment, knowledge, and other factors concerning safety measures, risks of radioactivity and radiation, etc.
   ↓
iii. Communicate with each other
   Both parties understand what the other desires and TEPCO's ideas.
   ↓
iv. Building a trusting relationship
   Continue a dialogue based on mutual trust.

Based on the circumstances of having caused severe accidents, TEPCO needs to recognize that it is not easy to rebuild trust once it is lost, and we need to understand the thoughts and feelings of people in society and the siting communities and to continue sincerely explaining and conducting a dialogue. We will continue to provide detailed explanations and dialogue in detail with people in the community, and to make serious and steadfast efforts while listening to what others (society) are saying in all sorts of situations, including communicating with contractors, providing timely and appropriate to the media, and so on.

All sorts of information within the power station will be relayed to risk communicators in order to understand the way of thinking of the nuclear power leaders and to offer comments on explanation policy related to public announcements of risks, formulation of measures and other such matters. In addition, risk communicators will work to share information and communicate with nuclear power leaders and nuclear power departments through participation in in-house committees on a regular basis. Furthermore, risk communicators also prepare frameworks for sharing knowledge and issues and preventing variability among the Head Office, power stations and individuals (resident at both Head Office and power stations), and will raise the ability of the risk communicator team especially for responding to emergencies.

Risk communicators possess the mindset and preparedness of a specialist in communication. They listen to what others say who have different standpoints and differing environments, and reply clearly and steadily in an easy to understand manner. They are sought out to appropriately carry out crisis communication in an emergency. In order to foster such skills and to carry out good communication with people in the siting communities and society, a risk communicator continues to learn from the hands-on experience of everyday conversations, and carries out situational setting-type training to provide a cool-headed response in an emergency, while seeking guidance and advice from outside experts. Furthermore, the previous roles and functions of "Engineering and PR officers” and the “PR spokesperson (nuclear power departments)” will be progressively incorporated into the risk communicator system and reinforced in terms of quality and quantity (see Table 4-4).

Table 4-4 Framework for Promotion of Risk Communication Based on Past Issues

	Engineering and PR officers	**PR spokesperson**	**Risk communicator**
Time established	➢ After falsification of data (Mar. 2007 onwards) ➢ Strengthening of roles after publishing findings on FB fault lines	After Niigata-Chuetsu-Oki Earthquake (Dec. 2008 onwards)	After accident at Fukushima Daiichi NPS (prospectively from Feb. 2013 onwards)
Form	Permanently stationed	Responds only during emergencies	Permanently stationed
Role	➢ Convey in an easy to understand manner information related to plant operation from the perspective of the community ➢ The Head Office and power stations to cooperate and become a cornerstone of providing information to the community	➢ Cooperate with the PR Department and other departments to quickly provide accurate information in the event a major crisis arises having an impact on society	<Role> ➢ Further strengthen items described on the left <Challenges> ➢ Management and nuclear leaders take the lead to support risk announcements ➢ In terms of management, delegation of authority to offer opinions has been clarified and monitoring mechanisms have been put in place ➢ During normal operations, steps into the details of operations to collect information, and works to educate others by being aware of and sharing the importance of sensitivity to the feelings and ideas of people in society ➢ During emergencies, posted in the command system of the Head Office PR team chief
Problems	➢ Risks went unannounced which could have led to a severe accident ➢ Unclear authority of “responsibility for engineering and PR officers (not defined)	➢ Absent during emergency due to the priority of duties in department assigned to ➢ Route for instructions were complex	
Points to overcome	➢ Clarifying principles for risk announcements ➢ Clarification of delegated authority and strengthened personnel	➢ Permanently stationed (including daily training) ➢ Unified command system	

(3) Establishment of Social Communication Office

As described in 2.4 (4) a), the nuclear power departments and the entire company have been taking the position that the right approach in dealing with society is "to just calm down the situation.” We were missing the attitude to take sincere action according to society’s standards and to carefully consider information that should be shared with the society and to communicate it. In dealing with the National Diet Accident Independent Investigation Commission also, we were culturally unable to recognize that it was a problem to raise the anxiety of people in society through an insincere response. Therefore, if reform of our corporate culture is not implemented, risk information will not be able to be properly shared, and there is a concern that, even if the aforementioned risk communicator position is established, it would not function effectively.

In order to promote sincere communication related to nuclear risks with society, the pressing issue is to work to improve by delving into corporate culture issues in the nuclear power departments. We regret that past improvement activities were not able to delve deeply to the roots of our corporate culture. However, this time, we will invite experts from outside the company, correct the gaps in benchmarks with society promptly and forcefully, and, at the same time, develop a framework that promotes risk communication in accord with society.

Specifically, we will establish the Social Communication (SC) Office (approximately 10 personnel) under the direct control of the president, and the director of the Office will be appointed from the outside of the company[31]. The SC Office will first urge the nuclear power departments to improve their culture by undertaking educational activities on the viewpoint and standards of society by thorough risk management.

- Educational activities for inside the company[32]
    - Risk communicators will be utilized to delve into the substance of operations to collect risk information, and such personnel will carry out educational activities to raise awareness about the importance of sensitivity toward the feelings of people in the siting communities and society.
- Information collection related to activity status, and improvement instructions[33]
    - Collected risk information will be analyzed and instructions given for the respective countermeasures necessary for potential and actualized risk in light of the standards of society.
- Sharing of examples of improvement directives within the company
    - Details of improvement directives will be shared widely within the company to contribute to improving the culture of the entire company and risk management.

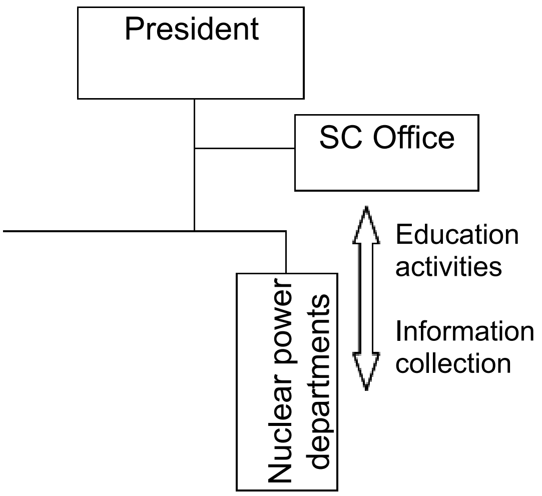


Figure 4-7 Illustration of Social Communication Office

31 Responding to Improvement Request b) from Third Party Investigation Committee
32 Responding to Improvement Request a) from Third Party Investigation Committee
33 Responding to Improvement Request c) from Third Party Investigation Committee

Risk communicators will assigned to the SC Office and perform the following functions.
- Input to the SC Office:
    - From information about nuclear power departments and daily dealings with outside parties, any perceived risks that may have significant impact in regard to management will be proposed as risks to be handled by management.
    - Risk communicators will manage risks confronted by the nuclear power departments as well as any concerns or matters in dealing with outside parties, and will share such information with the SC Office and all risk communicators.
- Output from risk communicators:
    - Each risk communicator will create talking points when presented with public announcement guidelines related to the important matters by the SC Office, and will implement risk communication on their own in the field.
    - Through the daily nuclear power communication work, risk communicators will acquire the viewpoint of society and take on some of the educational activities themselves for the nuclear power departments.

(4) Improvement of Skills for Conducting a Dialogue with Regulatory Authorities

TEPCO has been undertaking a broad range of technical explanations and discussions with regulatory authorities on topics such as compatibility with the existing legal requirements and guidelines, the examination of new technical guidelines, responses to problems in Japan and other countries. Basically, TEPCO has been engaged in discussions about safety, but even if these were initially technical discussions about as a plutonium thermal reactor use, long-term operation cycles, and introduction of the online maintenance, the matters which seems to be of great concern to the community and society, were not necessarily just technical discussions. Moreover, since introduction of the quality management system, the focus of these discussions tended to go too much towards compatibility to quality assurance requirements and guidelines, which is not closely related with safety, and away from discussions about safety requirements and guidelines. Along with this trend, we made decisions based only on the requirements put forth by regulatory authorities, responded without thinking independently about the technical significance, and we became increasingly reluctant to put the work into holding discussions, and started addressing rules or evidence that does not lead to safety improvement. We would spare our labor for efforts such as preparing rules and evidence which had no connection to improving safety.

In the future, we will practice and continue a dialogue centered on safety from the standpoint of improving safety based on technical grounds, and not perform work while remaining unconvinced technically just "because it is a request from regulatory authorities” nor fall into the rut of discussions in terms of quality assurance focusing mainly on manuals and evidence. In doing so, our basic goals will be to improve our technological capabilities for safety and to improve our own dialogue skills. In practicing this, everyone from the nuclear power leaders to working-level personnel will be required to have a shared recognition of the importance of conducting an appropriate dialogue with regulatory authorities. In particular, since the Head Office nuclear power departments account for a majority of the work of responding to regulatory authorities, the aforementioned dialogue will be promoted with general managers and deputy general managers serving as the risk communicators.

4.5 Reform of Emergency Response Organizations at the Power Stations and Head Office

(1) Reform the Emergency Response Organization (Introduction of ICS)

1) Aims of reform

A factor preventing prompt and appropriate decision making from being made amidst confusion in the field when responding to the Fukushima Nuclear Accident was that “information sharing and the command system at the power station headquarters was in confusion.” This situation occurred against the backdrop of imperfect preparation assuming simultaneous disasters at multiple units and organizational flexibility not being ample, and, more specifically, the following phenomena occurred.

- The system for sharing information became unusable following the loss of power.
- The delegation of power from the site superintendent was not appropriate, and there was a framework in place where site superintendent made most decisions.
- Despite the fact that accident conditions and progression differed for each individual unit, activities were carried in the conventional functional team units.

In the future, along with implementing a thorough facility response, it is necessary to prepare a status in which an organizational response is possible that does not allow a severe accident to result or mitigates the impact of an accident in responses when accidents end up occurring.

a) Construction of resilient organizations

The nuclear power department has taken the safety measures by means of building a robust system and by predicting damage based on certain assumptions and enhancing preparations against such. However, these means are limited in that "preparations are not made for damage which has not been assumed and no response can be mounted.” In the response to the Fukushima Nuclear Accident, it was precisely this limitation that became a problem. In the future, even in cases where a situation results which is beyond the scope of response and may arise even if anticipated and prepared for, it will be necessary to respond so that a state of normal equilibrium is restored without descending into an irrevocable situation and causing system collapse.

"The capability to maintain or restore a system to normal equilibrium even in the face of an extremely disadvantageous situation exceeding the response range of such a system” is known as resilience[34], which is defined as “resilient” in this report. Also, a response making use of this capacity is defined as a "resilient response.” In order for there to be organization capable of responding with resilience, the people who belong to the organization must have the initiative and cautiousness to respond to ever-changing situations, the ability to be able to carry out responses to changes as quickly as possible. They must consider the possibility that having the operation not adhere to the original plan may be necessary for the greater purpose of avoiding a decisive catastrophe.

Although there were problems in the organizational framework, among the responses carried out during the Fukushima Nuclear Accident, there were instances in which flexible responses were implemented exercising the above mentioned capabilities, such as the example of the shift supervisor in the main control room setting the rules when going out into the field in keeping with the situation (see Attachment 4-1). Such a response was made under near-extreme conditions. If a wide-range of preparations can be made in advance, that is, if personnel can broadly anticipate the risks to be responded to, prepare a work

[34] Resilience is originally a term of physics associated with stress, and stress is “distortion due to external force,” and resilience means the “ability to repel distortion due to external force.” This term has been used in the field of psychology and psychiatry as well. At present, this term has been used in the sense of restoration from damage, including a devastating disaster.

environment and gain experience through training, it is expected that a more appropriate and better response to reduce damage will be possible.

In consideration of the aforementioned factors, we will introduce the Incident Command System (ICS), which is an organizational framework for emergency response which has been standardized in the United States in order to carry out organizational responses with resilience when an emergency situation hits.

b) Basic approach of the incident command system (ICS)

The Incident Command System (ICS) is an organizational framework standardized for emergency response in the United States. The ICS is a system with an extremely high level of flexibility, capable of operating regardless of the extent of the situation that is being responded to. At present, it has been adopted by many governments and administrative agencies as well as military, firefighting, police, medical and other institutions, and it embodies the following characteristics.

<Characteristics of the Organizational Structure >

- <u>Establishment of supervisory limits (Maximum of 3-7 Persons)</u>

  The general rule is that the ICS is structured with the incident commander (field commander) at the top with direct subordinates confined to a range of 3 to 7 people. The significance of this structure comes from the fact that, based on experience, the number of people that a single person can directly give instructions and orders to in an emergency is limited to 7 (ideally no more than 5).
- <u>Organizational structure able to be scaled down or up in response to the magnitude of a disaster</u>

  The basic functions are command, operations (field response), planning (information collection and plan formulation), logistics (resource management), finance and administration. If possible, the field commander may carry out all of these functions, but, may establish independent teams when necessary taking into account the scale of the response. As the scale increases, the organization is expanded by adopting a deeper, multilevel organizational structure.

<Characteristics of Organizational Operation>

- <u>Clear command system in which only the orders of direct superiors are followed</u>

  Individuals receive briefings from the head of the organization that they belong directly to and gain a firm knowledge of the mission of each organization and their own role. Even if done with good intentions, individuals are not to act arbitrarily, without receiving instructions. Conversely, individuals are not to follow instructions from personnel who are not above them in the command system.
- <u>Clear division of Roles in which the field commander is given the authority to make decisions</u>

  The field commander is given the ultimate responsibility for responding to the situation, and the people around him (even those from higher-ranking organizations or in higher-ranking positions) are assigned roles in which they work to support the field commander (e.g., in the United States, even the President would be unable to give orders to the field commander).
- <u>Use of forms and tools for efficiency sharing information at all organizational levels</u>

  In order to compensate for discrepancies in the transmission of information resulting from a vertically-oriented command system, information transmission and collection forms are unified and tools for the provision of information are used so that the same information is provided to the entire organization.

- <u>Clarification of skills and requirements and thorough education and training to maintain them</u>

  In Japanese organizational frameworks, it is common for roles to be distributed based on job title or seniority, but an ICS operates so that "people who are able to exercise the duties" are put in each position, with the mission for each role being clearly articulated, the skills and requirements for the people who fill them being specified, and education and training being provided with the aim of enabling such personnel to fulfill these.

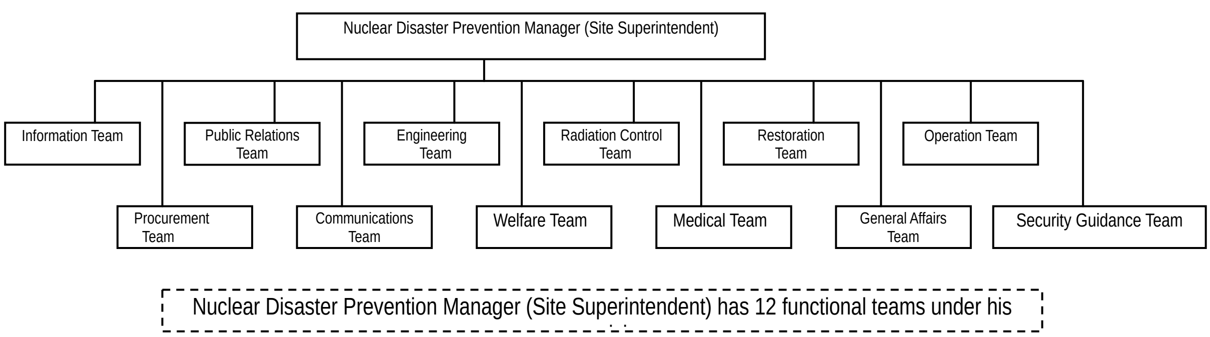
Because the ICS has the above characteristics, it is a resilient system for the purpose of responding flexibly to bring a situation under control, even, for example, when that situation exceeds assumptions. It is suitable for the goals for the emergency organization that is being considered here. For introduction of the ICS, we have investigated emergency systems at nuclear power stations in the United States. Based on those results, the following has been reflected.

- The power station emergency response organization has been arranged for every function, taking into account separating work locations. For example, the work area for the section reviewing measures to address technical issues is separated from that for the external response department so that each can concentrate on their duties without disturbance.
- Requirements for emergency personnel are specified, and a framework is created which allows teams to be alternated (In the United States, after emergency personnel assemble and ascertain the initial situation, a rotation system is laid out to control the necessary minimum number of personnel).
- Information sharing using systems is maximized. (In the United States, teleconferencing is not used, and information is basically shared over a system, and telephones are used if necessary. Since speaking out inside rooms is only when plenary meetings are held or important events occur, there is no sense of turmoil.) Preparations are also made in advance in case the system is inoperable. (In the United States, a white board having the prescribed format is readied in advance.)
- The frequency of training and its content are augmented. (In the United States, comprehensive training using undisclosed scenarios are implemented several times per year.)

2) Reorganization of power station emergency response organization

a) Approach of entire emergency response organization

The organizational framework during the response to the Fukushima Nuclear Accident is shown in Fig.4-8.



<u>Fig.4-8 Previous Emergency Response Organization</u>

Taking into account a retrospective view of the response to the Fukushima Nuclear Accident, we examined the following emergency response organization which incorporates the ICS framework. Furthermore, described in sections b through g is the example of the Kashiwazaki-Kariwa NPS.

b) New emergency response organization

Taking the basic characteristics of an ICS and the introduction example into account, the emergency organization of the Kashiwazaki-Kariwa NPS will be as indicated in Fig. 4-9. Furthermore, this organization chart is based on the assumption of the simultaneous disaster of all units (7 units), and it is necessary to reorganize as appropriate according to the scale and progress of the accident.

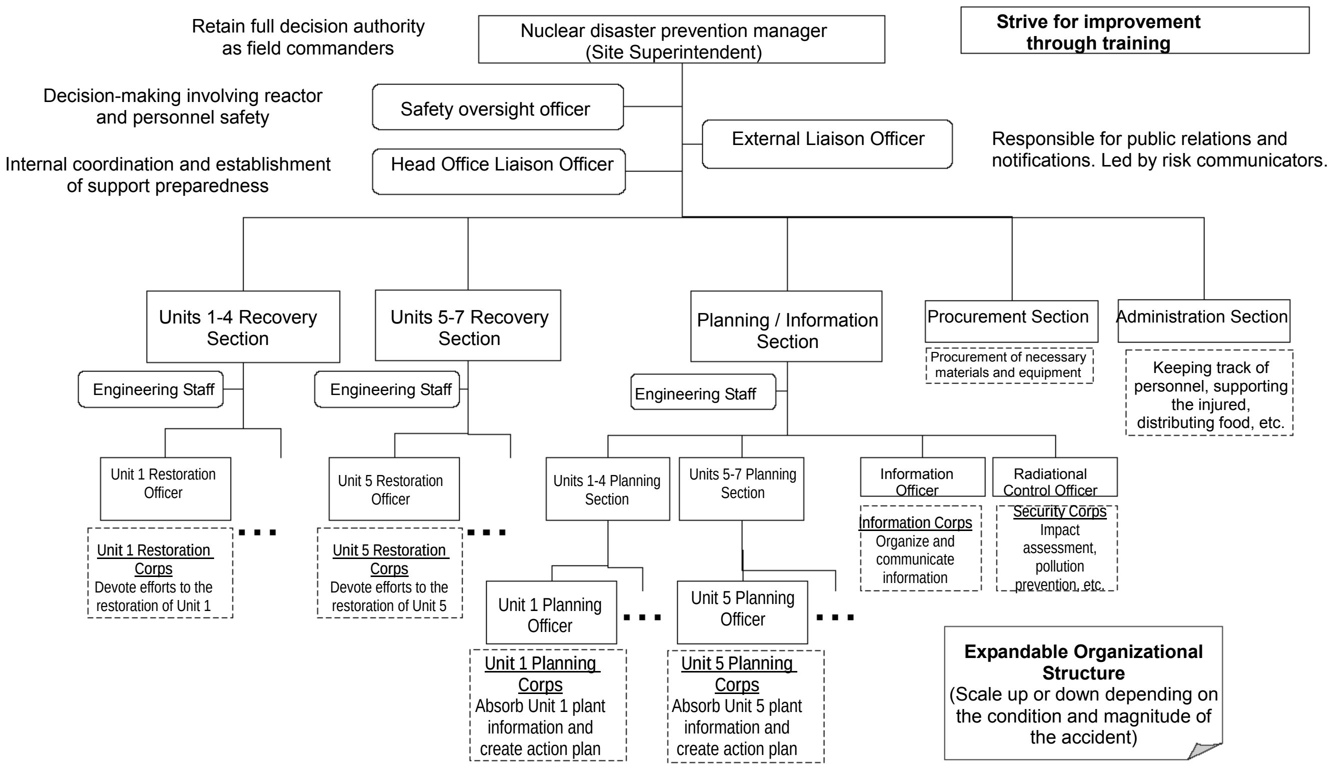


Fig. 4-9 Nuclear Power Station Emergency Organization (Ex. of Kashiwazaki-Kariwa NPS)

In this emergency organization, the site superintendent has overall responsibility for the accident response, and all accident responses are carried out in accordance with his instructions or requests. Those who the site superintendent actually gives orders or instructions to are the heads of functional units carrying out actual operations or logistic support. That is the five people in charge of Units 1-4 restoration, Units 5-7 restoration, planning / information, procurements and general affairs. The safety oversight officer, Head Office liaison officer and external liaison officer are active in supporting the decisions and activities of the site superintendent as his staff. In addition, they receive support from the Head Office in keeping with the site superintendent's requests.

The Attachment 4-2 shows the mission, roles and requirements of each functional unit, staff and other personnel in this organization. Each position in TEPCO's current emergency organization has been assigned to a managerial position (general manager, group manager, etc.) during normal times, but whether or not they had the competence commensurate with the relevant requirements was never before assessed. Meanwhile, at nuclear power stations in the United States, the responsibilities and authority of each position have been specified, and moreover, the competence (knowledge) necessary for each position as well as the method in which it is evaluated have been stipulated. Accordingly, in assigning people to such positions, with reference to the situation in the United States, we will assign people match the requirements for each position. For the time being, we are going to verify whether the person has the corresponding capability during training. In addition, we will maintain the necessary number of personnel within 3 years through human resource development and personnel rotations.

Additionally, along with working to improve for each individual's capabilities through repeated training in accordance with this framework, improvements will be made if weaknesses in the organizational structure are found.

c) First responses when accident occurs on holiday or at night

[Basic requirements for designing the emergency organization]

With a large-scale natural disaster as the initiating event and contingent upon unfolding an accident response which will be at the same level 24 hours a day, 365 days of the year (e.g. early morning during New Year's or during the day over a long holiday), we will assume the following chronological transition. The basic approach will comprise an emergency organization assuming the following conditions (see Table 4-5).

i. Period up to three hours after occurrence of an accident, respond with personnel at the power station for a period of (shift workers and night duty personnel).

ii. Period after three hours since occurrence of an accident, respond along with personnel assembled at the power station.

iii. After a period of 72 hours (3 days) following the accident occurrence, support from outside organizations is expected.

Because the Fukushima Nuclear Accident occurred in the afternoon on a weekday, many emergency response personnel could be secured. However, in the future, we will also assume that an accident may occur on a holiday or at night, and develop a framework that the first response can be executed by the operators on shift and night duty personnel. The assumptions and the goals of first response are as follows.

- The target of the first response will be the reactors in operation.
  - Cooling of reactors in shutdown and the spent fuel pools is not addressed in the first response since there is some margin of time.
- Conditions will be assumed in which the following may simultaneously occur.
  - Occurrence of earthquake equivalent to the design basis seismic ground motion
  - Scattering of debris due to a tsunami having a height of 15m or more (same magnitude as tsunami in the Fukushima Nuclear Accident)
  - Loss of all AC power sources
- Our goal is to restart cooling water injection as soon as possible after the accident occurs, and to ensure the reactor water level is over the top of the active fuel (TAF).
  - In the event all cooling water injection facilities are lost, including the reactor core isolation cooling system (RCIC) (AC power source not required), execute cooling water injection using the low pressure core spray system (LPCS) with power supplied by gas turbine generating vehicles within one hour.
  - Even if the gas turbine generating vehicles are not operable, promptly start supplying electricity using power supply cars, cooling water injection using fire engines and removing scattered debris following these operations and refueling.

Table 4-5 Assumed Chronological Transition of Accident Response

	Power station main control room	Power station seismic isolated building (power station emergency response headquarters)	Head Office (emergency response headquarters) other external organizations
Within 3 hours after accident [Targets: For heat removal, promptly ensure that the reactor water level is over the top of the active level (TAF).]	Recovery response using only shift workers	Night duty personnel implement the following: - Set up emergency response headquarters, and summon and instruct emergency response personnel - Collect information and review restoration policy - Transmit information (notifications, public announcements) - Field personnel undertake restoration activities (commence cooling water injection, restore power by starting up gas turbine generating vehicles, remove debris, etc.)	- Set up emergency response headquarters - Summon and instruct emergency response personnel - Collect information
From 3 hours to 72 hours after accident [Targets: Stabilize power station promptly and safely (improve reliability of first response measures)]	Respond while receiving support from the power station emergency response headquarters	- Start responses to stabilize the power station using the emergency response personnel who have been summoned. *	- Commence support for the power station* - Initiate request for support to external organizations* - Start holding press conferences*
After 72 hours since accident	[Continue]	[Continue]	- Target time when full support will be received from external organizations*

*: Transition to next phase as soon as preparations have been readied; each response may be moved up.

[Response immediately after accident occurs]

In the event an accident occurs (notification under Nuclear Emergency Act Article 10), the responsible personnel on night duty (agent of the Nuclear Disaster Prevention Manager) decrees a level 1 state of nuclear emergency, and establishes the emergency response headquarters with night duty personnel. Table 4-6 shows the number of night duty personnel based on the aforementioned assumptions and goals in a case where reactors are in operation at 2 units.

Table 4-6 Number of Night Duty Personnel Necessary for First Response (case of two reactors in operation)

Position	Number of personnel
1. Response personnel in the power station emergency response headquarters - Personnel in charge (nuclear disaster prevention manager class) - Planning and information personnel - Restoration personnel (coordinator) - Public relations and notification personnel - Safety personnel - General affairs and material personnel	20 persons
2. Response personnel in the field (electric power restoration, etc.)	10 persons
Persons on night duty Total	30 persons

The number of personnel will be reassessed in keeping with changes in the situation, such as when reliability and redundancy have improved due to conversion and augmentation of equipment. Also, the assumption and goals of the first response will also be reviewed depending on the results of the emergency response training. Also, the operators work in shifts, and first response will be undertaken by personnel on duty at that time. In the case of the Kashiwazaki-Kariwa NPS, before the Fukushima Nuclear Accident, there were always 41 or more personnel working on any given shift with 7 units in operation. After the Fukushima Nuclear Accident, we have reinforced each team with 1 to 3 more personnel (main control rooms differ depending on the facility being managed). Moreover, in the future, in order to undertake a respond in which, for example, the site is ascertained after the accident, applications are performed, and temporary measures are initiated, we have decided to gradually reinforce each team with three more personnel so as to always have more than 71 personnel on shifts when 7 units are operating. The following is to be achieved by this reinforcement.

- Combining a reinforced auxiliary operator class (2 persons) with personnel already in place, three teams can be dispatched to respond in the field with one team comprising two people at the time of an accident.
- One deputy shift manager (or senior operator), which will be added, is appointed from personnel with experience in maintenance operations, and he will communicate the messages concerning the extent of equipment damage and restoration methods in the event of an accident to the power station emergency response headquarters ("power station headquarters"), and will effectively provide support from the power station headquarters.

[Summoning of power station headquarters personnel]

The power station headquarters summons the people registered as power station headquarters personnel (650 in the case of the Kashiwazaki-Kariwa NPS) when notification is made under the Nuclear Emergency Act Article 10 (in the event of an earthquake, when an earthquake of 6-lower or greater seismic intensity occurs). During the first response, the operators and shift personnel proceed to restore electric power and remove debris, so the other personnel will assemble within 3 hours and proceed to restore facilities to bring the accident under control. After assembling, power station headquarters personnel will take over from the appropriate night duty personnel, and then commence their activities under the direction of the nuclear disaster manager (site superintendent) or his agent. So that restoration activities, communications, logistic support and other such activities proceed smoothly in accordance with ICS, the number of personnel necessary has been calculated using Attachment 4-2, and is given in Table 4-6, but the necessary number may vary depending on the number of plants in operation. On the assumption that the accident response will be prolonged, personnel are secured so that all personnel under the site superintendent can respond in rotation. Whether or not the personnel necessary in keeping with the condition of the plant can be summoned is managed also at night and on holidays. Also, training in summoning personnel will be conducted with consideration also being given to situations where transportation means are limited.

Table 4-7 Number of Personnel for Emergency Organization

	No. of plant in operation	
	Ex. of 2 units in operation	Ex. of 7 units in operation
No. of personnel (excluding operators)	Approx. 160 persons	Approx. 310 persons

* Review the above as appropriate through confirmation during emergency training.

Because problems arise such as stockpiled food and exposure controls at the power station, the principle is that persons other than personnel necessary in accordance with the scale of accident and its progression should not be allowed to stay at the power station, and returned home temporarily or stand by as replacement personnel.

d) Operation of new emergency organization

The emergency organization may not always be able to fully carry out its functions simply by changing its design, but it is necessary to carry out operations which make use of the design background, that is, simple command system and clarification of responsibility and authority which are characteristics of an ICS. In this accident response, the design was to respond to the accident with all functional teams gathering at the power station headquarters, which impaired the essential activities of the restoration team and other functional teams performing restoration work. Therefore, using the United States as an example, we should separate the work areas for the restoration team which is integrated under the main control room which are involved in technical reviews and execution, the team collecting and disseminating information about restoration and formulating recovery policy, and the team dealing with external organizations so that each team may focus their energies in an environment without disturbances on activities aimed at bringing the accident under control.

e) Transmitting and sharing information

In the response to this accident, the response was carried out using a flat framework in which the site superintendent managed all teams, so all sorts of information had to go through the headquarters, and the information stopped flowing correctly and confusion resulted. Also, because of the fact that workers were unable to get readings on plant parameters because they lost the power supply for such instruments, a situation arose in which data was not fully shared, a situation which brought on many redundant inquiries from the areas concerned. These problems can be resolved by clearly defining the command system, by introducing an ICS in which the management scope of each manager, including the site superintendent, will be reduced, but stratification would also become greater by reducing the management scope of these individuals. Therefore, on the premise that, in sharing and transmitting information, one ill effect of deep layering is that redundancies, omissions, delays, errors, and so on may occur., it is essential that we devise ways of minimizing those effects.

To address these issues, we will work to share information continuously by gathering information in a common database (common DB) which is accessible from the emergency response headquarters of both the power stations and the Head Office. The information sharing will be carried out not only by using the conventional SPDS, but also by making the fullest possible use of the library management systems and all tools to obtain the information necessary for predicting accident progression. Also, a paper-based information sharing system (information templates) will be prepared to handle cases where the common DB is not able to be used or does not perform as expected. Also, instructions and orders, which have primarily been given verbally, will be recorded for the purposes of:

- preventing the change of information
- uniformly controlling instruction and implementation content

f) Communications, notifications, and public relations

In the Fukushima Nuclear Accident, information was congested and confused because the personnel who had to prioritize fulfilling their roles in recovery activities became the ones who were performing the final checks for notifications and public relations with the outside, and were expected to handle both recovery activities and public relations activities at a demanding level. As a result, the people who were supposed to be engaged in recovery activities had difficulty concentrating on the recovery activities, causing failures of operation on one hand, also delaying the publication of information, providing information inconsistent with the facts, and with the added shortfall in of information sharing and the like among the concerned parties on the other hand. Thus, the trust in TEPCO was extremely compromised in the siting communities and society. From this point forward, a system will be established to gather and share accurate information quickly in an emergency as well as publicize it without letting the information collection activities as well as Public Relations and Communications jeopardize the recovery activities. Risk communicators will be assigned to key positions for responding to external organizations. At power stations, external liaison officers, who are responsible for taking care of external communication mainly within the siting communities, will be posted and the risk communicator will respond to local governments (report and notification) and communicate with the local media (public relations).

As actions corresponding to the above plan, the following rules by function about communication, notification and public relations will be specified and planned, and the design and preparation of measures will be implemented as well. The effectiveness of these measures will be checked and improved through training.

<Communications and Notifications>

- Communications and notifications will be sent out under the responsibility of the site superintendent at first, but will delegate the authority for the same to the external liaison officer, and will be sent in accordance with the rules concerning communications and notifications which have been specified beforehand. Actual tasks such as generating communications and notifications will be carried out by risk communicators under the external liaison officer. Unlike the response to this accident[35], the external liaison officer will issue communications without obtaining a sign-offs from Nuclear Disaster Prevention Manager or section chiefs at the power station headquarters. The communications they send will be shared in a common database and reported to the Head Office and headquarters by the external liaison officer.

[35] Upon notice from the shift supervisor, headquarters shares the information specified in the Articles 10 and 15 of the Nuclear Emergency Act.

- For situations triggering notification based on Article 10 and Article 15, means will be arranged for sharing the information simultaneously with the central and local governments because such situations require consideration be given to evacuating people who may be affected by releasing radioactive materials and the like. For example, the information is shared as needed by connecting off-site centers (where central and local government staff are in residence) and power station external liaison officer and the Head Office government liaison officers and public relations personnel via teleconferencing systems (see Figure 4-10).

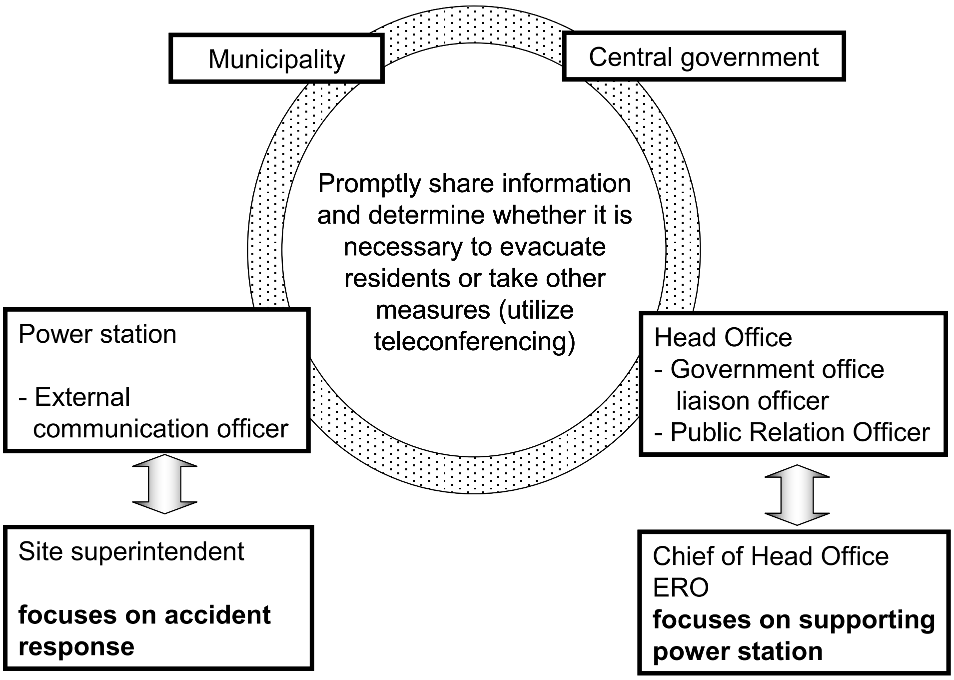


Fig. 4-10 Relationship between Emergency Organizations at Head Office and Power Station

< Public Relations >

- For events of a determined scale or larger, public relations will be separated from the power station and handled in a unified manner by the Head Office, and the power station will focus exclusively on bringing the accident under control.
- Risk communicators and the Corporate Communications staff will have primary responsibility for the public relations response, and risk communicators will be the ones to determine the content of communications based on the unified company-wide policy and strategies defined by the Head Office. Drafting of press releases as well as question and answer guidelines will be done by risk communicators using the common DB. The handling of explanations for siting communities will also be carried out by power station risk communicators in liaison with the Head Office.

g) Framework for procuring materials and equipment

In the case of this accident, because the needed materials and equipment for responding to the event at the power station were not ample, it was necessary to procure them from outside the station. Going forward, in keeping with the approach of defense in depth, materials and equipment will be stockpiled at the power stations, and reassessment of the system for procuring materials and equipment will be conducted and improved through training to prepare for an event in which new materials or equipment are needed. We are also taking into account the fact that because of the roads, communications facilities and other equipment near the power station were subject to the devastating impact of an earthquake and a tsunami, and of the release of radioactive material following core meltdown, material transport conditions were deteriorated to an extreme level of severity and transportation companies could not operate. An example of the framework is illustrated in Fig. 4-11 and specific example of actual operation is shown in Attachment 4-3.

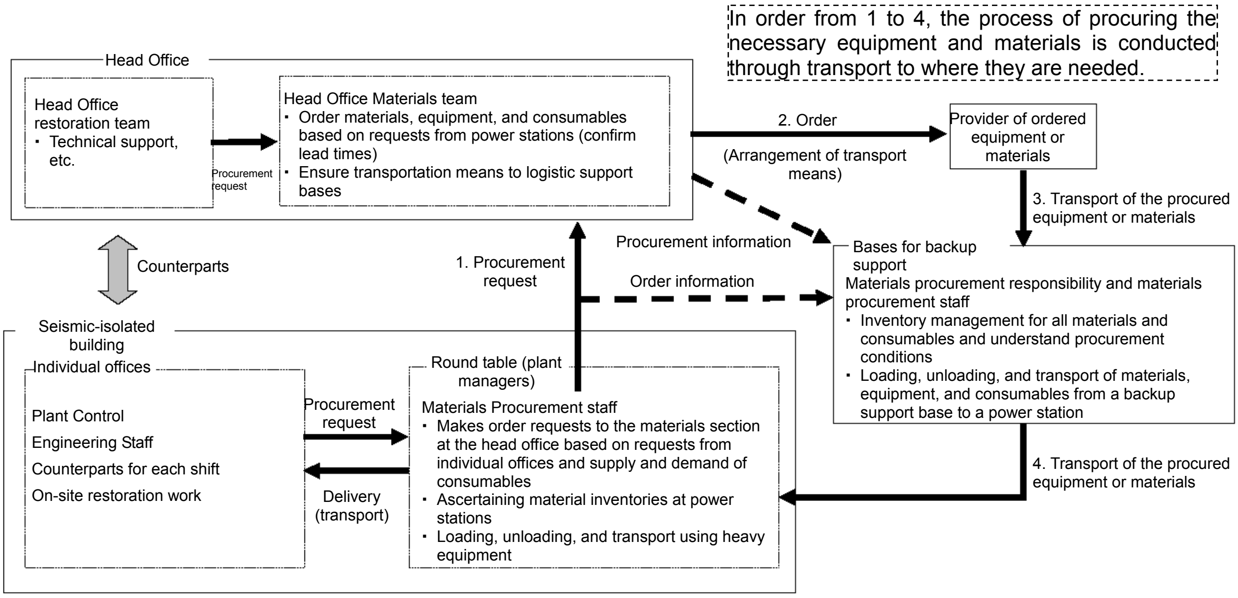


Fig. 4-11 Framework for Procurement of Materials and Equipment (Example)

3) Reorganization of Head Office Emergency Organization

One problem, which arose at the Head Office, in the response to the Fukushima Nuclear Accident was that "we were unable to coordinate external inquiries, instructions, and the like, which resulted in confusion for the command system at the power station." Therefore, together with a changing the power station emergency organization to the ICS approach, we will change the organizational system to improve the problems above (see Figure 4-12).

a) Approach of Head Office emergency organization

In accordance with the ICS approach, the general rule is that the role of the Head Office during a nuclear disaster is to fully support activities at the power stations toward concluding the accident, and it must carry out activities based on support requests from the site superintendent, and not to transmit detailed commands, orders and comments as in the case of this accident response. In addition, the Head Office will also serve in the role as a sorter of information so that direct external inquiries are not forwarded to the site superintendent nor the sending of external inquiries to the power station demanding responses as was done in the case of this accident.

b) Structure of Head Office Emergency organization

During a nuclear disaster, the emergency organization of the Head Office will align itself with the emergency organization at the power station to decide upon the counterparts[36] to the power station when responding to the accident. In coordination with the power station's

[36] Equally positioned other partner dealt with when implementing cooperative work.

emergency organization, there will be a system of four sections and staff under the head of the Emergency Response Center at the Head Office, which is currently made up of nine sections, and the counterparts will be established with the power station. As a general rule, exchanges will not be conducted with any entity other than the respective counterparts once the above structure is established. As for the emergency organization of the Head Office, the appropriate organization and command system will be modified to suitably correspond to the scale of the nuclear disaster and the extent of damage within the TEPCO service area.

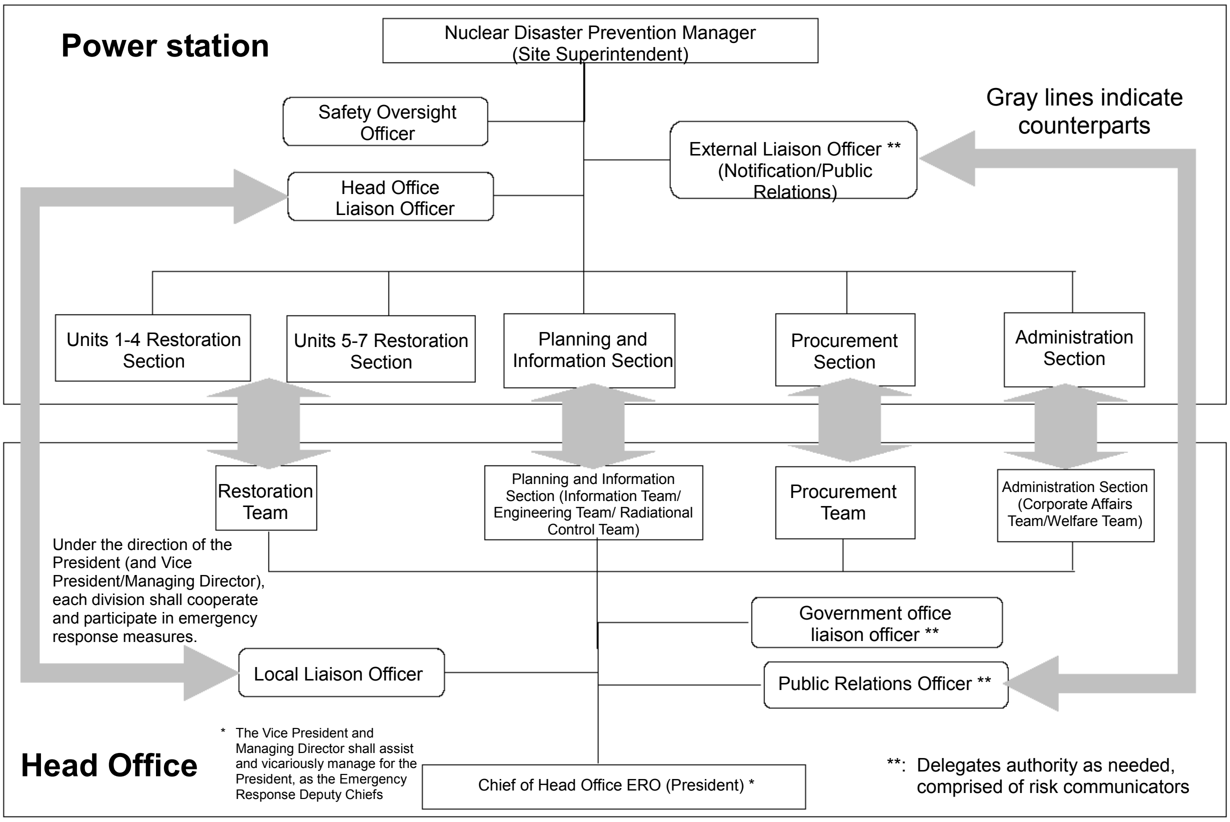


Fig. 4-12 Relationship between Emergency Organizations of Head Office and Power Station

Public Relations will be separated from the power station and will be handled in a unified manner by the Head Office. Corporate Communications personnel of the Head Office will plan and execute public relations policy and other such matters from a company-wide perspective though. Because a determination is also required which takes into account the specific situation unique to nuclear power from the viewpoint of society, such personnel will meet requirements equivalent to those for external liaison officers at power stations.

(2) Reinforcement of the Operational Side of the Emergency Response

1) Enhancement and strengthening of emergency response training and improvement through training

Although the emergency organizations will be reassessed, the critical thing is to confirm, through emergency response training, that we are capable of responding to accidents and that we make improvements as needed. As a premise for confirmation through training, it is necessary to share knowledge and awareness about what sort of doctrine the emergency organization is designed in accord with and what is expected of all of the individuals who make up that organization. Until now, we tended to be somewhat careless about this kind of sharing of fundamental knowledge based on the assumption that such matters went without saying. However, it turned out that when we went to the hearings on the cases that had failed in Japan in other businesses when trying to deploy an ICS, this shortfall in sharing of fundamental knowledge, which everyone was presumed to be aware of, was common cause in the failure of ICS introduction.

Therefore, along with training for all personnel (individuals) including the site superintendent and chiefs of all functional departments who would part of the emergency organizations, we are having them study the ICS online education materials prepared by the Federal Emergency Management Agency (FEMA) in the United States to learn about sharing fundamental knowledge in that emergency organization. Also, in order to respond smoothly during an emergency, we will create programs to learning the necessary knowledge, including conferring the skills (knowledge) for each position, general knowledge about emergency responses such as human behavior during emergencies, and issuing orders during an emergency as necessary.

For the emergency response, in accordance with the individual functions, information to be shared as well as the basic matters concerning implementation (including mission, role, supervisor, personnel to lead and their counterparts, contacts, information necessary for first response) will be prepared in order to prevent omissions. All of this information will be consolidated in a handbook.

As for the training with an emergency organization, in addition to annual comprehensive disaster training, training by teams to perform the role and responsibility of each function and cooperative training involving closely related multiple functions will be implemented with more frequency and for a longer periods than before. Training will be implemented systematically in which scenarios currently conducted on a limited basis are uncovered. A reassessment plan detailing the types and frequency of training is shown in Table 4-8. In this training, evaluations and feedback will be provided after the training, including reviews by external organizations, to improve the emergency response ability of the organization and to further enhance the content of the training.

Table 4-8 Type and Frequency of Emergency Response Training

	Individual	Functional unit	Collaborative training	Comprehensive emergency drill
Details	Attend basic training for emergency personnel - Acquiring fundamental knowledge of ICS and emergency response - Training on human behavior during emergencies and commands	Drill to carry out roles and responsibility of various functions such as operating equipment, connecting provisional facilities, etc	- Training for verifying collaborations between various functional units, and between the power station and the Head Office - Classroom training to verify the overall command system	Comprehensive training combining appropriate training items
Frequency	Once a year (finish a designated curriculum)	* Verification of technical skills, etc.	Total of 4 times a year, and at times of personnel rotation	Once a year

* The training frequency for each function will often be enough to assure satisfactory execution of duties at the time of an emergency. For those required to maintain or improve technical skills, training will be scheduled to satisfy individual needs, and the verification of the technical skills will be done through actual work.

Training for each functional unit is roughly divided into the improving the necessary knowledge and the acquisition and maintenance of skills and techniques. Improvement of knowledge, such as confirming locations of machinery and materials have been placed, will be implemented at suitable intervals. The main objective of the acquisition and maintenance techniques and skills is to be able to perform the vitally necessary response actions with the required quality within a limited time. Technical skill is involved in work and operations such as installing, connecting and operating power supply cars. It begins with confirming operation methods and verifying the soundness of facilities. At the time of an actual emergency, necessary personnel will assemble at a designated location and then steadily execute predetermined tasks until starting the operation. Also, during the training, it will be verified that the skills and techniques necessary to complete activities are maintained, such as periodically transporting fuel or refueling from a fuel storage location within a predetermined time after the start of the operation. It is necessary to provide training for all emergency response personnel including those on night shifts for each role. Training will be conducted the established minimum number of times and implementation period as defined in an annual plan. Naturally, if the acquisition and maintenance of skills and techniques is determined to be imperfect at the designated frequency, the personnel concerned will undergo the training again to verify their technique and skills, and frequencies or contents of training will be reexamined.

In addition, as part of the training for each functional unit in regard to equipment for which there is no opportunity to verify such operational status other than during an actual emergency, the operational status will be confirmed within a scope not endangering the safety of the nuclear reactor. For those activities, such as constructing a lineup within a building for alternate cooling water injection or connecting emergency power sources, it will be verified that the functions (injecting cooling water into the reactor, supplying emergency power during the power outage) can fully operate assuming actual conditions.

In cross organizational cooperative training in which response activities are carried out under close cooperation between various functional units, the training will be provided so that cooperation can be carried out smoothly.

Followings are examples of the cross organizational cooperative training :

<Materials procurement (power station – Head Office)>

- Confirmation to check that information can be reliably transmitted as concerns specification, volume, unloading location, unloading means (such as a crane) for heavy items and securing operators at the time a procurement request is put to the Head Office.

<Information sharing (power station – Head Office)>

- Confirmation to check if it is possible to effectively and securely share information with regard to information sharing using a common database and communication to confirm unclear information, etc.

<Press conferences (Head Office, power station)>

- Generation of press releases as well as question and answer guidelines utilizing the common database to extract items for public announcements and not depending on the planning and information teams.
- Holding simulated press conferences to confirm the viewpoint of journalists and to respond to additional questions.

<Information provision to customer center (power station – Head Office– customer center)>

- Include the customer center and customer service office within the scope of the training, and instead of simply distributing press releases and question and answer guidelines, provide support so as to prepare on basis of positions of the customer service office and the customer center

<Company-wide cooperation during a large scale disaster>

- Confirm cooperation between the nuclear power departments and other divisions to prepare for cases where a nuclear power station and TEPCO service area are simultaneously damaged, such as the Great East Japan Earthquake.

2) Improvement of other issues related to responding during an accident

a) Installation of surveillance cameras to ascertain conditions in the field during an emergency

In the event that multiple reactors experience severe accidents at the same time, it may become difficult to ascertain conditions in the field because of a high risk of a hydrogen explosion, elevated levels of radiation, or other risks. For that reason, in order to collect information necessary for formulation of an appropriate restoration plan, cameras will be set up around the periphery of the power station, around buildings, inside reactor buildings, inside turbine buildings, inside the main control room, and other important places, and the image information will be available for monitoring by those in the power station headquarters (seismic isolated building), the emergency response center in the Head Office, and the main control room (see Figure 4-13).

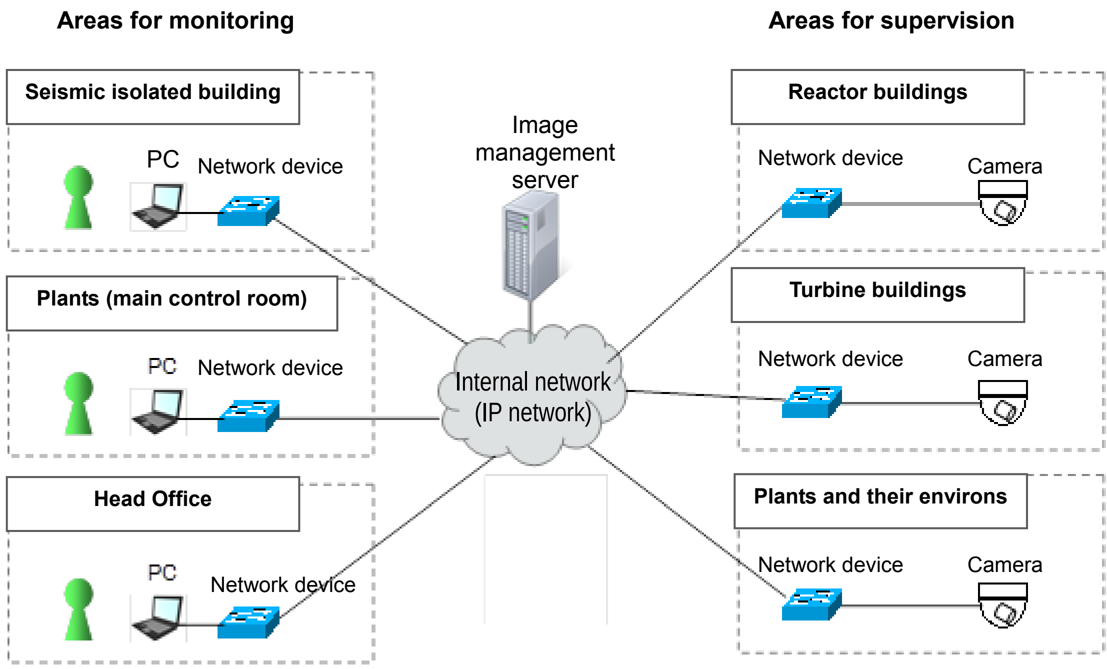


Fig. 4-13 Overview of Surveillance Camera Network Equipment

b) Improvement of division of roles with contractors

In the response to this accident, many contractors provided tremendous cooperation in the first response, including removing debris from the site and transporting fire engines and other such work in order to supplement our directly-managed engineering capabilities. Nevertheless, going forward, we are considering how to construct a system which does not count on the support of any contractor for roughly 72 hours after a severe accident occurs. Still, since we believe that it is better to ask for the necessary support from contractors, especially when they can act more quickly, reliably or efficiently, we are making arrangements with contractors for prior preparation.

The most important point is having a trusting relationship with contractors. Therefore, daily communication between contractor personnel and power station employees led by the site superintendent will be enhanced and will grow further by thinking and working together through directly managed and other operations.

4.6 Reassessment of Non-Emergency Power Station Organization and Enhancement of Capability for Direct Maintenance Work

(1) Reassessment of Non-Emergency Power Station Organization

The power station organization during normal times will be reassessed from the standpoint of organizational composition to ensure nuclear safety and will include the assignment of risk communicators.

i. As shown in 2.3.1 (1) Problems (Accident-iii), proper technical judgments (awareness of operational status of Unit 1 IC system, etc.), which are important for safety, were not able to be provided amidst the congestion of information.

ii. As shown in 2.4 (3) Problems (Organization-xii), it is believed that the functions governing safety of the nuclear reactor have been weakened due to personnel exchanges between divisions at power stations as well as the related organizational change after the 2002 cover-ups.

iii. As shown in 4.4 (1), the importance of the risk communication will be recognized, and risk communicator will be posted.

Also, regarding organizational revisions, although purpose is the resolution of issues related to enhancement of direct-management engineering capability as is described in the aforementioned three points and will be mentioned later, it is necessary to construct a system based on the current personnel capability and their future growth. Thus, organizational changes will be implemented systematically based on such standpoints. The approach to organizational revision is described below (see Figure 4-14).

- As the function related to the oversight of reactor safety for the entire power station, the relevant functions of the present Safety Management Group of the Quality & Safety Management Department and the present Engineering Management Group of the Engineering Department as well as radiation safety and disaster safety will be combined and managed as the Nuclear Safety Management Center, and the unit control (power generation and maintenance) will be supplemented in terms of safety.
- Within the emergency organization, the organizations under planning and information control are the sections which will formulate restoration policy, and personnel with knowledge related to nuclear reactor safety are needed. Thus, a division will be established by including personnel related to nuclear reactor safety in the organization during normal operation.
- In order to quickly and safely stabilize the plant, it is important for the emergency response organization to carry out the restoration activities by fully understanding the situation in which the plant was placed in by this tsunami and other such factors, and by analogizing the state of mechanical safety facilities. For this reason, the functional and technological capabilities of system engineering, which requires a thorough knowledge of design, authorization, operation and maintenance related to critical systems such as the cooling system, will be strengthened. The system engineers will be assigned to the emergency organization as technical staff to support overseeing the recovery. The system engineering function matches the function of improving reliability based on technological capability for critical system design, and therefore, during normal operation, the system engineers will be placed under the Maintenance Department, drafting a maintenance plan for reliability improvement. Based on their functional and technological capabilities, the system engineers will also support safety issues within the maintenance department by evaluating technology of various devices within the system and identifying non-conformities.
- The Nuclear Power Planning Department will be established as the department to appropriately allocate resources such as personnel rotation planning, technical training and other matters in conjunction with operational planning, equipment

planning and human resource development. In regards to personnel allocation especially, the personnel composition of an entire power station will be understood and personnel rotations in conjunction with human resource development will be centrally managed, together with the Administration Department.

- In the future, unit management (equipment operation and maintenance), the Nuclear Safety Management Center (improvement of quality and safety) and the Nuclear Power Planning Department (operational and budgeting planning and human resource development) will work together as one to operate the power station while complementing the others.
- The function of organizing safety inspections and safety management audits, which is currently assigned to two different departments, will be consolidated in the Nuclear Safety Management Center from the standpoint of organizing the entire plant, while listening to the opinions of the regulatory authorities.

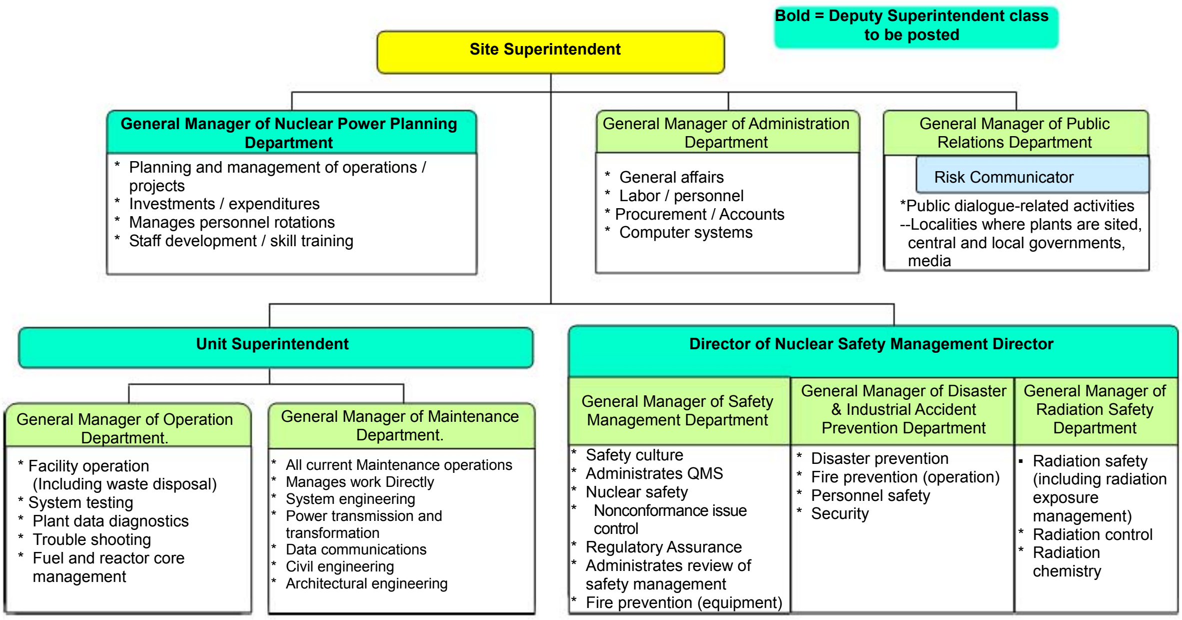


Fig. 4-14 Proposed Organizational Reform of Power Stations

Also, in order to ensure the requirements of each position in the emergency organization, a framework for mid- to long-term personnel rotations will be created. The technical staff and restoration officers, many of whom are needed for an emergency response, will be systematically provided with opportunities to experience maintenance and operation to gain technical skills (see Attachment 4-4).

(2) Expansion of Direct Maintenance Work for Emergency Response

Until now, onsite work (implementation), including facility maintenance at power stations was basically consigned to contractors or the manufacturer, but now as a lesson learned from the Fukushima Nuclear Accident, a system will be put into place so TEPCO employees can take responsibility during the first 72 hours after an accident occurs and perform emergency work. Therefore, in expanding direct maintenance work, operators and night duty personnel will take part in thorough training depending on their roles, which will include restarting the injection of cooling water into reactors that can be implemented in one hour, restoring power and the ultimate heat sink as well as other tasks. However, accidents do not always proceed as anticipated, so emergency responders need the ability to adapt. Workers will be trained through direct maintenance work in the field in order to practically acquire such applied skills (see Fig. 4-15).

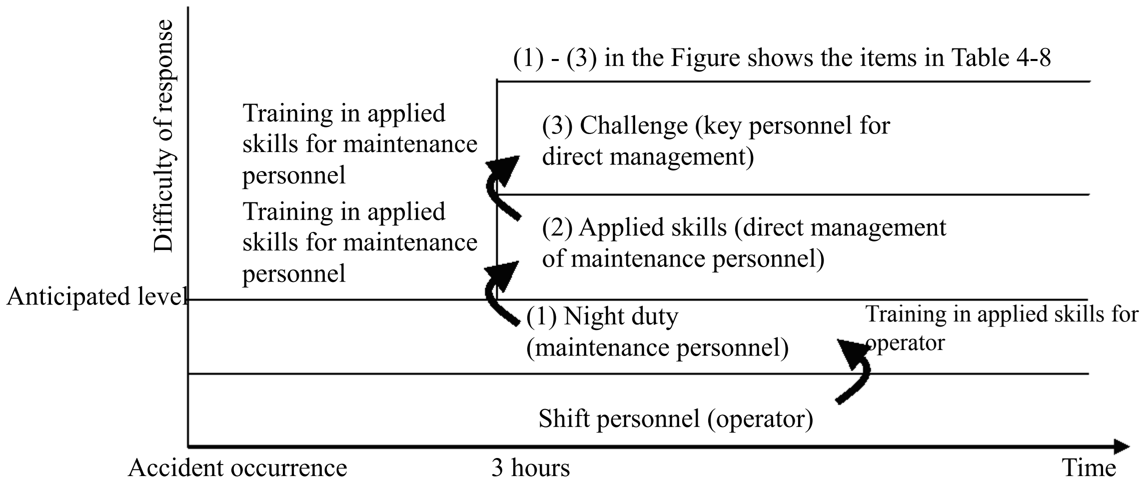


Fig. 4-15 Expansion of Direct Maintenance Work for Emergency Response (Illustration)

<Operators>

The applied skills of operators will be developed through training such as operating and connecting power supply vehicles and fire engines so that they can back up the work of restoration teams during emergency work in the event such personnel become injured or otherwise disabled.

Also, along with strengthen the emergency response of operators, they will learn how to perform daily maintenance work[37] and equipment diagnosis (data acquisition and simplified diagnosis) as a part of their normal duties to further expand their applied skills regarding on-site work and knowledge of equipment.

<Maintenance personnel>

An organization (team) will be formed to perform direct maintenance work within the Maintenance Department and develop applied skills for times when an accident occurs by having such personnel undertake direct maintenance work of operations with reference to the emergency work deduced from the experience of the Fukushima Nuclear Accident. An implementation plan will be developed so that over a period of approximately three years, 20% of maintenance personnel will be able to directly handle the required heavy machinery, tools, instruments, and other equipment and can repair equipment in the field when required in an emergency response situation. For six months, they will implement a disassembly of systems that combined pumps, motors, instruments and other equipment (see Table 4-9). In revising the organization, multiple key personnel will be assigned to the Maintenance Department to provide instructions and advice as leaders of actual direct maintenance work teams to formulate implementation plans and prepare direct maintenance work (creation of operating procedures, request support of contractors, etc.). The allocation of core members and the six-month training period will be addressed by scrapping and making certain operations more efficient and supplements of organizational personnel.

[37] Includes re-torquing, greasing and supplying lubrication of machines, strainer cleaning, repair painting, meggering test, nuclide analysis, etc. (target work will be further expanded depending on the technical skills learned).

When moving forward with direct maintenance work, the Skill Training Center will be utilized during the initial stages, but existing equipment will also be actively used. The utilization of actual equipment might create some problems, but it is important to perform PDCA from those failures and not give up on the efforts for introduction of direct maintenance work when failures occur.

The first three years will be used to develop the initial personnel, but after three years of continuous efforts (new and repeated), those who have experience in direct maintenance work will be assigned to different areas in abundance. Through such direct maintenance work, improvements to construction supervision capabilities related to job safety and the ability to offer proposals related to field work can be expected. Therefore, those that have mastered capabilities through the effort for introduction of direct maintenance work will be assigned in the future to instruct subordinates in the position of team leaders and group managers where they can put their leadership to work.

Operators and maintenance personnel will strive to learn techniques based on the implementation plan through direct maintenance work, but no target goals will be set and each section, group, division and power station will compete on the following points to attain further heights:

- What technical level has been achieved?
- How many people have achieved this level?

Table 4-9 Direct Maintenance Work Arrangements

	Response training and direct maintenance work according to accident management procedures, taking into account the Fukushima Nuclear Accident	Applied skills training in preparation for unexpected accidents beyond the scope of the accident management procedures
Operator	Viewing operations, making operations, making field responses , etc., based on driving operation standards.	In terms of the applied skills of operator, we will ensure that they will be able to provide backup for emergency tasks (1) usually conducted by restoration personnel (maintenance personnel). [Skills to be strengthened this time] (1) - Starting and connecting the air-cooled gas turbine generator and power-supply car - Operating and connecting fire trucks, etc. Connecting temporary batteries to the main instruments to be used until power is restored - Connecting the compressor and temporary battery to operate the air-operated valves - Installing and connecting alternative heat exchanger cars - Installation of temporary monitoring equipment (digital recorder, webcam), etc.
Maintenance personnel	(1) - Starting and connecting the air-cooled gas turbine generator and power-supply car - Operating and connecting fire trucks, etc. Connecting temporary batteries to the main instruments to be used until power is restored - Connecting the compressor and temporary battery to operate the air-operated valves - Installing and connecting alternative heat exchanger cars - Installation of temporary monitoring equipment (digital recorder, webcam), etc.	(2) Conduct applied skills training by referring to the emergency operations example (*) extracted from the lessons learned from the Fukushima Nuclear Accident. (*) - Transporting/laying/feeding/terminal processing/connecting/powering operation of high- and low-voltage cables - Replacing power circuit breakers - Installing seawater system submersible pump and hose - Plumbing repair (flange cleaning, repair) - Installing chain hoists - Driving and unloading from truck with crane - Operating heavy machinery, etc. [Skills to be strengthened this time] (3) Working on direct maintenance work always aiming for a high level, in order to enhance applied skills.

It will be difficult for both operators and maintenance personnel to carry out direct maintenance work initially. Therefore, it is necessary to seek the following cooperation from contractors that are currently carrying out such work:

- Requesting contractors to dispatch technical advisors. Under their advice, operators and maintenance personnel will carry out direct maintenance work.
- TEPCO's employees will be dispatched to contractors and carry out actual work together with and under the contractor (fostering a relationship of mutual trust by working and thinking together with contractors).
- Depending on the balance between quality and amount of direct maintenance work we want to do ourselves, we will directly employ contractor workers.

The Maintenance Department had adopted a group manager framework (organizational framework where positions from group manager on down are flattened to a team leader and members in three different tiers to enable timely responses and speedy decision making). The direct maintenance work team formulated in the Maintenance Department should clarify its command system and commanders (responsible persons) like foreman organization[38] to ensure human and equipment safety. In addition, implementing emergency responses requires business operations that are conscious of the command system in day-to-day business operations. Combinations of the following business practices will be evaluated and implemented, such as groups other than the direct maintenance work team, which also should operate as a foreman organization. To raise awareness, group managers (GMs) and team leaders (TLs) should display their respective positions by wearing an armband, and each document having a column for the chief to sign and seal. As a secondary benefit of the foreman system, the development of responsible subordinates and improvements in performance quality (without depending on the group manager or team leader too much) are expected.

4.7 Consistency of Proposals and Other Suggestions from Accident Investigation Reports with Nuclear Safety Reform Plan

In addition to the "Fukushima Nuclear Accidents Investigation Report" prepared by TEPCO, the following reports regarding this accident have also been released and we realize there are useful recommendations in these reports, which should be addressed.

- Final Report by Investigation Committee on the Accident at Fukushima Nuclear Power Stations of Tokyo Electric Power Company (Government's Investigation Committee)
- Report of National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission (National Diet Accident Independent Investigation Commission (NAIIC))
- Technical Knowledge of the Accident at Fukushima Dai-ichi Nuclear Power Station of Tokyo Electric Power Co., Inc. (Nuclear and Industrial Safety Agency）
- Final Report: Lessons Learned From Fukushima Dai-ichi (Dr. Kenichi Ohmae）
- Lessons Learned from the Nuclear Accident at the Fukushima Daiichi Nuclear Power Station (INPO)
- Research Investigation Report prepared by Independent Investigation Commission on the Fukushima Nuclear Accident (Independent Investigation Commission)

Therefore, although the Nuclear Safety Reform Plan has been compiled, we have confirmed that the recommendations of each report have been brought together here in conjunction with the accident measures which are currently being implemented at each power station (see Attachments 4-5 and 4-6). TEPCO will continue to steadily move forward with the Nuclear Safety Reform Plan and continually improve the safety of its nuclear power facilities.

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[38] In the foreman organization, the positional hierarchy under the group manager includes a team leader, section leader, subsection leader and person in charge.

5. Implementation of Nuclear Safety Reform Plan

(1) Activities for Understanding the Nuclear Safety Reform Plan

In implementing the Nuclear Safety Reform Plan, it is vital that management stand at the forefront in helping TEPCO employees and especially those in the nuclear power departments to understand and implement the goals of the Reform Plan. In conjunction with this effort, the Secretariat of the Nuclear Reform Special Task Force will also make an effort to spread understanding of the reforms. The background surrounding the establishment of the reform plan and expectations will be explained through a general overview of the Fukushima Nuclear Accident and the goal of the effort, in other words "defense in depth will be built up so that we will never again cause a severe accident." will be shared with everyone. In addition to normal briefings, efforts will be made such as establishing a place for interactive discussions using intranet, in all possible ways, to increase it's the degree to which this information is transmitted. In order to continually move forward with reforms organizationally, we will continue efforts to promote understanding, monitor progress and consider enhancements continuously.

(2) Monitoring and Announcements of Implementation and Progress

Necessary reviews of the Nuclear Safety Reform Plan will be conducted and implemented under the responsibility of the leader of the organizations which are the locus of responsibility for the plan. Deliberations will be undertaken with those concerned accordingly when implementing the reforms in accordance with the stipulated plan (Attachment 5-1).

The nuclear power departments will shine a light on and confirm the expected results of progress with each plan, once every three months, to see to what extent the reforms have progressed and what has been achieved. When there are opportunities to take a look at and compile the reforms which have been achieved, we will check whether or not the plans need to be reformed and make any revisions as necessary. This will not only include process management, but, if delays occur, we will pursue the cause of such delays in conjunction with implementing any necessary improvements. Monitoring and follow-up for the reform plans will be conducted by the Secretariat of the Nuclear Reform Special Task Force for the time being and the Task Force will then provide a progress report to the various levels of management. The management will then be the first to transmit and share details of the reported information throughout the entire company, in addition to promptly announcing such details.

(3) Reassessment and Improvement of the Nuclear Safety Reform Plan

It is absolutely critical that each organization take initiative in considering and implementing the Nuclear Safety Reform Plan. Some divisions may directly review or improve equipment or safety, while other divisions will provide indirect support, depending on the role of the organization. Each organization will consider whether revisions are necessary once every six months from the viewpoint of further improving the reform plan and implement further improvements, which may include adding plans from different perspectives.

In addition, while everyone in the organization will be putting all their efforts into implementing the Nuclear Safety Reform Plan for the foreseeable future, over time we must not think of these reforms as the Nuclear Safety Reform Plan and aim to implement them the same as any other task. We must always work to revise and improve reforms by looking back in retrospect to the start of the Nuclear Safety Reform Plan, which has been formulated, in other words, "2. Fukushima Nuclear Accident and Other Accidents in Retrospect" and we must not simply see the implementation of the Nuclear Safety Reform Plan as a goal in itself.

(4) To Prevent Ossification of the Nuclear Safety Reform Plan

1) Preservation of symbolic buildings, facilities, etc. of the accident

Along with stabilizing the power station, areas of the plant will be preserved so that the lessons of the Fukushima nuclear power station do not fade and continue to serve as a significant part of the Nuclear Safety Reform Plan. Specific efforts will include the following:

- Preservation of the current Fukushima Daiichi NPS[39] and its utilization in emergency response training
- Creation of a media library of past videos and photos as well as exhibition panels
- Learning and expanding on efforts in other industries to keep the lessons learned fresh

2) Organization to prevent ossification and mechanisms for continuity even if people change

Secretariat of the Nuclear Reform Special Task Force will monitor the Nuclear Safety Reform Plan for the foreseeable future and will operate in a way which will ultimately establish the Reform Plan as one of the company-wide missions. The following efforts will to prevent ossification also be undertaken.

- In order to strongly continue to acknowledge the significant impact of the nuclear power accident, TEPCO employees (especially those who work in the nuclear power departments) will participate in reconstruction efforts in Fukushima for a certain period of time. Seeing and experiencing[40] the state of Fukushima, including symbolic Fukushima buildings and equipment affected by the accident, will help in developing the Nuclear Power Safety Reform.

- March 11 will be established as “Fukushima Nuclear Accident Day” and employees in the nuclear power departments will look back[41] on the accident during the morning hours each year and discuss the events of that day with those who dealt with the situation, even if that day happens to fall on a holiday or weekend. In March of every year[42] based on progression of the Fukushima Nuclear Accident, employees will carry out the emergency response training, and will be joined by the management.

- Operations at power stations are not focused at all times on preparing for emergencies, such as the Self-Defense Forces, police and fire department, and in general, focuses on normal tasks such as operation, maintenance, and so on. Therefore, too much of an emphasis placed on the emergency organization and emergency response will create a shortfall of operational resources during everyday tasks, which is thought to have the opposite effect of causing ossification. Continuous investigations and improvements will be made on the balance of emergency and everyday operations.

- The intranet and other systems will be used so that necessary opinions can be provided regarding the nuclear power reform efforts from divisions other than the nuclear power departments.

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39 Items which express the force of the tsunami such as a car which was thrusted into the back wash pit upside down and the crumpled steel frame of the building which reveals the power of the hydrogen explosion that occurred.

40 Due to problems such as the radiation exposure dosage of the escort, a specific implementation plan will be established separately.

41 Materials that will be used to look back at the accident include video and photos of the accident, media coverage and creation of a video (DVD) of witness testimony of those involved in the accident.

42 Night training will also be performed as needed and rations and other provisions stored for emergencies at the plant will also be eaten to reflect on the time the accident occurred at the Fukushima nuclear power plant.

6. Our Resolution

Through the events of the Fukushima Nuclear Accident, we resolve hereunder, as a nuclear operator, to regain the trust of people in the siting communities and society. With this resolution, we will promote and share the lessons learned from this accident with the world and steadily move forward with the Nuclear Safety Reform Plan so that another severe accident will never occur.

<Our Resolution>

We will never forget the Fukushima Nuclear Accident. We will increase the level of safety today more than yesterday and tomorrow more than today, and we will become a nuclear operator that continues to create unparalleled safety.

End

<Reference: Nuclear Power Reform Framework>

Nuclear Reform Monitoring Committee

Chairman:	Dr. Dale Klein (Former Chairman of the U.S. Nuclear Regulatory Commission)
Deputy Chairman:	Lady Barbara Judge (Former Chairman of the United Kingdom Atomic Energy Authority)
Committee Member:	Mr. Masafumi Sakurai (Former member of the National Diet of the Japan Fukushima Nuclear Accident Independent Investigation Commission; former Superintendent Public Prosecutor, Nagoya High Public Prosecutor's Office)
Committee Member:	Dr. Kenichi Ohmae (CEO, Business Breakthrough, Inc.)
Committee Member:	Mr. Kazuhiko Shimokobe (Chairman, Tokyo Electric Power Company)
Secretary-General:	Mr. Kazuhiro Suzuki (Co-Chair of the Reliable Nuclear Fuel Services Working Group, International Framework for Nuclear Energy Cooperation; CEO, Nuclear Fuel Transport Co., Ltd.)

Report ↑ ↓ Monitoring Supervision

Nuclear Reform Special Task Force

Chief of the task force:	Mr. Naomi Hirose (President)
Deputy chief of the task force:	Mr. Zengo Aizawa (Vice-President and Chief Nuclear Officer)
Chief of the secretariat:	Mr. Takafumi Anegawa (Nuclear Asset Management Department General Manager)
Members of the secretariat:	35 members