Reassessment of Fukushima Nuclear Accident and Outline of Nuclear Safety Reform Plan (Interim Report)

December 14, 2012
Nuclear Reform Special Task Force

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Contents

I. Reflection on Fukushima Nuclear Accident (1/2)

1. Reflection on facility aspects of nuclear power

We submitted a construction permit application including specifications of nuclear power generation facilities, safety design policy and results of safety analysis to the government in July, 1966 in order to obtain a construction permit for Fukushima Daiichi Nuclear Power Station. In the application, we explained that multiple facilities would work reliably; cooling and shutting down of the nuclear reactors and preventing the discharge of radioactive substances.

However, the earthquake and tsunami of March 11, 2011 disabled most of the functions of these safety facilities, which were assumed to be effective in handling accidents. (Reference 1)

This was caused by a lack of consideration for common cause failures due to external events (earthquake and tsunami) at the design phase. In addition, sensitivity for overseas safety measures such as U.S. antiterrorist measures (B5b) was low and continuous safety improvements of the facilities were not enough. Official information about B5b was not disclosed because of its characteristics as an antiterrorist measure. However, we will study overseas trends on safety measures more carefully, and increase the sensitivity of risk. (Reference 2)

We deeply regret this severe accident including a meltdown of the reactor and the release of large amounts of radioactive substances due to a subsequent lack of effort in continuous safety improvements.

I. Reflection on Fukushima Nuclear Accident (2/2)

2. Reflection on public relations at the time of the accident

We lacked readiness and accuracy in all public relations after the accident of March 11, 2011.

We have divided the contents of the announcement after the accident into three categories;

a) Publication based on misinterpretation of facts
b) Lack of rapid attitude of publication
c) Delay of publication because we took time to adjust with external organizations

We deeply regret that we made the people at the plant siting area, the Japanese people and the people throughout the world feel uneasy and suspicious as a result of our lack of readiness and accuracy in public relations.

We will try to prepare fully for emergencies and correct the lack of training and technological capabilities for distributing and sharing information.
In addition, we will strengthen the appropriate communication efforts so as not to hesitate in releasing negative information.

II-1. Root Cause Analysis behind the Fukushima Nuclear Accident (Defects in Measures for Severe Accidents)

Root Cause: We had a fixed idea that it was less likely for severe accidents to occur due to loss of all power and therefore not necessary to improve safety, which interrupted improvements in safety measures.

[Problems in Safety Awareness]

- We did not have sufficient awareness that it was important to improve safety continuously.
- We thought we only had to meet the requirements set by the regulatory authority and did not have sufficient awareness on improving safety by ourselves.
- We overestimated the accident management measures we had conducted as severe accident measures.

[Problem with Technological Capabilities]

- We did not think that external events (natural phenomena and terrorism) would cause loss of all power, which was highly likely to lead to severe accidents.
- We did not have sufficient capability to use limited resources and come up with rational safety measures within a short period of time.
- We did not have sufficient capability to find effective measures from information from overseas countries and problems in other power stations.

[Problems with Ability to Promote Dialogue]

- We thought it would have been difficult to explain that the current nuclear power station was completely safe if we had recognized that measures for handling severe accidents were necessary.

II-2. Root Cause Analysis of the Fukushima Nuclear Accident (Defects in Measures for Tsunamis) (1/2)

1966	Application for construction permit (Assumed the tsunami in Chile as the largest one in the past; O.P. +3.122m)
1993	Tsunami risk attracts attention as a result of the tsunami from the Hokkaido Nansei-oki Earthquake
1999	Japan Society of Civil Engineers (JSCE) started considering a prediction evaluation method for tsunami height
2002 Feb	JSCE designed “Tsunami evaluation technology for nuclear power stations”
	・Took uncertainty into account in their assessment, thought the assessment was conservative (revised O.P. +5.4 to 5.7 m)
	・ Performed assessment assuming no tsunami wave source along ocean trench offshore Fukushima Prefecture
2002 Jul	The Headquarters for Earthquake Research Promotion expressed the opinion that it could not deny a possibility of a tsunami even at or near the trench off the coast of Fukushima Prefecture
2003	JSCE started considering a probabilistic evaluation of tsunami hazard
	・Had a limitation in evaluation such as insufficient data of past tsunamis and consideration of the results through a vote by specialists
2004	The seawater pump at the Madras Nuclear Power Station in India was flooded due to a tsunami off Sumatra
2006	Failed to take measures while we were aware of the risk of loss of all power due to an unexpected tsunami in the study session about overflow
2008	In-house consideration obtained a height of 15.7m of tsunami flooding when locating a tsunami source at or near the trench off the coast of Fukushima Prefecture.
	・Requested JSCE to study with scenario of tsunami wave source at or near the trench off the coast of Fukushima Prefecture

II-2. Root Cause Analysis of the Fukushima Nuclear Accident (Defects in Measures for Tsunamis) (2/2)

Root cause: We did not prepare a defense in depth because we judged a tsunami beyond our expectations would not happen even though we had little knowledge regarding such tsunamis.

[Problems in Safety awareness]

- We lacked an attitude to take measures for a defense in depth against unexpected natural events.
- We lacked a sense of danger of tsunamis whose impact would be magnified by cliff edge effects.
- We underestimated professional opinions that there was no denying that a massive tsunami could occur even off the coast of Fukushima Prefecture.
- We thought it a risk that we were forced to take excess measures by the regulatory authority.

[Problem with Technological Capabilities]

- We lacked an attitude to judge by ourselves based on further additional investigations and considerations because we were deeply dependent on the JSCE.
- We did not understand the limitation in the method of quantifying the likelihood of a tsunami through questionnaires.
- We lacked flexibility in thinking in taking feasible cost-effective measures within a short period of time.

[Problems with Ability to Promote Dialogue]

- We lacked an attitude to consult with the regulatory authority and site area about the necessity of tsunami measures.

II-3. Root Cause Analysis of the Fukushima Nuclear Accident (Insufficient Preparations for Accidents)

Root cause: Preparations to respond to simultaneous occurrence of severe accidents at multiple units were insufficient.

[Safety Awareness Issues]

- Our training was merely formal because we had assumed that no severe accidents would occur and training plan was insufficient.
- We lacked in preparation of required materials and equipment.

[Technological Capability Issues]

- We lacked the ability to perform work required at the time of an emergency quickly by ourselves. (Power station)
- We lacked the ability to identify and estimate the status of the plant, and formulate a plan quickly. (Power station and headquarters)
- We failed to share information smoothly due to insufficient training and mechanism for sharing information. (Power station and headquarters)
- We failed to adjust external inquiries and instructions, causing confusion in the command and control system of the power stations. (Headquarters)
- We were not able to fully support preparation, transportation and delivery of materials. (Headquarters)

[Dialogue Capability Issues]

- We failed to notify interested organizations, local authorities and the public about the ongoing status of the accident quickly and accurately.

III-1. Limitation of Previous Reform Activities

○ Taking past scandals of our nuclear power divisions as an opportunity, we have undertaken various reforms.
- Climate reform taking falsification of data of containers for transporting spent fuel as an opportunity (1998)
- Introduction and enhancement of nuclear power regeneration and QMS taking cover-ups of faults as an opportunity (2002)

○ We were not able to prevent the accidents even though a lot of good approaches were included in the reforms such as the resignation of top management and assigning personnel from other divisions to the nuclear power divisions.

○The task force considers the following as causes.

(1) Since the scandals were not viewed as a sign of deterioration of the safety culture because complete nuclear safety had been achieved, measures to improve organizational safety awareness were insufficient.

(2) Management did not have concrete reform proposals based on a recognition that middle management members and on-site organizations caused the scandals.

Based on (1) and (2), management will take the initiative to improve safety awareness in our organizations with an unflagging resolve. Furthermore, we will monitor decisions by management members through external monitoring bodies and internal control organizations.

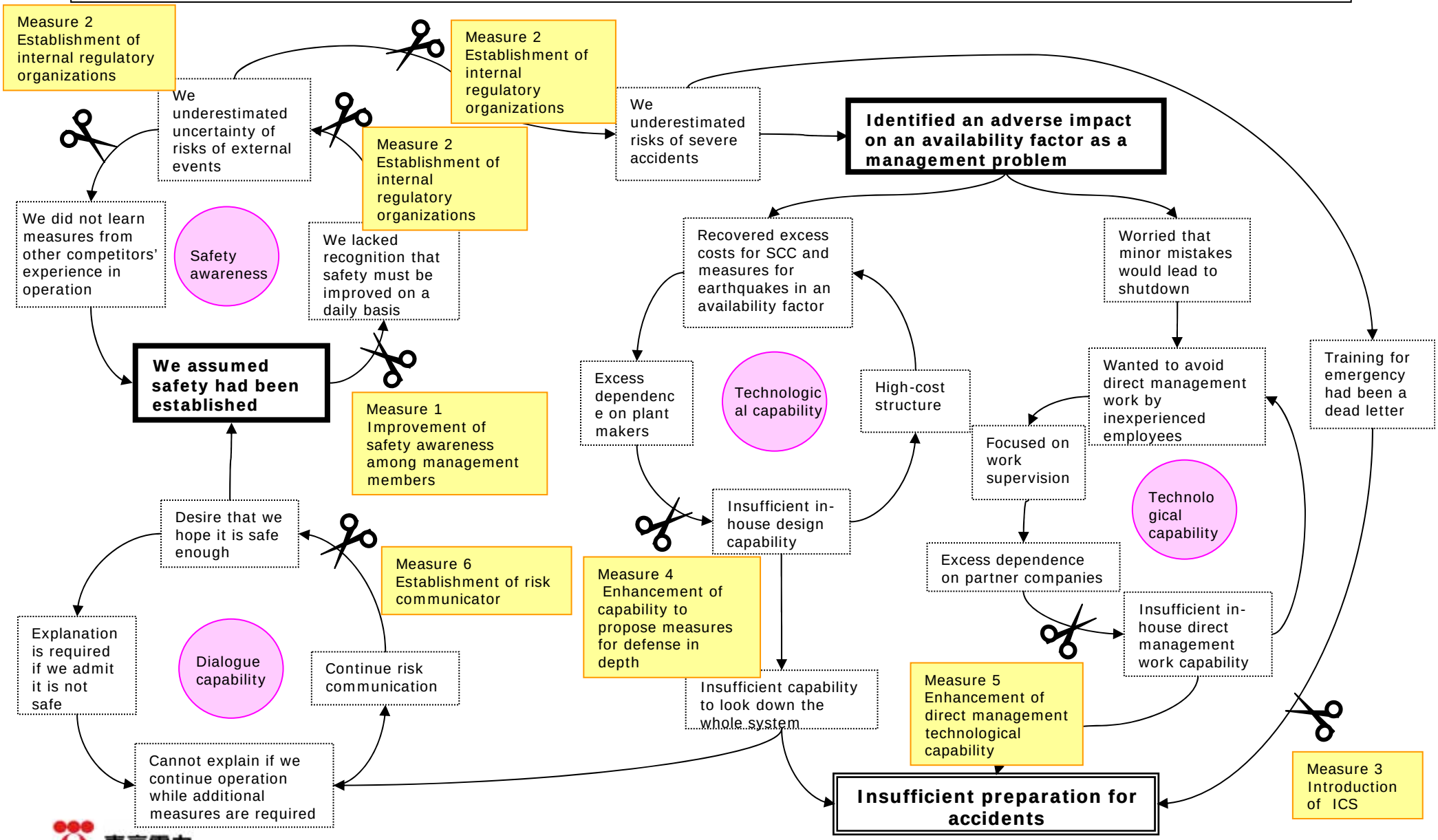
(3) Although the ambiguity of the authority and responsibility of our organizations became obvious, those of the management are remarkable even under normal circumstances.

To achieve the reforms, we will operate our organizations by clearly matching the authority and responsibility both under normal circumstances and in times of an emergency.

(4) It was difficult to resolve the negative links solidly fixed in the organizations, which had fostered structural problems of the nuclear organization. We will prepare a measure to cut the negative chain at several points at the same time. (Diagram on the next page)

III-2. Cutting Negative Chain of Insufficient Preparation for Accidents

Since we assumed safety had been established and identified an adverse impact on an availability factor as a management problem, we lacked preparation for accidents.



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IV. Major Countermeasures

1.Direct measures based on Fukushima Nuclear Power Station Accident

(Attachment 1)

Basically, we will reflect on all of the accident analysis reports from the private sector, the Diet and the government, reports from the Institute of Nuclear Power Operations (INPO) and the facility safety measures proposed by Kenichi Ohmae, a member of the Nuclear Reform Monitoring Committee. (References 4,5)

As well as sincerely accepting the facility safety measures proposed in the accident analysis reports, we will take effective measures based on our analysis of the progress of the Fukushima nuclear power station accident and results of onsite surveys.

2.Measures to structural problems with the nuclear organization

(Attachment 2)

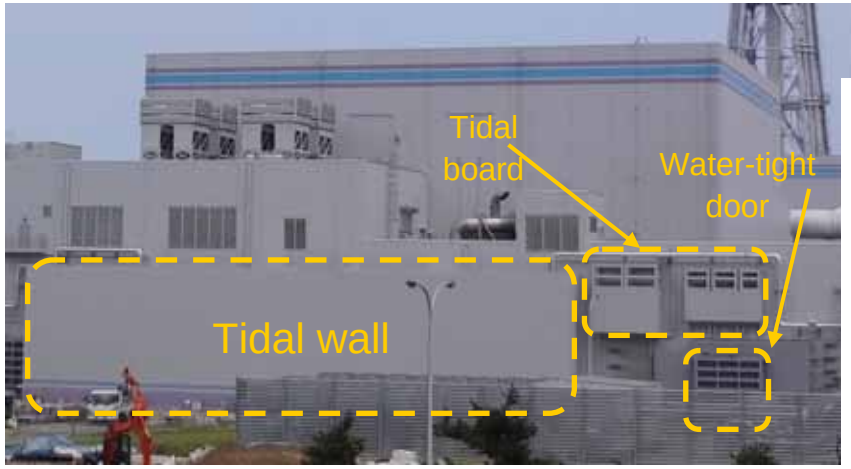
The measures required by a facility in regards to loss of all power and heat sinks due to a tsunami can be obtained by analyzing the accident. However, we must identify the background factors (root causes) for failing to prevent the accident and take measures to solve them in order to prevent similar accidents from occurring due to causes other than a tsunami.

The Nuclear Power Reform Task Force will analyze the root causes of “insufficient measures for handling tsunamis”, “insufficient measures for handling severe accidents” and “lack of onsite preparations for handling accidents”, and summarize measures based on their analysis in a report.

IV-1. Direct measures based on lessons learned from Accident (1/4)

Lesson : Protection against a tsunami exceeding assumptions was vulnerable and resulted in all the power sources loss.

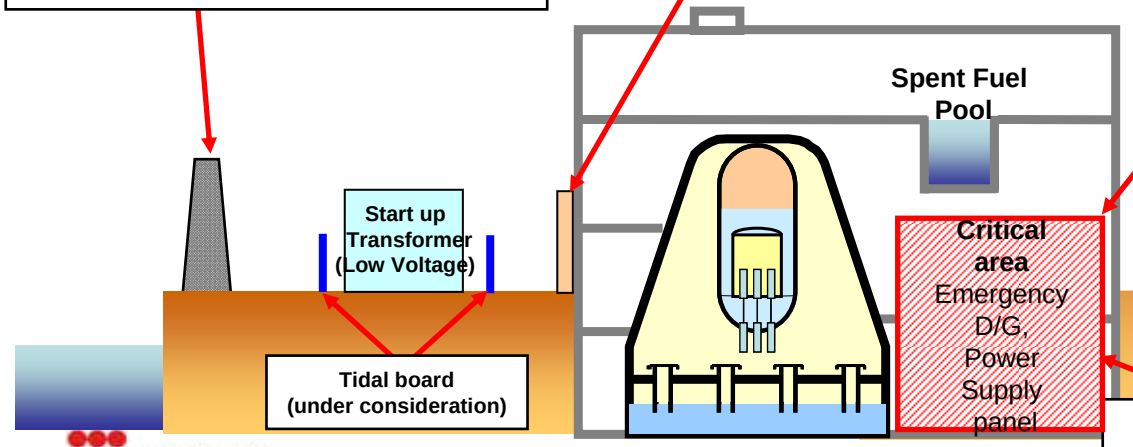
Measure : The flood by tsunami is prevented and the measure which protects power sources and other important apparatus is implemented.



Sea wall : Preventing inundation of site

Tidal wall : Preventing inundation of building

Water-tight door : Preventing flooding of critical areas (about 60 places)



Waterproof done at Cable trays (ex.)

Waterproof done at Pipes (ex.)

Waterproof done : Preventing flooding of critical areas (about 300 places)

IV-1. Direct measures based on lessons learned from Accident (2/4)

Lesson: Sufficient preparations had not been made for cases where all power sources would be lost nor had there been adequate means provided for the subsequent response (high pressure cooling water injection, depressurization, low pressure water injection, heat removal, injection of cooling water into fuel pool, securing water sources, etc.). Workers were forced to respond while thinking about these issues on the spot.

Enforcement measure for HP water injection

Deployment of Turbine Water Lubricant pump

Enforcement measure for depressurization

Deployment of spare gas cylinder

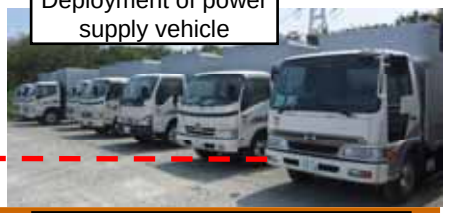
Enforcement of LP water infection Fuel pool cooling

Employment of Fire engine (deployed on high ground)

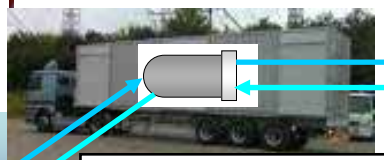
Enforcement of various power supply means

Deployment of GTG

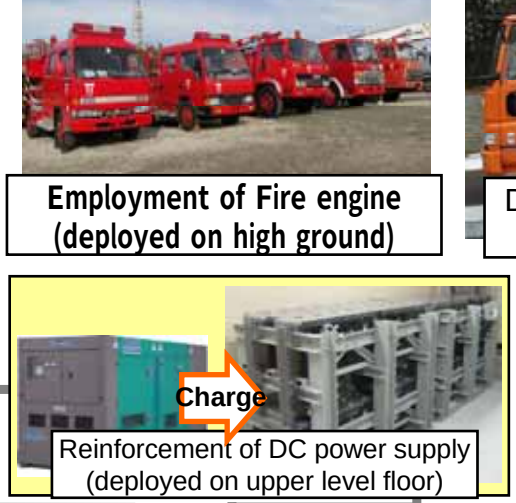
Deployment of power supply vehicle



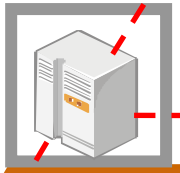
Assure means of heat removal



Employment of alternative sea water heat exchanger (deployed on high ground)



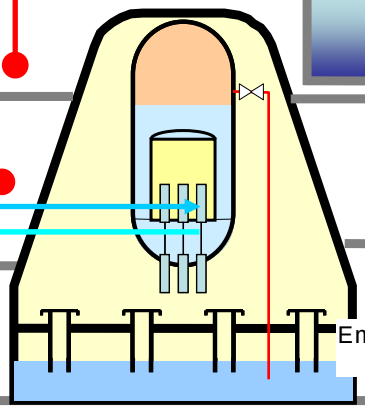
Reinforcement of DC power supply (deployed on upper level floor)



Deployment of emergency HV power supply panel

Assure water sources

Deployment of water reservoir



Critical area

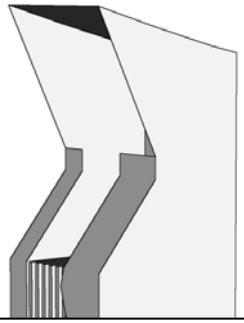
Emergency HV power supply panel

IV-1. Direct measures based on lessons learned from Accident (3/4)

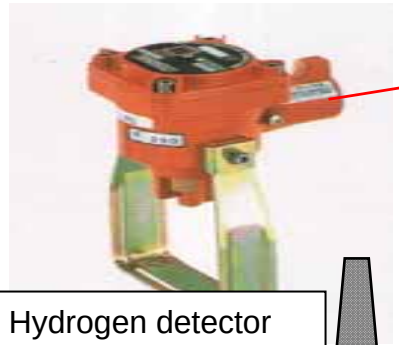
Lesson : Means for mitigating the impact after reactor core damage had not been prepared (preventing primary containment vessel damage, controlling hydrogen, preventing release of large amounts of radioactive materials into the environment, etc.).

Controlling hydrogen

Deployment of top vent

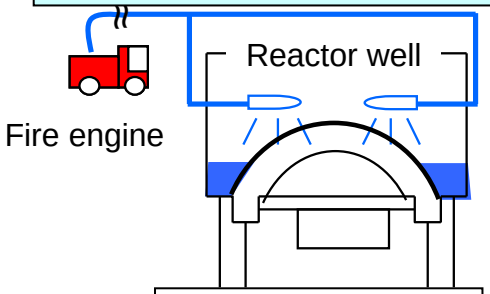


Deployment of Passive autocatalytic recombiner



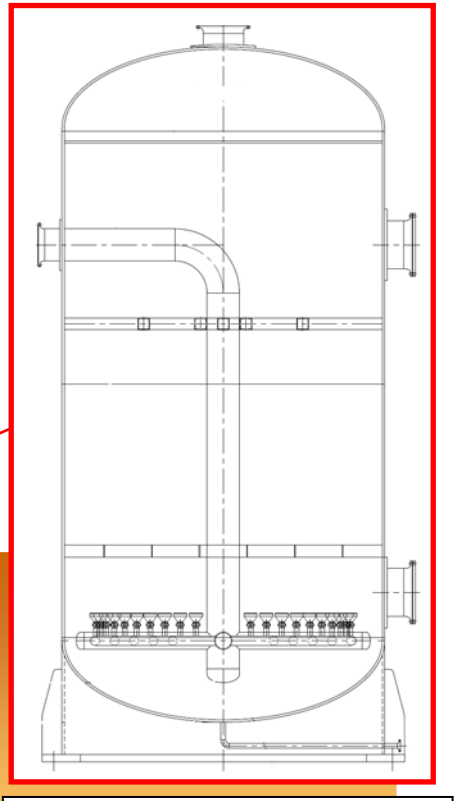
Hydrogen detector

Preventing primary containment vessel damage

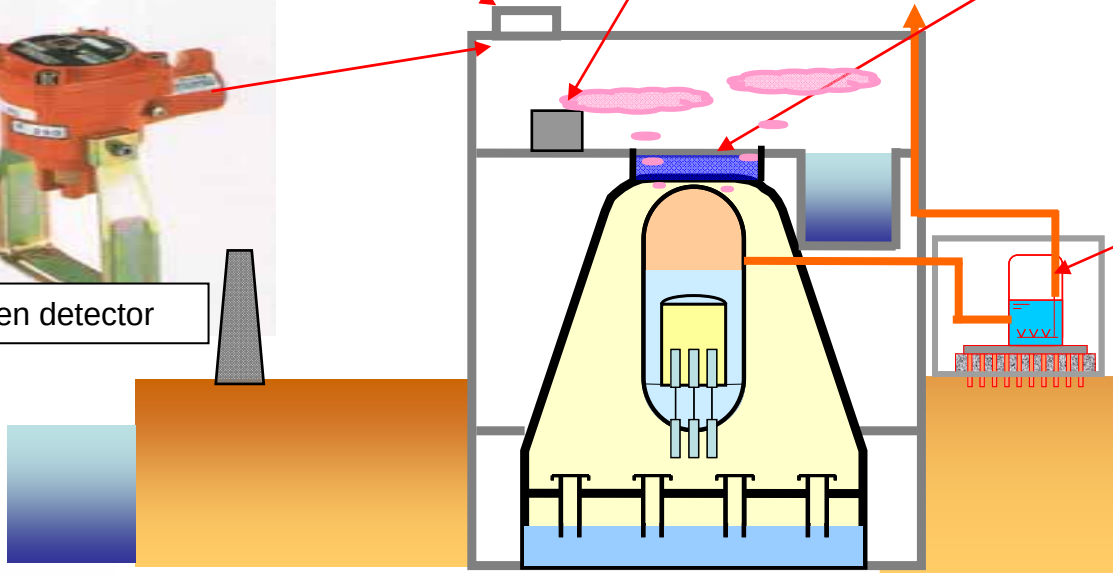


Deployment of Top head flange cooling

Preventing release of radioactive materials



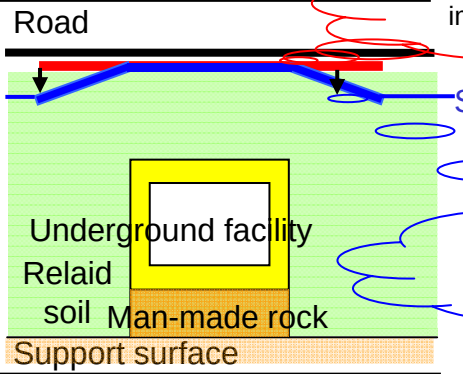
Deployment of Filter venting



IV-1. Direct measures based on lessons learned from Accident (4/4)

Lesson : In addition to limited lightning and communication tools, monitoring and measuring means were also lost and the plant status was no longer able to be ascertained. Due to severe aftershocks, concerns about tsunami accompanying aftershocks, scattered debris and so on, accessibility and workability in the yard was reduced. These and other factors leading to a deterioration of the work environment made it difficult to respond to the accident.

Access road reinforcement



The measure against level difference control is implemented to the road surface or a subgrade.

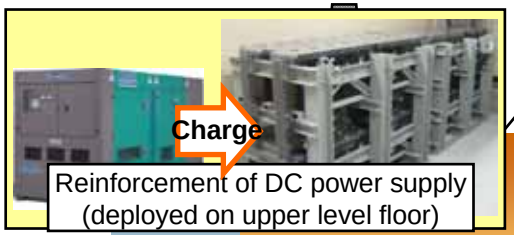
Subsidence is followed and a rapid level difference is canceled as much as possible.

Measure against level difference control

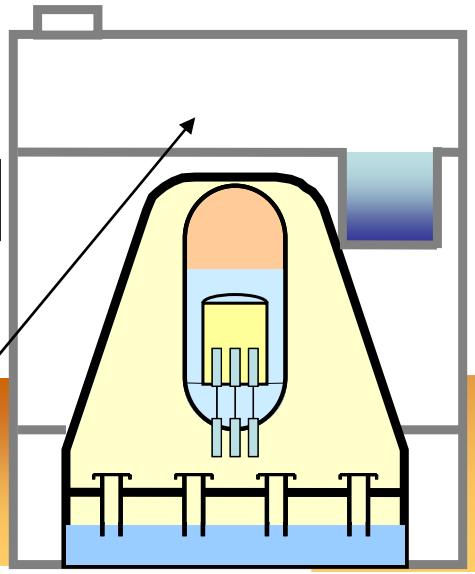
Enforcement of support function

Deployment of heavy industrial machines for debris withdrawal

Enforcement of various power supply measures

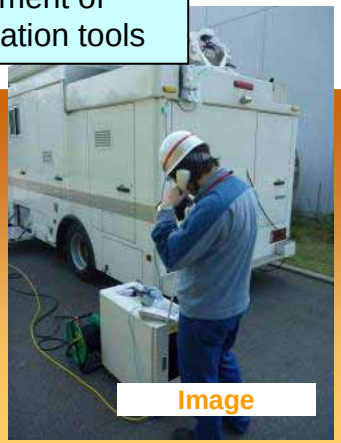


Reinforcement of DC power supply (deployed on upper level floor)



Enforcement of Communication tools

Deployment of mobile communication tools



Image

Deployment of lighting tools

IV.-2 Measures to structural problems of nuclear organization (1/2)

[Measure 1] Safety Awareness Among Management Members

・Top management and all management members must have a high level of awareness about nuclear power.

[They should become fully aware of the fact that they assume primary responsibility, and strongly recognize the huge risks of nuclear power.]

・ Training programs are given, basic principles of nuclear safety design, safety culture and causes of and measures taken for the Fukushima accident.

・Conduct a 360-degree evaluation about the degree of embodiment of the 5 behavioral indicators above for nuclear power leaders from their supervisors, colleagues, subordinates, partner companies and people at the site areas and feed the results back to them.

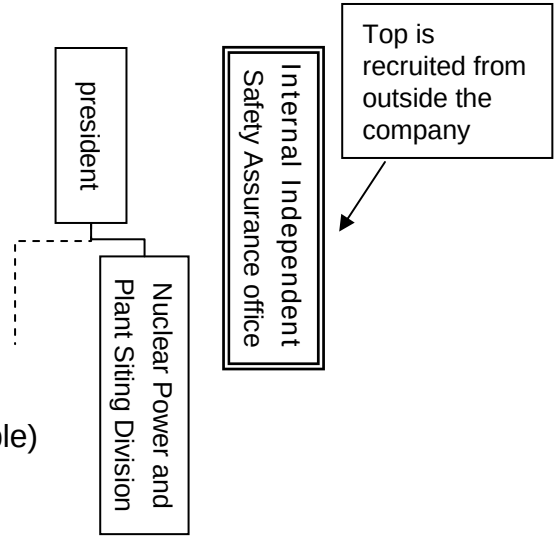
[Measure 2] Internal Regulatory Organization (reflect comments from the committee)

・The office is an organization directly controlled by the president, independent of the Nuclear Power and Plant Siting Division.

・The top is a person familiar with the affairs about nuclear safety who is from outside the company.

・The office directly reports about whether new safety measures are required or not and whether efforts to improve safety by the Nuclear Power and Plant Siting Division are sufficient or not to the president, who follows the report.

(Example)



[Measure 3] Emergency Organizations

・In light of ambiguous responsibility and authority about responding to accidents and reflection on confused information sharing, commands and controls, we will introduce ICS.

・Bring in the concept like Maximum number of persons under supervision (3-7 persons), Transparent command and control system etc and strengthen the emergency training.

IV.-2 Measures to structural problems of nuclear organization (2/2)

[Measure 4] Technological Capability to Propose Measures for Defense in Depth

- Requesting measures to enhance safety every year and implement better measures. The construction implemented as follows ; investigate from the perspective of multilateral, improve safety immediately, directly implement managed detailed design and selecting constructing partners.
- Evaluation for improving safety by middle management level
- We will conduct a 360-degree evaluation of the degree of embodiment of the 5 behavioral indicators above for superiors, subordinates and colleagues.

[Measure 5] Enhancement of On-site Direct Management Technological Capability

- Expanding directly managed work for response in emergency situation
- We will improve technological capabilities regarding the "Preparation of facility recovery plans and implementation of recovery" by employees. Because of this, we will implement a development rotation for operators and the security division together.

[Measure 6] Establishment of Risk Communicators

[Appointment of specialists]

- Since the accident of March 11, the level of explanation requested by the society has increased. We have to explain in a more technically and advanced manner.
- Amid this background, advanced dialogue and technological capabilities are required to promote dialogue about risks. Therefore, "risk communicators" with technical responsibilities are appointed.

[Allocation]

- A risk communicator should be allocated for each power station as spokesperson of site manager and Nuclear Power and Plant Siting Division manager, and dispatched as necessary for risk communication.

V. Past Exchange of Opinions Between the Nuclear Safety Monitoring Committee and the Nuclear Reform Special Taskforce

October 12	1st Nuclear Safety Monitoring Committee meeting
November 5	Committee Sakurai ・Validation of response to Fukushima-2 plant accident ・Prevention of deterioration of nuclear power safety reform plans
November 7	Committee Ohmae ・Delayed release of information about Fukushima-1 plant information
November 10	Deputy Chairman Judge ・Establishment of internal regulatory organizations
November 23	Committee Ohmae ・Whether explanations to the area were sufficient or not at the time of establishment of Fukushima-1 unit ・Crisis communication
November 29	Committee Sakurai ・Success factors of response to Fukushima-2 accident ・Prevention of organizations in emergency situations from becoming a dead letter
November 30	Chairman Klein ・Propagation of safety culture
December 7	Committee Ohmae ・Check of facility measures against loss of all power

<Our Determination>

We will continuously keep the Fukushima nuclear accident in our mind and become a nuclear power operator creating an unparalleled safety culture, while raising day by day the level of nuclear safety.

<Positioning of the Task Force discussion>

- Under the consideration that the nuclear safety reform can't start in recognition it was unexpected or it was not the omission, we discuss the nuclear safety reform without being bound the conclusions of the internal accident report and without providing a sanctuary.

- It is the indisputable fact that the Fukushima site being attacked by the giant tsunami and accidents occurred. The cause of the accident is standing on the idea that " there were not been enough prepared", and in order not to repeat the Fukushima Nuclear Accident again, we look back the accident and made the reform plan.