Nuclear and Industrial Safety Agency
Ministry of Economy, Trade and Industry

International Nuclear Safety Cooperation after the TEPCO's Fukushima Accident

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NISA Nuclear and Industrial Safety Agency

Thanks for Your Great Support and Cooperation

- Japan has received a wide array of support from the world. Japan would like to express its deepest gratitude.
- Japan will overcome this accident sharing latest information and lessons learned.

A presentation delivered at the last day of RIC 2011, 16 hours before the earthquake.

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The Accident at Fukushima Dai-ichi NPS

- The accident at Fukushima Dai-ichi NPS was caused by long lasting complete power loss due to common cause failure (CCF) of electrical equipment following tsunami, and insufficient provision against severe accident.
- It is temporarily rated at INES Level 7, and people where lived in the specific areas including those within 20 km radius from the site are still not able to return home.

The moment when tsunami attacked Fukushima Dai-ichi NPS (source: TEPCO)

General View of root causes of the Accident

CCF of electric equipment and insufficient severe accident provision were induced by following root causes:

- Too late or missed incorporation of new tsunami knowledge into hazard evaluation,
- The regulatory system not covering severe accident,
- Insufficient application of state-of-the-art technologies and international good practices to the regulatory programs.

New Nuclear Regulatory Organizations

Nuclear Regulatory Authority (NRA) will be established as an external organ of the Ministry of Environment (MOE) by:

- separating the nuclear safety regulatory function of NISA from METI and,
- unifying relevant functions of other ministries (Size: 500 Staff, 50 billion yen Budget).

New Nuclear Regulatory Systems

NRA will implement new regulatory systems stipulated in amended laws, including:

- Regulation taking severe accidents into consideration.
- Regulation applying latest scientific/technical knowledge on safety issues to existing facilities. (backfitting)
- An operation limit of 40 years to deal with aged reactors

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Current Status of Fukushima Dai-ichi NPP

Step 2 of the "Roadmap towards Settlement of the Accident at Fukushima Daiichi Nuclear Power Station, TEPCO" were completed (Dec 16th , 2011)

- Reactor : A condition so-called "Cold Shutdown"
  - ✓ Temperature of RPV bottom is, in general, below 100℃.
  - ✓ Release of radioactive materials from PCV is under control and public radiation exposure by additional release is being significantly held down. (Not exceed 1 mSv/y at the site boundary as a target.)
  - ✓ Mid-term Safety of Circulating Water Injection Cooling System
- Spent Fuel Pool : More stable cooling
  - ✓ Circulating Cooling System by installation of heat exchanger
- Radioactive Contaminated Water : Reduction of total amount
  - ✓ Full-fledged processing facilities
  - ✓ Desalination processing (reuse)
  - ✓ Storage
  - ✓ Mitigation of contamination in the ocean

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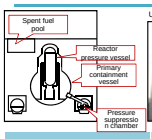
Current Status of Fukushima Dai-ichi NPP




Unit 1 — TEPCO


Unit 2 — Ministry of Defense


Unit 3 — Air Photo Service


Unit 4 — Air Photo Service

	Unit 1	Unit 2	Unit 3	Unit 4
Reactor Pressure vessel Temperature at reactor vessel bottom*	Circulating water injection cooling 24.3℃	Circulating water injection cooling 47.1℃	Circulating water injection cooling 51.4℃	No fuel
Primary Containment vessel Temperature of air in PCV*	Nitrogen injection 25.4℃	Nitrogen injection 54.3℃	Nitrogen injection 44.4℃	–
Fuel pool Temperature of pool water*	Circulation cooling 26.5℃	Circulation cooling 14.2℃	Circulation cooling 14.4℃	Circulation cooling 26℃
Highly-contaminated water in R/B and T/B**	14,100 m³	22,000m³	23,800 m³	18,300 m³

* As of 12:00 on February 24, 2012 ** As of February 21, 2012

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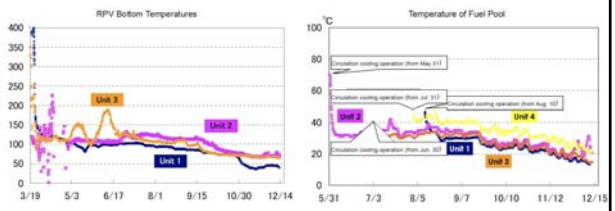
Temperature Trends



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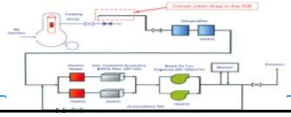
Result of Gas Sampling at PCVs Gas Control System

Nuclides	Concentration of sample (Bq/cm3) Unit 1 (Sampled on Mar. 8, 2012) Gas vial container	Detection limits of Unit 1 (Bq/cm3)	Concentration of sample (Bq/cm3) Unit 2 (Sampled on Mar. 7, 2012) Gas vial container	Detection limits of Unit 3 (Bq/cm3)	Concentration of sample (Bq/cm3) Unit 3 (Sampled on Mar. 1, 2012) Gas vial container	Detection limits of Unit 3 (Bq/cm3)
I-131	N.D.	1.3×10^{-1}	N.D.	1.2×10^{-1}	N.D.	1.3×10^{-1}
Cs-134	3.5×10^{-1}	3.0×10^{-1}	5.9×10^{-1}	3.0×10^{-1}	4.0×10^{-1}	3.2×10^{-1}
Cs-137	5.5×10^{-1}	3.6×10^{-1}	8.1×10^{-1}	3.6×10^{-1}	7.2×10^{-1}	3.8×10^{-1}
Kr-85		2.5×10^{-1}	N.D.	2.5×10^{-1}	N.D.	2.5×10^{-1}
Xe-131m		2.9×10^{0}	N.D.	3.0×10^{0}	N.D.	3.3×10^{0}
Xe-133		2.4×10^{-1}	N.D.	2.7×10^{-1}	N.D.	2.2×10^{-1}
Xe-135		1.1×10^{-1}	N.D.	1.0×10^{-1}	N.D.	1.0×10^{-1}

N.D. : not detected (Source: TEPCO)



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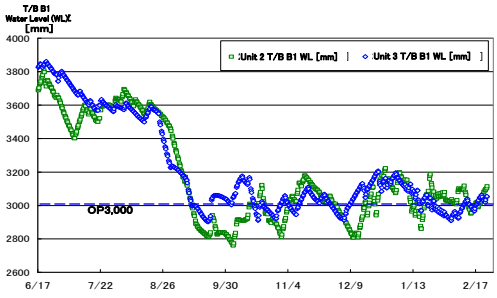
Trend of Amount of Accumulated Water

- Total amount of the accumulated water level has been decreased around the tentative target level of O.P. 3000 during STEP 2 and maintained.



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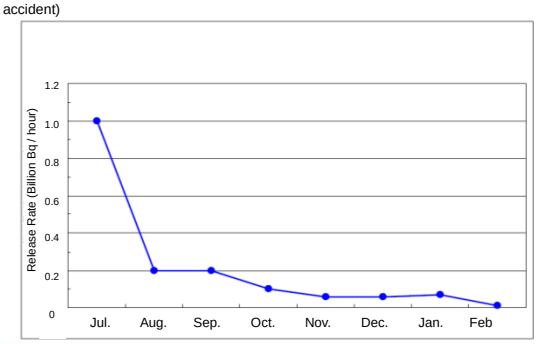
Release Rate of Radioactive Materials from PCVs of Units 1-3

- Current total release rate of Cesium 134 and 137 from PCVs of Units1-3 is estimated to be approx. 0.01 billion Bq/h at the maximum. (1/77,000,000 of early stages of the accident)



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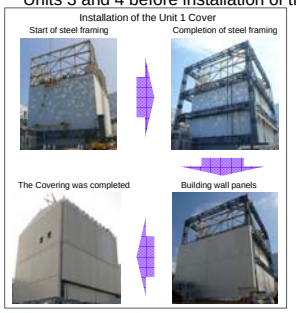
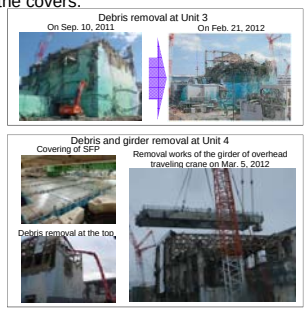
Installation of Reactor Building Cover (on Oct. 28, 2011)

- A cover was installed in the Unit 1 building to restraint release of radioactive materials.
- Rubble is being removed from the upper part of the reactor buildings for Units 3 and 4 before installation of the covers.





(Source: TEPCO)

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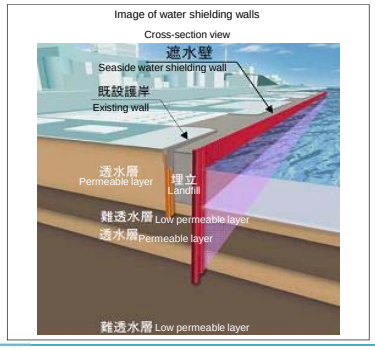
Construction of Water Shielding Wall

- A measure to prevent contamination of the ocean via the underground water.



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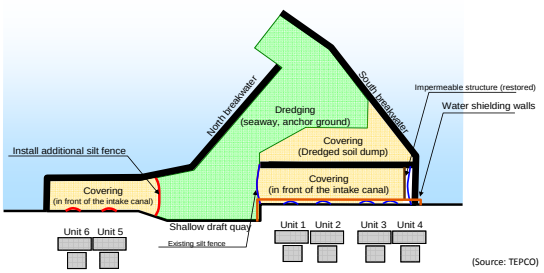
Start of Marine Soil Covering Construction at Inside Port

- High concentrated radioactive materials were detected from marine soil sampled at inside of the port
- To prevent contamination of the ocean outside of the port, marine soil in front of the intake canal is planned to be covered with solidified soil.



(Source: TEPCO)

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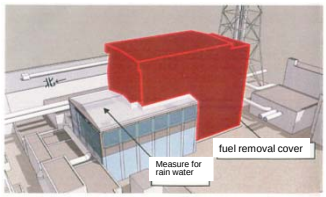
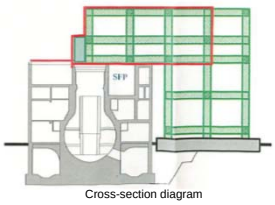
Prepare for Fuel Removal from SFP of Unit 4

- Fuel removal are planned to be initiated in autumn 2013.
- Currently Rubble is being removed to prepare for the relevant works.
- Construction of covering structure will be initiated in spring 2013.



Building image of fuel removal cover



Cross-section diagram

(Source: TEPCO)

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2. Japan's International Nuclear Safety Cooperation

1. Bilateral Cooperation
   Information sharing
   Technical cooperation of experts
   Goods

2. Cooperation through international organization
   Information sharing
   IAEA Nuclear Safety Action Plan

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2.-I. US – Japan Cooperation

Overall cooperation framework

- Based on an order from the Prime Minister, and an offer of support from the U.S. government
- US: NRC, DOE, U.S. army, research centers
  Japan: Related ministries, agencies, TEPCO
- From March 22 to December 20, regular plenary meetings were held.

Technical experts meetings

Under the framework, experts from NRC, NISA, etc. have frequently conducted discussions issues e.g.,
-Latest information of the plant,
-Cooling methods,
-Severe accident management.

2.-II-1. Info. Sharing & Peer Reviews through IAEA and OECD/NEA

(2011)

May-Jun:	IAEA Fact Finding Mission
Jun:	Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety
Sep:	Additional Report of the Japanese Government (Second Report) to the IAEA
Oct:	IAEA Decontaminating Review Mission IAEA IRRS Work Shop International Symposium on Decontamination
Nov:	International Seminar on Stress Test

(2012)

Jan:	International Workshop on Nuclear Safety Regulation IAEA Stress Test Review Mission
Mar:	IAEA International Expert Meeting
Aug:	Extraordinary Meeting on CNS
Dec:	The Fukushima Ministerial Conference on Nuclear Safety

(TBD)

IAEA Decommissioning Review Mission

2.-II-2. Sharing Lessons Learned

–28 Lessons in Japanese Government's Report to IAEA-

- Category 1
  Prevention measures against a severe accident (8 items)
- Category 2
  Mitigation measures against a severe accident (7 items)
- Category 3
  Responses to the nuclear accident (7 items)
- Category 4
  Safety infrastructure (5 items)
- Category 5
  Safety culture

First Report in June 2011

Additional Report in September 2011

Mr. Goshi HOSONO, Minister of State for the Nuclear Power Policy and Administration announced to invite IRRS to Japan at the IAEA 55th General Conference on 19 September 2011.

2.-II-2. Sharing Lessons Learned (cont'd)

–16 Lessons in IAEA Fact Finding Mission's Report-

Lesson 1: Considering external natural hazards
Lesson 2, 3: Providing any necessary equipment for severe accident management
Lesson 4, 5: Housing the Emergency Response Centres
Lesson 6: Taking account of the potential unavailability of instruments, lighting, power and abnormal conditions
Lesson 7: Pooling experienced personnel adequately
Lesson 8: Revisiting the risk and implications of hydrogen explosions
Lesson 9: Providing adequate diversity for essential safety functions
Lesson 10: Providing hardened systems, communications and sources of monitoring equipment
Lesson 11: Making off-site emergency preparedness and response even more effective
Lesson 12: Introducing concepts of 'deliberate evacuation' and 'evacuation-prepared area' for effective long term countermeasures
Lesson 13: Taking advantage of the data and information generated from the Fukushima accident
Lesson 14: Organizing appropriately and with well led and suitable trained staff
Lesson 15: Establishing effective on-site radiological protection in severe accident conditions
Lesson 16: Ensuring regulatory independence

2.-III. IAEA Action Plan

1. Safety assessments in the light of the accident at TEPCO's Fukushima Daiichi Nuclear Power Station
2. IAEA peer reviews
3. Emergency preparedness and response
4. National regulatory bodies
5. Operating organizations
6. IAEA Safety Standards
7. International legal framework
8. Member States planning to embark on a nuclear power programme
9. Capacity Building
10. Protection of people and the environment from ionizing radiation
11. Communication, information dissemination and analyze relevant technical aspects
12. Research and development

2.-III.-a-1. Stress Test in Japan (as IAEA AP #1)

Objectives

Carry out safety assessment to ensure public/residents relief and confidence in improved safety of nuclear power plants, according to new procedure/rule and referring to stress tests conducted in European countries as references.

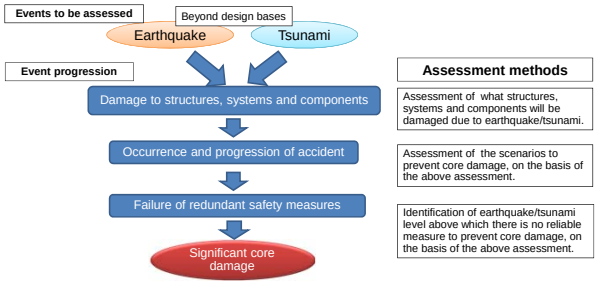
Overview

- **Primary assessment: (Decision on whether to restart operations at nuclear power stations currently suspended for the purpose of regularly scheduled checks)**
  Evaluate safety margins of structures, systems and components important to safety to endure the events beyond design bases, for nuclear power plants under periodic inspection and ready for start-up.
- **Secondary assessment: (Decision on whether to continue or halt operations of nuclear power stations that are currently in operation)**
  Conduct comprehensive safety assessment for all nuclear power plants including those in operation and those subject to primary assessment, considering the status of stress tests in European countries and progress in investigation by the Investigation and Verification Committee on the Accident.

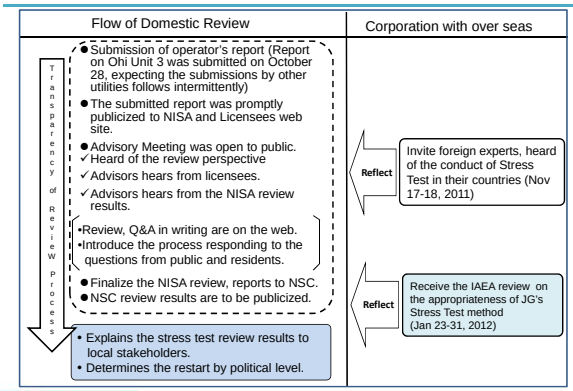
" **Confirmation of the Safety of Nuclear Power Stations in Japan** " (July 11)

2.-III.-a-2. Events Assessed and Safety Margin Assessment Process

Assess the safety margins (overall system margins) from the occurrence of events beyond design bases (earthquake and tsunami), through functional loss of individual component and damages to redundant safety measures, finally to core damage.



2.-III.-a-3. Review Process of Stress Test (Primary Assessment)



2.-III.-a-4. Review Process of Stress Test (Primary Assessment) (cont'd)

(As of February 24, 2012)

Licensee	Power station (Unit)	Date of report on primary evaluation	Date of NISA's evaluation completion	Date of report to NSC	Date of NSC's confirmation completion
Kansai Electric Power Co.	Ohi Power Station (Unit 3)	Oct. 28, 2011	Feb. 23, 2012	Feb. 23, 2012	—
Shikoku Electric Power Co.	Ikata Power Station (Unit 3)	Nov. 14, 2011	Evaluation under way	—	—
Kansai Electric Power Co.	Ohi Power Station (Unit 4)	Nov. 17, 2011	Feb. 23, 2012	Feb. 23, 2012	—
Hokkaido Electric Power Co.	Tomari Power Station (Unit 1)	Dec. 7, 2011	Evaluation under way	—	—
Kyushu Electric Power Co.	Genkai Nuclear Power Station (Unit 2)	Dec. 14, 2011	Evaluation under way	—	—
Kyushu Electric Power Co.	Sendai Nuclear Power Station (Unit 1)	Dec. 14, 2011	Evaluation under way	—	—
Kyushu Electric Power Co.	Sendai Nuclear Power Station (Unit 2)	Dec. 14, 2011	Evaluation under way	—	—
Kansai Electric Power Co.	Mihama Power Station (Unit 3)	Dec. 21, 2011	Evaluation under way	—	—
Japan Atomic Power Co.	Tsuruga Power Station (Unit 2)	Dec. 27, 2011	Evaluation under way	—	—
Hokkaido Electric Power Co.	Tomari Power Station (Unit 2)	Dec. 27, 2011	Evaluation under way	—	—
Tohoku Electric Power Co.	Higashidori Nuclear Power Station (Unit 1)	Dec. 27, 2011	Evaluation under way	—	—
Kansai Electric Power Co.	Takahama Power Station (Unit 1)	Jan. 13, 2012	Evaluation under way	—	—
Tokyo Electric Power Co.	Kashiwazaki-Kariwa Nuclear Power Station (Unit 1)	Jan. 16, 2012	Evaluation under way	—	—
Tokyo Electric Power Co.	Kashiwazaki-Kariwa Nuclear Power Station (Unit 7)	Jan. 16, 2012	Evaluation under way	—	—
Kansai Electric Power Co.	Ohi Power Station (Unit 1)	Jan. 27, 2012	Evaluation under way	—	—
Hokuriku Electric Power Co.	Shika Nuclar Power Station (Unit 2)	Feb. 1, 2012	Evaluation under way	—	—

- Currently 54 units of nuclear power plants are in operation. (The Units 1~ 4 at the TEPCO Fukushima Daiichi Nuclear Power Station were decided to be decommissioned .)
- 2 units (Tomari Power Station (Unit 3) and Kashiwazaki-Kariwa Nuclear Power Station (Unit 6)) are operating and 48 units are in stoppage.

2.-III.-a-5. Recommendations and suggestions form IAEA Review

- IAEA Stress Test Review Mission's Summary Report (on Jan 31, 2012) -

Recommendations:
- Clarify guidance regarding the expectations for conducting and reviewing Comprehensive Safety Assessments;
- Ensure implementation of future actions by the licensees (documentation, follow-up inspection);
- Meetings with interested parties near the nuclear facilities;
- Ensure on the definition of the safety margin capacity specification and communication to the licensees;
- Ensure that the seismic safety margin assessment includes the proper walkdowns;
- The secondary Assessment addressing the provisions for mitigation of severe accidents; and
- Licensees to develop comprehensive accident management programmes.

Suggestions:
- Identify and implement lessons from the experience gained during early assessments and reviews;
- The Secondary Assessments with appropriate timescales;
- Seismic and Tsunami Probabilistic Safety Assessment to check effectiveness; and
- Consider action of closer integration of accident management and on-site emergency preparedness measures.

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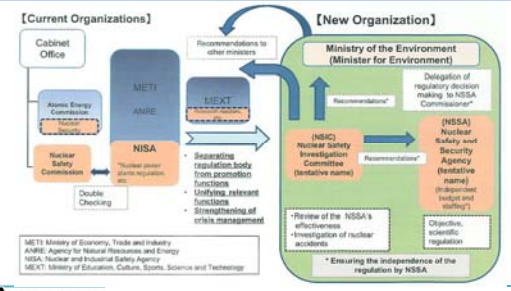
2.-III.-b-1. New Safety Regulation (as IAEA AP #4)

- **NSSA (tentative name)** will be established as an agency (Size: 500 Staff, 50 billion yen Budget), an external organ of the MOE by separating the nuclear safety regulation section of NISA from METI and unifying relevant functions of other ministries NSIC, a council-type third party to be created with NSSA, will review the effectiveness of regulatory actions taken by NSSA, investigate causes of nuclear accidents and make recommendations to monitor the regulatory independence of NSSA.(Diet agreed personnel)



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2.-III.-b-2. Reform of Japan's Nuclear Safety Regulation

- With a strong determination "To protect people and the environment from harmful effects of radiation," the Government of Japan will establish "a new regulation that applies the latest scientific/technical knowledge on safety to existing facilities and operation (backfitting)," reinforce "a licensee's responsibility of seeking to constantly improve the safety of its facilities," and make the regulation visible by statutory transparency.

○Reform of the Atomic Energy Basic Act

Considering the international understanding of nuclear safety, the objective of nuclear safety in the use of nuclear energy, that is "to protect people and the environment from harmful effects of ionizing radiation," will be clearly written in the Atomic Energy Basic Act.

○Reform of the Nuclear Reactor Regulation Law

1. Dealing with "the unexpected" - The new regulation takes severe accidents into consideration.
2. Regulation based on the latest knowledge - The new regulation applies latest scientific/technical knowledge on safety issues to existing facilities.(backfitting)
3. An Operational limit of 40 years will be introduced to ensure the safety of aged power reactors.
4. Specified licensee's responsibility - a licensee's responsibility to constantly improve the safety of its facilities
5. Thorough protection of the lives and health of citizens in case of nuclear disasters
6. Unification of legislation – Separation from the Electricity Business Act

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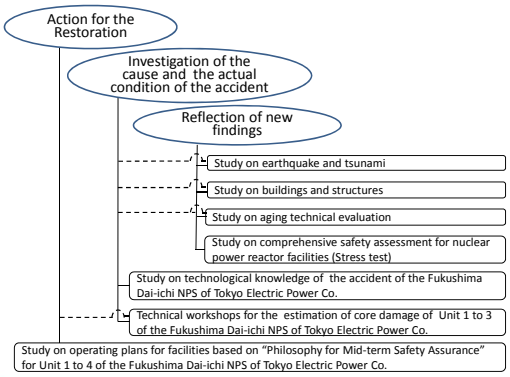
2.-III.-c-1. Analysis of Relevant Technical Aspects (as IAEA AP #11)

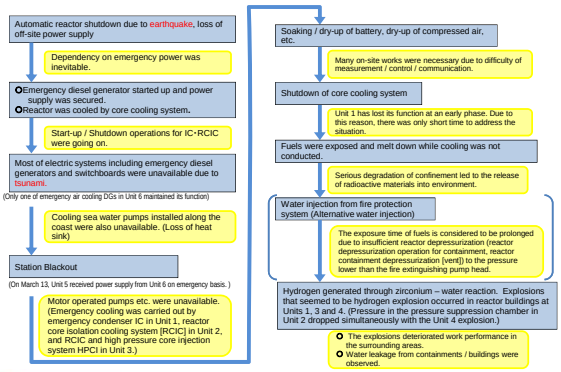


2.-III.-c-2. Comparison with other NPSs (damages by earthquake and tsunami)

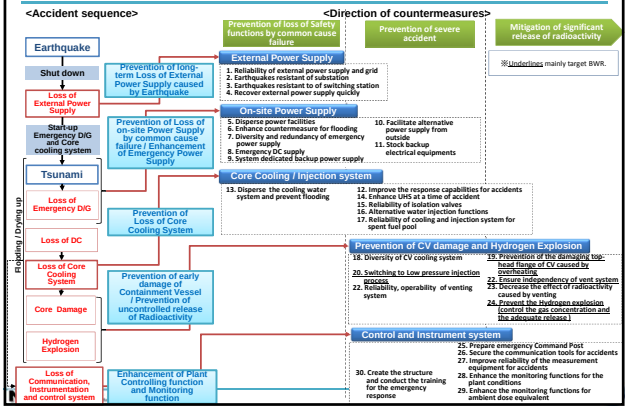
	Fukushima Dai-ichi NPS	Fukushima Dai-ni NPS	Onagawa	Tokai Dai-ni	(Status of Fukushima Dai-ni, Onagawa and Tokai Dai-ni)
Seismic intensity (Observation point: city / town /village)	6 upper (Ohkuma Town, Futaba Town)	6 upper (Naraha Town, Tomioka Town)	6 lower (Onagawa Town)	6 lower (Tokai Village)	-
Max. acceleration on observation record (on basement) [Comparison with basic design earthquake ground motion (Ss)]	550 Gal (Unit 2 E-W direction) [Partially surpassed Ss]	305 Gal (Unit 1 Up-down direction) [Lower than Ss]	607 Gal (Unit 2 S-N direction) [Partially surpassed Ss]	225 Gal (E-W direction) [Lower than Ss]	-
Elevation of site* (Subsidence due to earthquake is not considered)	Units 1-4: 10m Units 5-6: 13m	12m	14.8m	8m	-
Estimated Tsunami height* (Estimate using the methods of Society of Civil Engineering, as of 2002)	5.4-5.7m	5.1-5.2m	13.6m	5.75m	-
Tsunami run-up height*	Units 1-4: 14-15.5m Units 5-6: 13-14.5m	7.0-7.3m (Only south side of Unit 1 building: 15.3-15.9m)	13.8m	6.2m	-
Power receiving status from (off-site) power cable	Loss of all circuits (out of 6 circuits)	1 circuit available (out of 4 circuits)	1 circuit available (out of 5 circuits)	Loss of all circuits (out of 3 circuits)	AC power (Emergency power supply) was available. → **Core cooling was possible.**
Emergency generator (Installation location)	Units 1-5: × (Water cooling) Units 2&4: × (Air cooling) Unit 6: ○ (1 unit: Air cooling) × (2 units: Water cooling)	Units 1& 2: × Unit 3: ○ (2/3) Unit 4: ○ (1/3) (All water cooling)	Unit 1: ○ Unit 2: ○ (1/3) Unit 3: ○ (All water cooling)	○ (2/3) (All water cooling)	
	T/B basement (Sea side) Operation auxiliary common facility on the 1st floor DG building	Reactor building basement (Land side)	Reactor building basement (Land side)	Reactor building basement (Land side)	Emergency generator is installed in reactor building.
Sea water pump motor (Pump location / height)	Totally soaked	Partially soaked	Partially soaked	Partially soaked	Pumps were partially available and functioned.
	Outdoor O.P. 4m	Indoor O.P. 4.2m	Partially Outdoor O.P. 3m	Outdoor T.P.0.8m	No specific difference (Height of tsunami that attacked Fukushima Dai-ichi NPS was enormous.)
Tools arranged for power supply	Power source car (could not be connected)	Power source car was used partially	Because off-site power supply by power cable or emergency diesel generator survived, power source car was not necessary.		

* It refers to the altitude from base point in each power station.

2.-III.-c-3. Progress of Accident (Outline of accident development common to Units 1-3)



2.-III.-c-4. Technical Knowledge Learned
Direction of Countermeasures (Point) - Interim Report -



3. Conclusion

- Japan has been making every effort to share knowledge and lessons learned conducting thorough investigation of the accident with the international community and to contribute to enhancing international nuclear safety.
- And, again:
  - **Deployments of new design reactors are globally planed, especially in newcomer countries.**
  - **"Accident anywhere is accident everywhere." The potential size of "anywhere" is growing fast.**
  - **Nuclear safety must internationally be maintained, however, regulatory resources are limited in every country.**

The international community must take effective, efficient and sustainable approaches

Including implementing IAEA Action Plan in a well harmonized way!

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