

Where Japan Is and Where Japan Will Go: Update of the Fukushima Accident and Post-Fukushima Nuclear Energy Policy in Japan

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March 11 Event

- The Great East-Japan Earthquake and the resulting tsunamis struck the Fukushima Daiichi Nuclear Power Plant of TEPCO on March 11, 2011.
- This caused a nuclear accident that was unprecedented: the simultaneous progression of accidents at multiple units and the continuation of accident over an extended period of time.
- The fact that this accident has raised concerns around the world about the safety of nuclear power generation is a matter which Japan takes with the utmost seriousness and remorse.
- In the face of this hardship, Japan has received supports and expressions of solidarity from around the world. I would like to express Japan's sincere gratitude to you.



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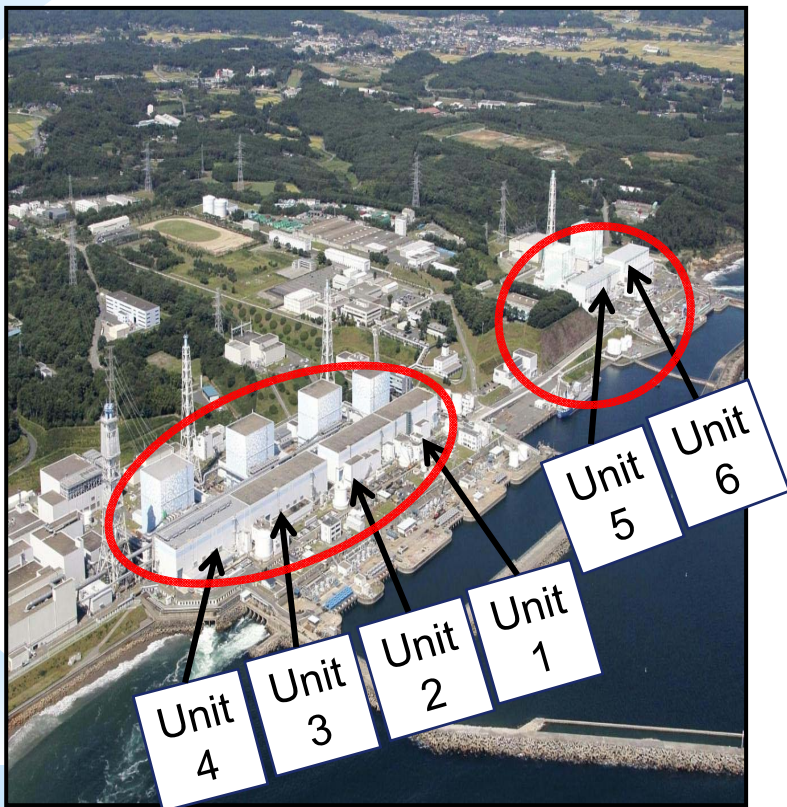
Presentation Topic

- ◆ Accident Progression
- ◆ Root Causes of Accident
- ◆ On-site Management: Activities and Future Plan
- ◆ Off-site Management: Activities and Future Plan
- ◆ Post-Fukushima Nuclear Energy Policy
- ◆ Conclusion

Fukushima Daiichi Nuclear Power Plant

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6
Reactor Type	BWR-3	BWR-4	BWR-4	BWR-4	BWR-4	BWR-5
PCV Model	Mark-I	Mark-I	Mark-I	Mark-I	Mark-I	Mark-II
Electric Output (MWe)	460	784	784	784	784	1100
Commercial Operation	1971,3	1974,7	1976,3	1978,10	1978,4	1979,10

Before the Earthquake and Tsunamis



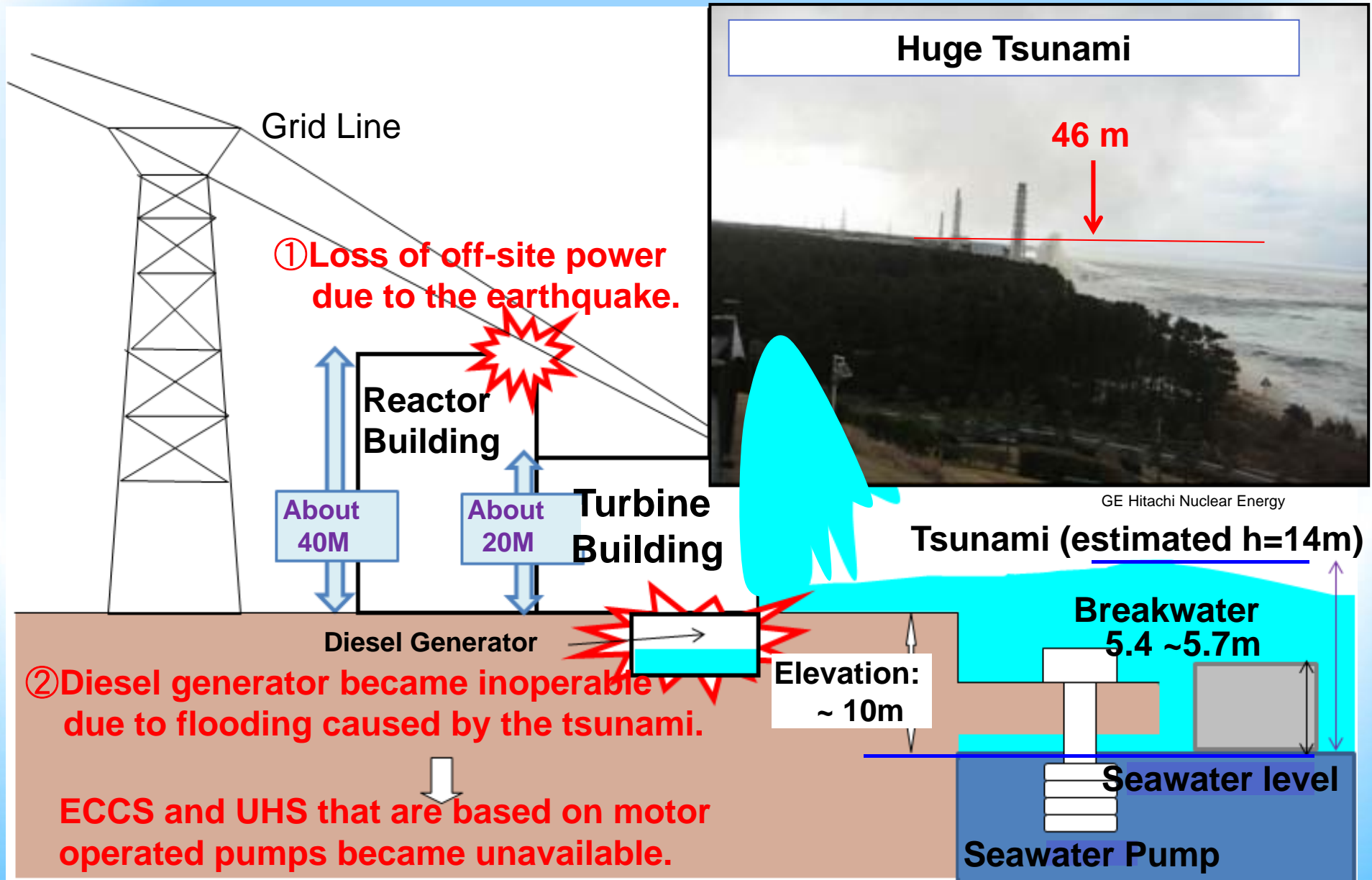
(Source: TEPCO)

After the Earthquake and Tsunamis

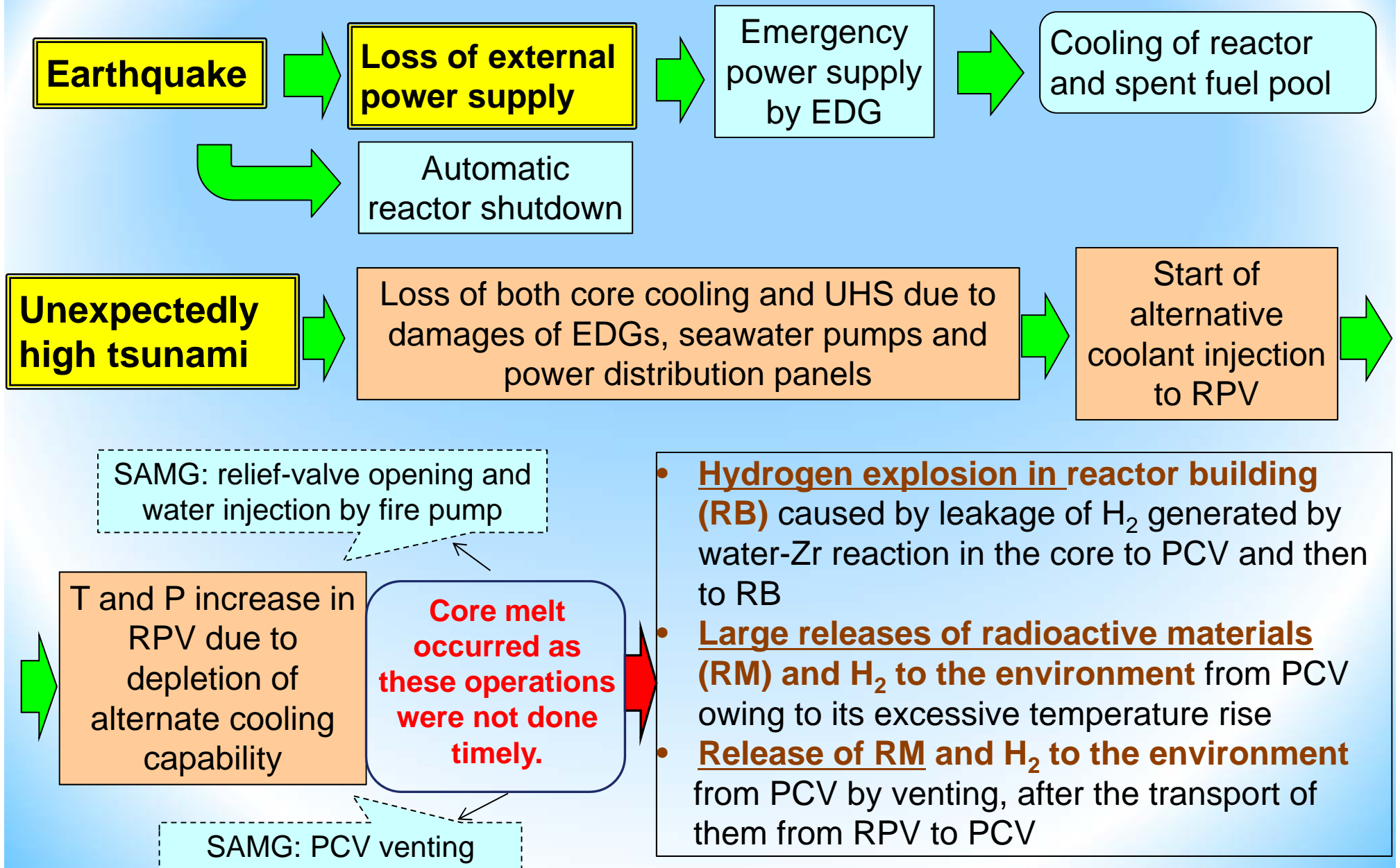


(Source: Air Photo Service Inc (Myoko, Niigata Japan))

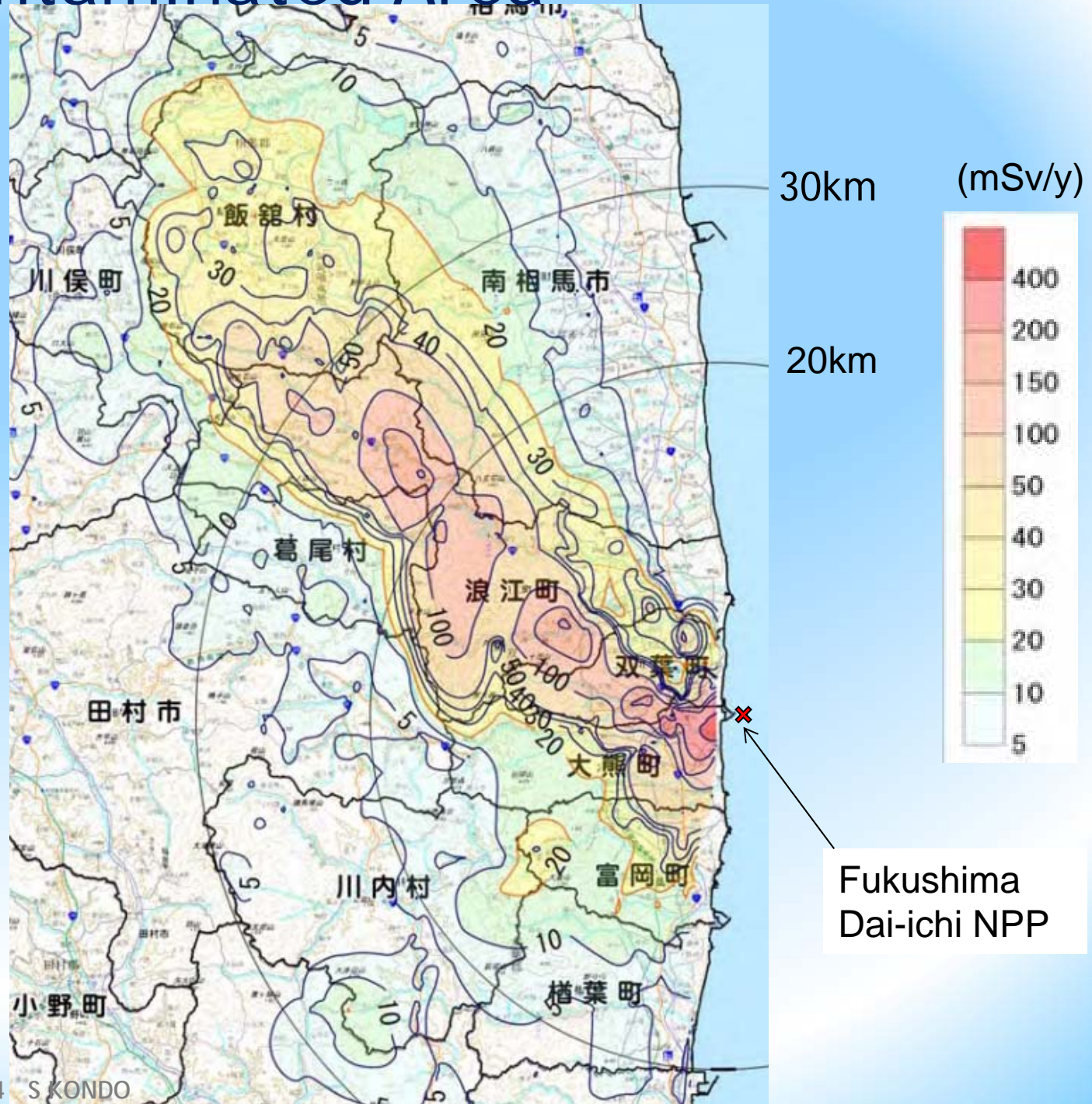
Damage of Fukushima Daiichi NPP due to Earthquake and Tsunami



Accident Sequences



Highly Contaminated Area



Root Causes of the Event

Safety Goals and Defense-in Depth

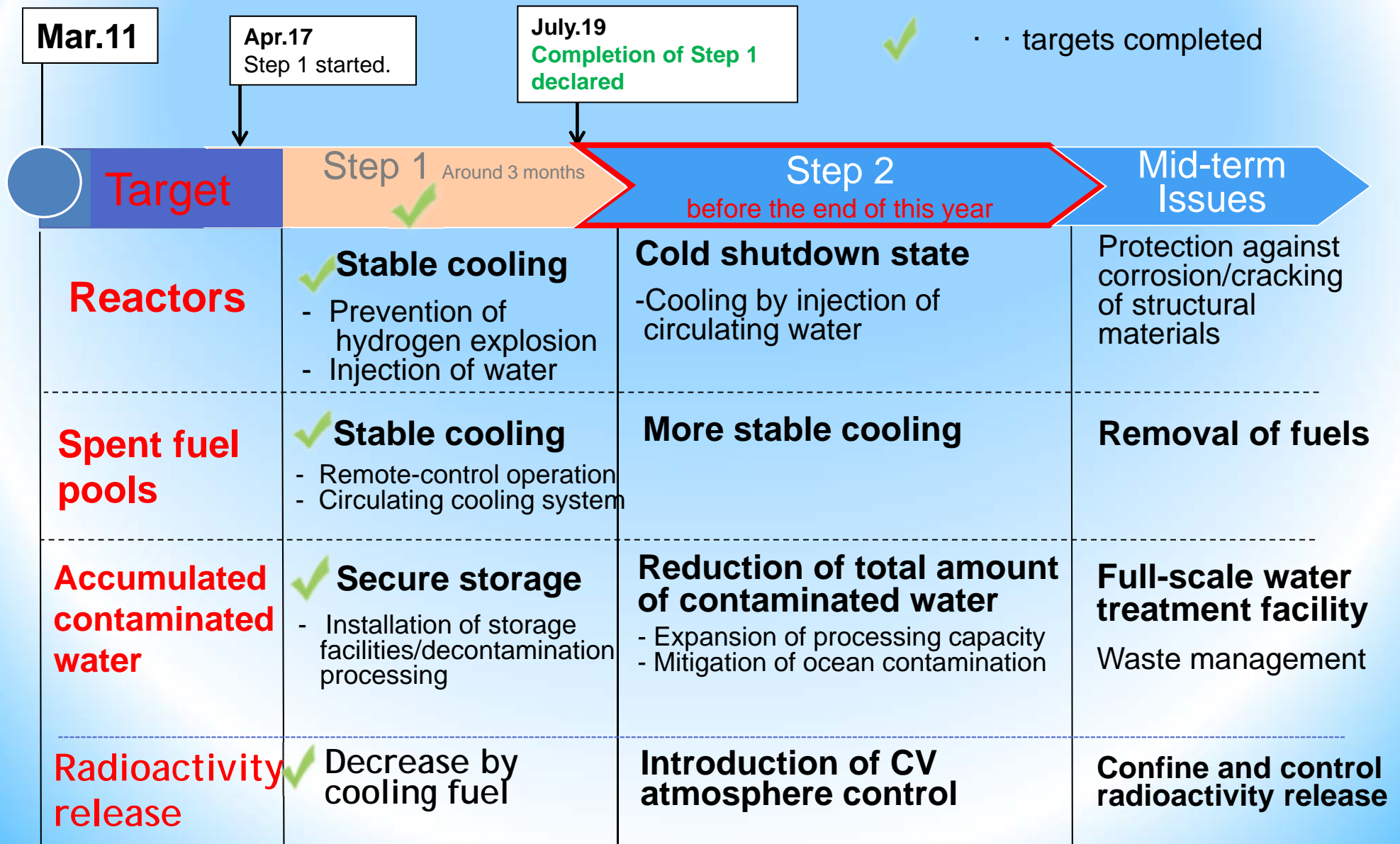
- ◆ Japanese nuclear safety people should have been more keen to **the prevention of soil contamination** due to large releases, after witnessing the tragedy caused by the Chernobyl.
- ◆ The regulators have not promoted the **IPEEE** and lost the opportunity to identify weaknesses that contribute to large releases of I and Cs.
- ◆ Japanese nuclear regulator and operators, **who were shy with probabilistic analysis**, failed to let the experts of tsunami know the necessity of having information about a tsunami that has a **frequency of exceedance of less than 1 in 10,000 years**.
- ◆ The experts of tsunami have been interested before 2000 or so in finding **the historical maximum tsunami height at a given site with limited resources available** and nuclear people has utilized it as a design basis without paying attention to the limitation.
- ◆ Nuclear regulator failed to request nuclear power plant operators to satisfy the internationally recognized need for defense-in-depth features that will prevent a disproportionate increase in radiological consequences from an appropriate range of events which are more severe than the design basis event (cliff-edge).

Root Causes of Such Degradation

- They have lacked clear lines of responsibility and the peer reviewed safety policy statement that declare the objectives of and the commitment to nuclear safety consistent with global standards.
- They have tended to limit their attention to accident prevention, one part of defense-in-depth, i.e. to issues within deterministically-set design basis, which should have been reviewed periodically based on probabilistic analysis, questioning attitude, the learning from experience, and a commitment to excellence.
- Think over these situation, the Government has decided to establish "The Nuclear Safety and Security Agency" around April of next year, by separating off the Nuclear and Industrial Safety Agency (NISA) from the Ministry of Economy, Trade and Industry, for the purpose of centralizing the regulatory system and ensuring a thorough safety culture.

On-site Management: the Current Status and Future Plan

Roadmap Towards Restoration



Cool Down of the Reactor Core

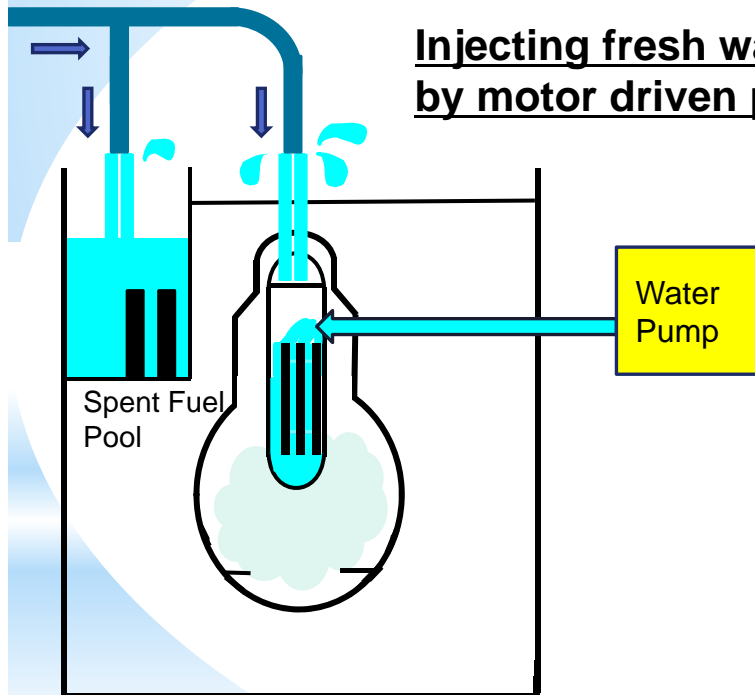
- Sustainable Reactor Cooling System -

**Provisional Cooling
by Spraying/Injecting Fresh Water**

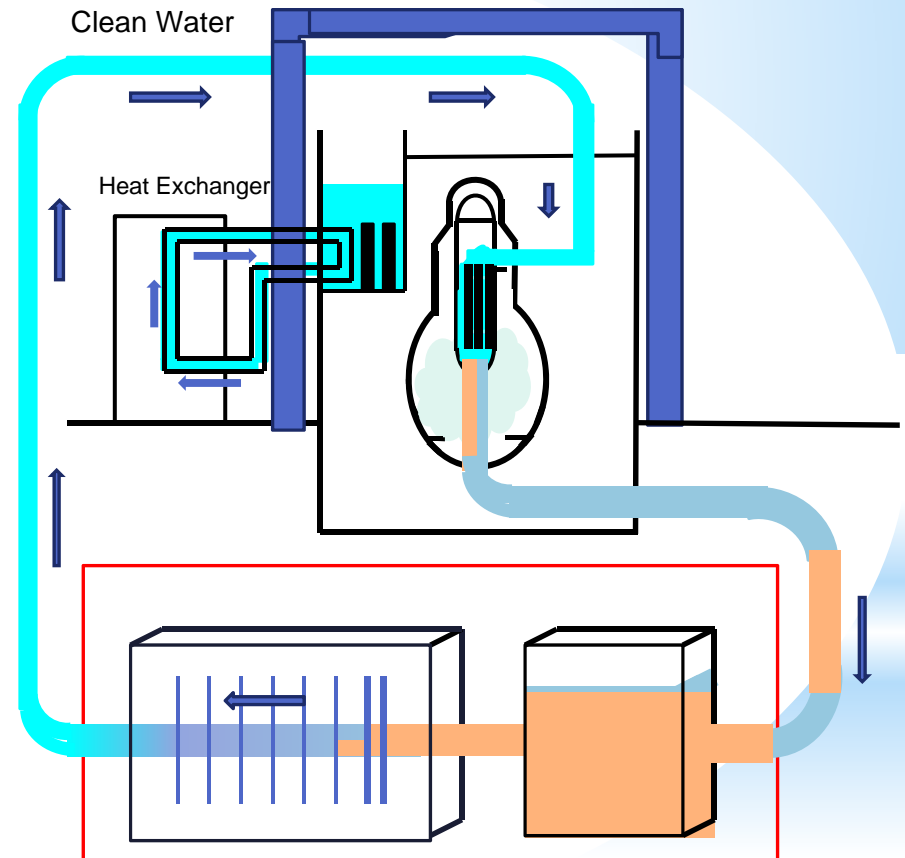
**Steady and Sustainable Cooling
by Injecting Circulating water**

Spraying fresh water

Injecting fresh water
by motor driven pump



July 2nd



Water Purification System

Cleanup Program: Activities Beyond Stabilization Phase

- Maintaining the reactors in a safe condition, by protecting against corrosion/cracking of structural materials
- Full-scale treatment of contaminated water and wastes
- Removal of spent fuel (SF) from the SFPs
- Decontamination of the reactor buildings
- Recovery of leak-tightness of CV and RPV
- Removal of core debris from RPVs and CVs
- Decommissioning of the plant
- Disposal of generated wastes at final disposal facilities

Deliberation of Both Arrangement to Remove SFs and Core Debris and A List of Technology R&D Programs

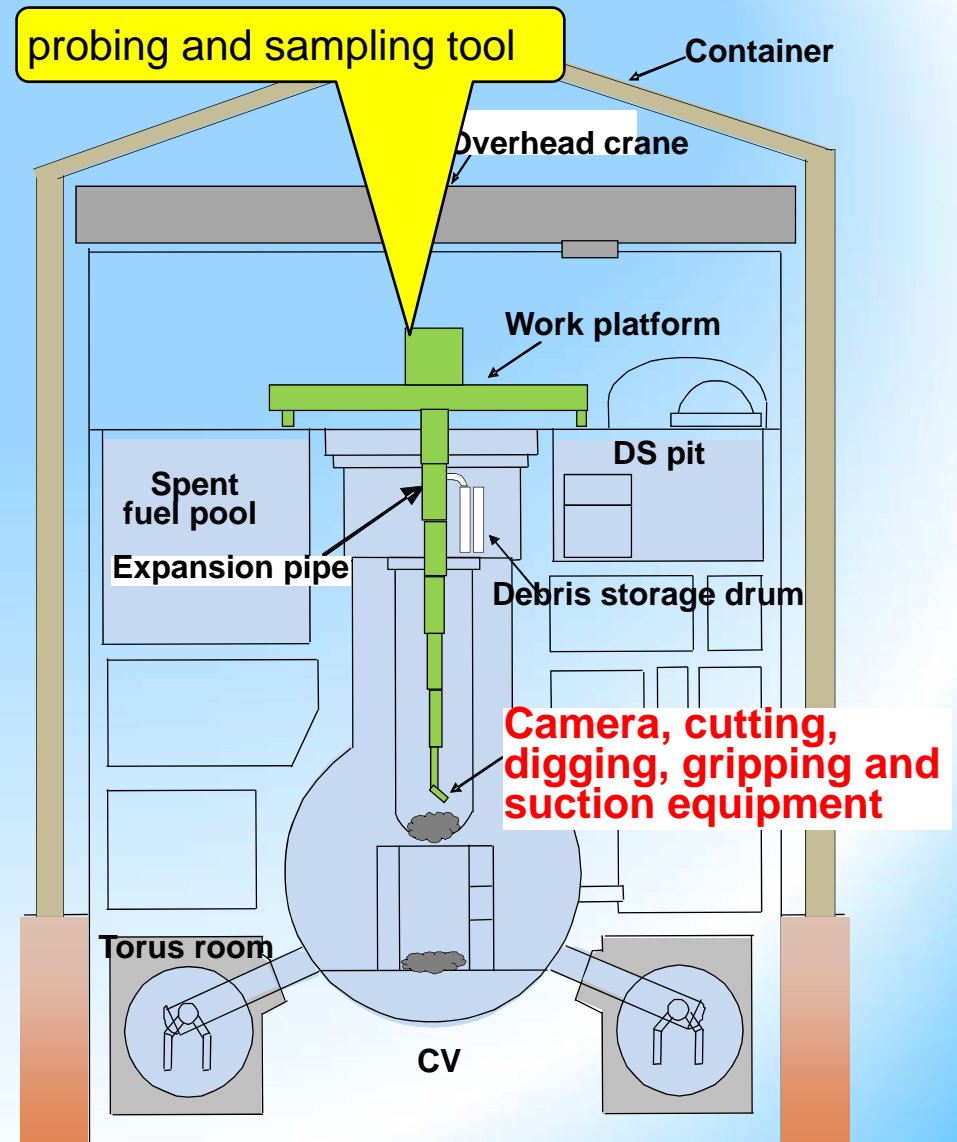
Example

Activity

- * Probing the inside of RPV and taking samples

Necessary Technology R&D

- * Decontaminate the building
- * Reestablish leak tightness
- * Remotely probe and take samples in high radiation area
- * Clarify properties of debris/material
- * Treat contaminated water and waste



Off-site Management: Remediation of Contaminated Environment

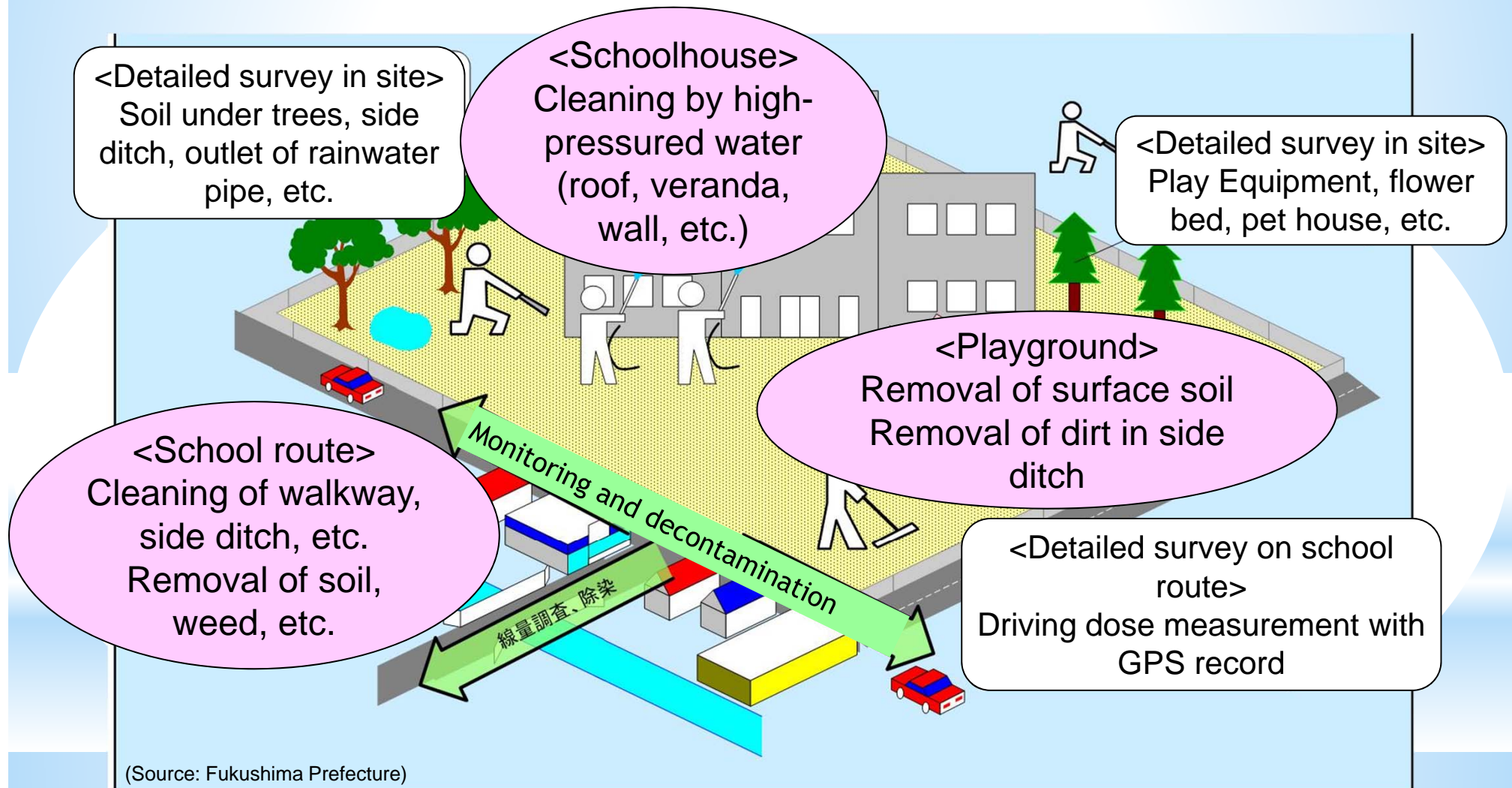
Measures for Off-site Remediation

- To decrease existing and potential annual exposures, we should pursue;
 - * Reducing the number of exposed people
 - * Modifying pathways of contaminant to a people
 - * Removing existing sources by decontamination.
- The priority choices the Government is pursuing are
 - A) Restriction of inhabiting in the area where expected annual additional dose is larger than 20 mSv;
 - B) Strict shipping control for agricultural products, animal products and marine products through radiological surveys
 - C) Step-by-step decontamination of the land.

Strategy for Decontamination

- Reduce the size of the areas where estimated additional annual exposure is larger than 20 mSv and residents have been already evacuated through step by step decontamination activities.
- Reduce the additional annual exposure below 1 mSv in the areas where it is currently below 20 mSv but above 1 mSv on a long term basis
 - Municipalities are leading the execution: wide area decontamination activities in highly contaminated areas and localized decontamination in relatively low contamination areas, identifying hot spots such as those locations where sludge in the drains or gutters has collected.

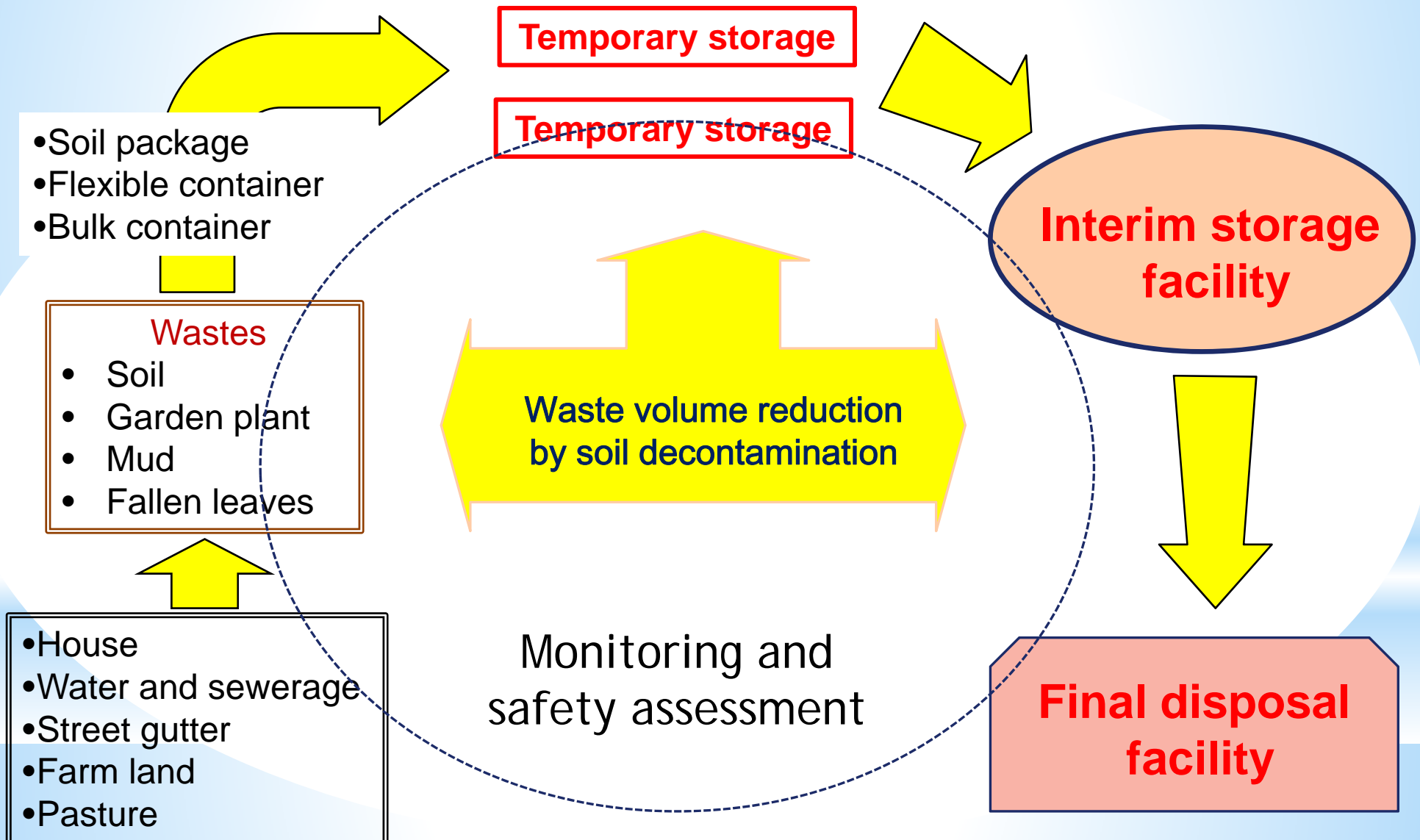
Activities to Reduce Dose-Rate in School and School Route



Current Situation in Evacuation Area

- The Government has started **one demonstration decontamination project in every municipal area** to demonstrate various approaches and establish the guideline for their widespread implementation.
- With regard to agricultural land, the Ministry of Agriculture, Forestry and Fisheries has promoted activities to verify the effectiveness of various decontamination technologies to be applied to contaminated agricultural fields.
- Based on the results of such projects and safety assessment activities, the Government will plan and promote a full-scale decontamination activity before the end of the year in cooperation with the municipal governments so that displaced people can return home as soon as possible.

Concept of Managing Waste from Decontamination Activities



Post-Fukushima Nuclear Energy Policy

Energy Supply- Demand Structure and Policy Issues in Japan

- A major energy consuming and importing country in the world
 - * 5th largest energy consumer, 3rd oil importer and 1st LNG importer
 - * Fossil fuels are dominant in primary energy mix: oil 46%, coal 22%, gas 18%, nuclear 11%, hydro 3% and other renewables 1%.
- Low self-sufficiency; about 4% but 15% if nuclear is included.
- Most of fossil fuels supply depends on imports: 90% of crude oil supply are imported from the Middle East.
- Unfailing issues:
 - * Volatility in global energy prices
 - * Security of supply: growing energy demand in Asia
 - * Combat to global warming

Challenges in Energy Sphere After March 11th

- Top priority: stabilization of Fukushima Daiichi & Restoration and reconstruction of energy-related facilities and infrastructure
- Electric power shortage: sudden loss of 10 fossil fuel power plants and 9 nuclear power plants due to the earthquake and tsunami
 - Assure power supply capacity by restoration of standstill power plants, securing fossil fuel for such plants.
 - Enhance power saving and efficiency improvement
- Re-establish mid- and long-term energy strategy
- Political leadership and national consensus making

Post-Fukushima Nuclear Energy Policy: Near-term

- Goals: pursue best use of existing facilities, making them safe against tsunami based on the lessons learned from the accident at Fukushima and restoring the public trust in nuclear safety.
- In reality, the number of nuclear power plant in operation has reduced from 26 (excluding 9 units affected: 16 units were under periodic inspection.) in March to 10 in October due to the difficulty in obtaining the consent of central and local government to restart after the compulsory periodic inspection.

Restart of NPPs that Completed Compulsory Periodic Inspection

- Just after the accident at Fukushima, the NISA, nuclear safety regulator of Japan asked every operator of nuclear power plants to implement emergency safety measure for preventing the occurrence of severe core damage in the case they are hit by beyond design basis tsunami.
- On May 6, the NISA confirmed that as all NPP had properly implemented the measure and established a plan to further improve the safety of their plants against external hazards, they were eligible to resume operation after periodic inspection.
- The Government requested the Chubu Electric Power Company to shut down the Hamaoka NPPs for the reason of a high occurrence probability of a magnitude 8-level earthquake that should trigger major tsunamis in the region, until permanent measures against tsunami such as 20m breakwater and the improvement of water-tightness of important buildings are completed.

Restart of NPPs after Compulsory Periodic Inspection

- Prime Minister expressed his view that the NPP should pass a “**stress test**” before restart.
- The NISA deliberated under the guidance of the Nuclear Safety Commission the content of the test called “**comprehensive safety assessment (CSA)**” that clarifies the beyond design basis margin or distance between design basis event and the threshold of events beyond which severe accident will be inevitable.
- Currently plant operators are submitting the result of their preliminary CSA for restart of shutdown plants and all units are to submit the results of the secondary CSA in due time.
- The regulators and operators still have to do hard work for restoring the public trust in these activities.

Mid- and Long-term Energy Policies

- The Energy and Environment Council of the government, that is a ministerial committee in the cabinet, has initiated the work to formulate mid- and long-term energy policy.
- They set the goals of energy policy as stability of supply, economy, friendliness to environment and safety & peace of mind, based on the deep reflection on the March 11 event at Fukushima.
- The Council will start from the beginning of 2012 the discussion about the best mix of fossil, renewable, nuclear and efficient use of energy for the attainment of these goals.
- As more than 70% of Japanese people are in favor of abolishing the nuclear power plants, they plan to discuss the feasibility of eventual or early graduation from the use of nuclear energy and instead, significant increase in the share of renewable energy for attainment these goals in Japan, which is an island nation making a living by foreign trading.

Mid-and Long-term Nuclear Energy Policy

- * Make every effort to explore the ways to make nuclear power system trustworthy to the public in a range by improving the merit and reduce the demerit as a way to attain the specified energy policy goals under possible new condition for competition.
- * Deliberate how the fuel cycle system should be for a given future nuclear energy utilization scenario and how we can continue to promote bilateral, multilateral and international cooperation and joint activities for R& D of nuclear safety, security, safeguards, nuclear fusion energy and so on, as a responsible country.
- * Assure the safety, security and proliferation resistance of nuclear energy supply system (including the fuel cycle activities committed) by establishing and maintaining the excellence in operation and regulation from the view point of global standards and building human resources enthusiastic about these tasks.

Conclusions

- ◆ The accident at Fukushima was caused by tsunami of unprepared violence and contaminated a wide area around the plant.
- ◆ The root cause of this accident seems to be operators and regulators' weakness in the establishment of a safety culture, the responsibilities of the operating organization, and the provision of regulatory control and verification of safety related activities.
- ◆ To recover the life of suffered people and society by way of the on-site and off-site activities should be a prime task for nuclear community, as many peoples are still suffering, though it will cost a huge sum of resources and extend over a long period of time.
- ◆ The deliberation of future energy policy has been started, searching the possibility of reducing the dependence on nuclear power in future: the nuclear energy community is asked to rectify the defect and talk to the public its merit and demerit in a level-playing field to reverse the tide.