In Pursuit of the Highest Levels of Safety in the World Surpassing New Regulatory Requirements

The accident at TEPCO's Fukushima Daiichi Nuclear Power Station brought about a realization that greater measures should have been taken to prepare for severe accidents with extremely low rates of probable occurrence, and that we should have a higher safety awareness, even beyond the levels required by law. Kansai Electric Power is therefore doing everything in its power to improve safety so as to restore trust in nuclear power generation. New regulatory requirements were enacted in July 2013. While we are meeting those requirements, of course, we are also pursuing the highest levels of safety in the world through voluntary and continuous efforts in this area.

■Efforts to Improve the Safety and Reliability of Nuclear Power Plants

After the Great East Japan Earthquake, Kansai Electric Power adopted urgent safety measures at its nuclear power plants. Thereafter, by responding to guidance issued by the national government and requests made by Fukui Prefecture, and by voluntarily implementing policies to improve safety, we have taken extraordinary measures to ensure that even in the event of another earthquake and tsunami of the same magnitude as that which occurred at the Fukushima Daiichi Nuclear Power Station, our nuclear reactors would not be damaged.

The national government validated the efficacy of those measures by conducting stress tests at Ohi Power Station Units 3 and 4. With the approval of Fukui Prefecture and the town of Ohi, this plant was restarted based on a final judgment issued by the national government.

We have been implementing measures from the perspective of providing defense-in-depth not only against earthquakes and tsunamis, but also against the threats posed by other natural phenomena.

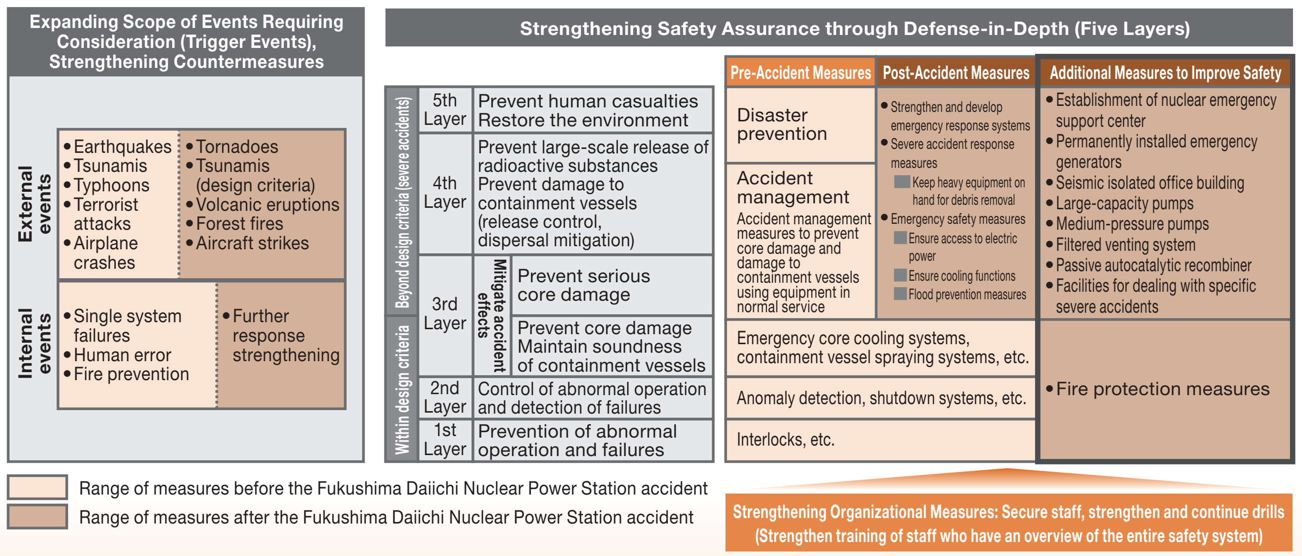
On July 8, 2013, new regulatory requirements were enacted for nuclear power plants. Even before this, however, Kansai Electric Power submitted compliance confirmation results for Units 3 and 4 at the Ohi Power Station, based on the draft of the new regulatory requirements issued by the Nuclear Regulation Authority (NRA) and on July 3, we received an assessment from the NRA indicating that "there is no immediate threat of a major safety-related problem occurring." Following on from Units 3 and 4 at Ohi Power Station, on July 8 we submitted an application for confirmation that Units 3 and 4 at our Takahama Power Station, where inspection preparations have likewise been made, are also in compliance with the new regulatory requirements.

Timeline of Application Process for Confirmation of Compliance at Ohi Power Station Units 3 and 4 and Takahama Power Station Units 3 and 4 (2012–2013)

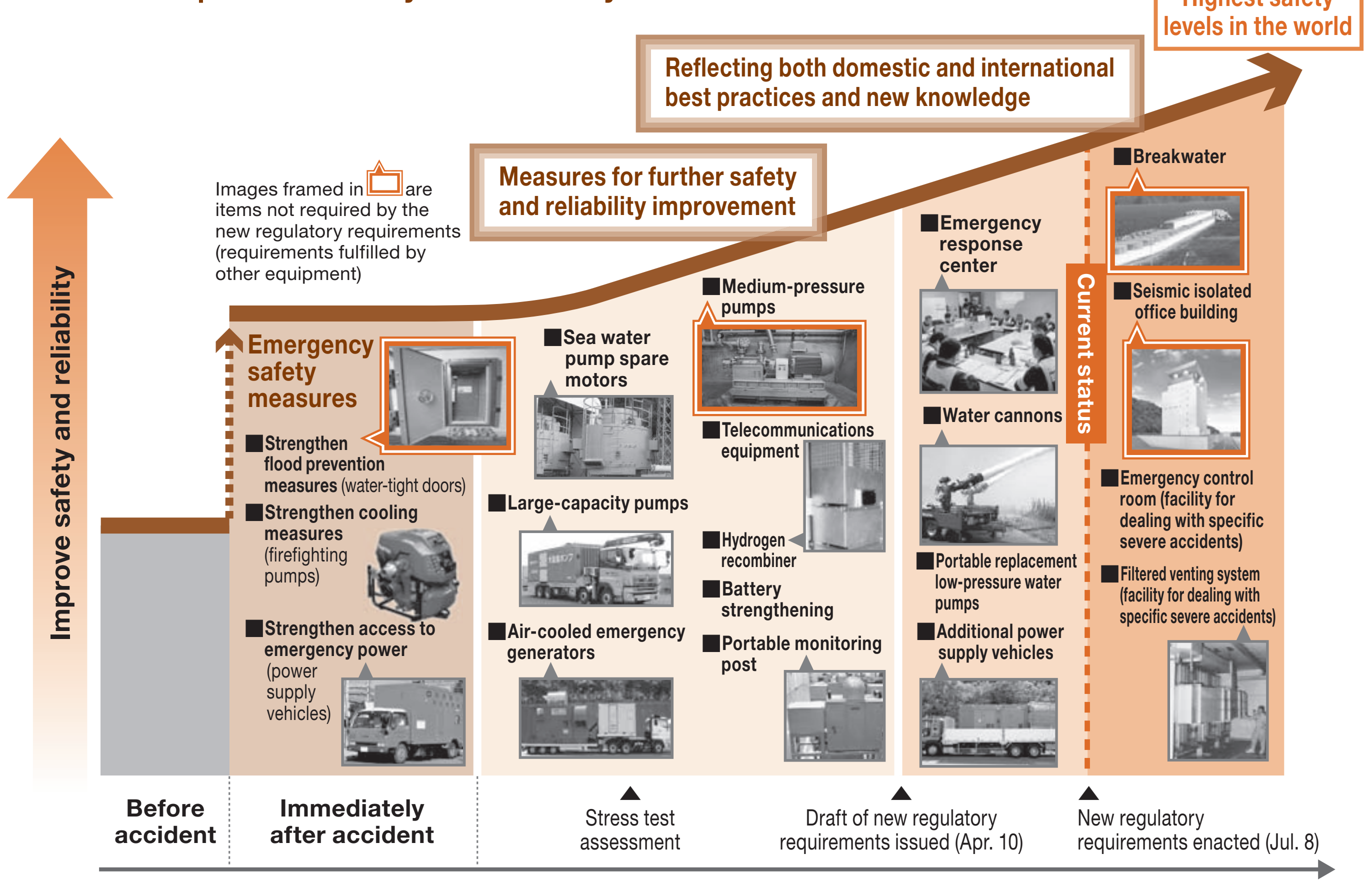
2012 June 16	The national government confirms that even in the event of another earthquake and tsunami like those that caused the Fukushima Daiichi Nuclear Power Station accident, the same type of disaster at Ohi Power Station Units 3 and 4 would not result. Having gained the approval of Fukui Prefecture and the town of Ohi, and having received a final judgment by the national government that we would be able to restart those reactors, procedures and inspections aimed at restarting the reactors begin.
July 9	Constant operations at the rated thermal output begin at Ohi Power Station Unit 3.
July 25	Constant operations at the rated thermal output begin at Ohi Power Station Unit 4.
Sept. 19	The NRA is established.
2013 Apr. 18	Based on a request from the office of the NRA, Kansai Electric Power submits results confirming that Ohi Power Station Units 3 and 4 are compliant with the new regulatory requirements.
July 3	The NRA determines that "there is no immediate threat of a major safety-related problem occurring at the currently operating Ohi Power Station Units 3 and 4."
July 8	New regulatory requirements are enacted. Kansai Electric Power requests permission for installation and upgrade work at Ohi Power Station Units 3 and 4 and Takahama Power Station Units 3 and 4.

Strengthening Safety Assurance Through Defense-in-Depth (Five Layers)

Defense-in-depth is an approach to ensuring the safety of nuclear facilities in which safety measures are organized in multiple tiers. In domestic safety regulations, the design and operations of nuclear power plants have thus far generally reflected defense layers 1 to 3, but with the enactment of the new regulatory requirements, we have incorporated a five-tier approach that includes defense layers 4 and 5 based on international standards such as those established by the IAEA.



Efforts to Improve the Safety and Reliability of Our Nuclear Power Plants



Note: Photos are for informational purposes only. (Implementation period indicates that for Ohi Units 3 and 4.)

Overview of New Regulatory Requirements

The new regulatory requirements are comprised of three sections: A design criteria related to anti-seismic, anti-tsunami performance, B design criteria in consideration of natural phenomena and fires, and C severe accident measures. The new regulatory requirements strengthen criteria A and B, and add new C criteria.

Previous Regulatory Requirements

Criteria ("design criteria") for preventing severe accidents (ensuring that envisaged single system failures do not result in core damage)

Design Criteria	B	Consideration of natural phenomena
		Fire protection
		Reliability of power supply
		Function of other equipment
	A	Seismic/Tsunami resistance

New Regulatory Requirements

Severe Accident Response Measures	C	Response to intentional aircraft crashes	**Newly introduced** Measures against terrorism
	C	Measures to suppress radioactive material dispersion	**Newly introduced** Measures against severe accidents
		Measures to prevent containment vessel failure	
		Measures to prevent core damage (postulate multiple failures)	
Design Criteria	B	Consideration of internal flooding (newly introduced)	**Reinforced or Newly introduced**
		Consideration of natural phenomena (new addition of volcanic eruptions, tornadoes, forest fires)	
		Fire protection	
		Reliability of power supply	
		Function of other equipment	
	A	Seismic/Tsunami resistance	**Reinforced**

Prepared using materials issued by the NRA on July 3, 2013

Compliance of Ohi Power Station Units 3 and 4 with the New Regulatory Requirements: Results Overview (submitted Apr. 18, 2013)

A Key responses to requirements relating to design criteria for anti-seismic and anti-tsunami performance

(1) Confirm that there are no active faults beneath safety-related facilities

We surveyed the crush zone at the site and confirmed that our safety-related facilities are located on ground that has been confirmed to have no faults with the potential to become active in the future appearing on the surface.

Trench survey

(This is largely consistent with the opinion indicated at a meeting of experts held by the Nuclear Regulation Authority on September 2, 2013, that "the F-6 crush zone is not an active fault.")

(2) Determine the design basis earthquake ground motion

We determined a peak ground acceleration of 700 Gal as the design basis earthquake ground motion when conducting our anti-seismic safety confirmation work, and confirmed that, based on the latest knowledge, this design basis earthquake ground motion is sound.

(An assessment committee meeting of the NRA held on May 10, 2013 conducted an assessment of ground acceleration of about 760 Gal, taking into account the movement of three peripheral active faults.)

(3) Determine the design basis tsunami

We investigated earthquakes generated at offshore active faults in the vicinity of the power plant site, based on the latest knowledge, and confirmed that the design basis tsunami has been appropriately determined. (Assessment that water levels will rise to a height of 2.85 m near the seawater pump.)

(An assessment committee meeting of the NRA held on June 10, 2013 conducted an assessment of tsunami height (sea level + 3.68 m) in consideration of the fault near the Wakasa Sea Knoll Chain.)

(4) Design structures to allow the safety of safety-related facilities to be maintained in the event of an earthquake

As a result of our anti-seismic assessments using the determined design basis earthquake ground motion, we confirmed that our safety-related facilities would be able to retain their safety functions.

(5) Design structures to ensure that the safety of safety-related facilities will not be compromised by a tsunami

We confirmed that the height of the site where our safety-related facilities are located (sea level + 9.7 m) is higher than the height of the design basis tsunami, and thus that the safety functions of those facilities can be assured.

B Key responses to requirements relating to design criteria for natural phenomena and fires

(1) Design structures so that the safety of important facilities will not compromised by natural phenomena

We confirmed that the safety of our nuclear reactor facilities would not be threatened as a result of natural phenomena (e.g., volcanic eruptions, tornadoes, forest fires).

(2) Design structures so that the safety of important facilities will not compromised by fire

We confirmed that the design of our safety-related facilities incorporated fire prevention and protection measures, such as systems to prevent, detect, and extinguish any outbreaks.

We confirmed the use of flame-resistant cables.

(3) Ensure reliability of electric power systems

We confirmed that our structures are connected to power sources via four power transmission lines connected to two independent transformer substations, and thus that our structures are reliably configured.

We confirmed that we have reserves of emergency diesel-powered generator fuel that would be required in the event of an external power loss lasting 7 days or longer.

(4) Design structures in such a way that the integrity of the reactors and containment vessels remains sound in the event of a complete loss of AC power

We confirmed that in the event of a complete loss of AC power, we would be able to safely shut down our reactors and then cool them, thus confirming that we can ensure the soundness of our reactors and containment vessels.

- Diesel generators are kept on site as a power source for emergency use.
- Reactors can be safely shut down using control rods that can be inserted into the reactor core using gravity.
- Reactors can be cooled using an auxiliary feed-water pump with a steam-driven turbine without the need for electrical power.

Emergency diesel generators

(5) Design structures so that radiation status can be appropriately measured, monitored, and displayed in the control room

We confirmed that facilities are equipped with fixed monitoring posts with wired data transmission functions and portable monitoring posts with wireless data transmission functions, thereby allowing for system redundancy.

Portable monitoring post

(6) Design main control room so that operators will be able to stay as long as possible to take emergency response measures in the event of a severe accident

We confirmed that the main control room is designed such that in the event of an accident, it would remain accessible to operators who could remain and conduct necessary emergency response measures.

- The main control room is designed with fire protection and prevention measures.
- We have secured multiple access routes to the main control room.
- The main control room is designed to protect operators from radiation exposure.

Main control room

C Key responses to requirements relating to severe accident measures

(1) Measures involving equipment for handling severe accidents

We confirmed that our portable alternate power equipment and alternate water injection equipment have the reserve supply capacity needed, and that their connection points are situated in multiple locations to prevent the simultaneous loss of connections.

Power supply vehicles

(2) Measures to ensure access to power in the event of a complete loss of power

To secure the electrical power needed for preventing core damage, we are maintaining power supply vehicles and air-cooled emergency generators, ensuring the connectivity of our emergency and everyday storage batteries, and ensuring power interchange between units.

Air-cooled emergency generator

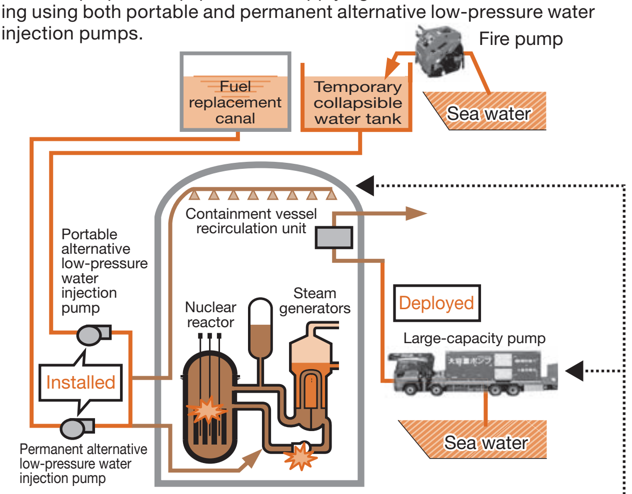
(3) Design emergency response center at which staff will be able to stay and perform on-site crisis management headquarters functions in the event of a severe accident

We have modified the conference rooms, which are equipped with communications functions and located next to the main control room of Units 1 and 2 at Ohi Power Station, so that they can serve as an emergency response center. They are equipped with equipment and materials that would be needed by emergency response staff to manage radiation and reduce their exposure.

Ohi Power Station Units 1 and 2 Conference room next to the main control room (emergency response center)

(4) Measures to prevent nuclear reactor damage

We have prepared equipment for supplying water to reactors for cooling using both portable and permanent alternative low-pressure water injection pumps.



(5) Measures to prevent hydrogen explosions in containment vessels

Ohi Power Station Units 3 and 4 have large containment vessels, and we confirmed that the hydrogen that would be generated in the event of a severe accident would not reach concentrations that might cause a hydrogen explosion that could impact on the soundness of those containment vessels. To further improve safety, we installed passive autocatalytic recombiners in the containment vessels. These can continuously convert hydrogen to water (steam) through catalytic functions without electric power.

Passive autocatalytic recombiners (photo is for informational purposes only)

(6) Ensure the availability of materials and equipment necessary for replacing replaceable equipment at safety-related facilities

We have secured supplies such as sea water pumps and electric power cables for sea water and electric power systems which are extremely important for maintaining safety and whose replacement can help restore the functions of multiple different facilities.

Extra sea water pump motors

(7) Make adaptations and manage operations to ensure secure access routes that will be needed for performing restoration work

Secure operational vehicles for removing debris so as to guarantee outdoor access routes.

Dozer shovel for debris removal

Power shovel for debris removal

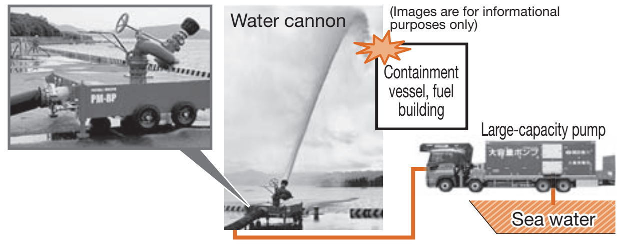
Large truck with crane ideal for work in hard-to-reach places

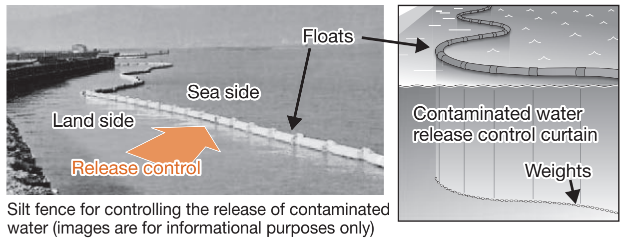
(8) Take measures to control the dispersal of radioactive particles beyond the plant site

To control the dispersal of radioactive particles in the event of damage to containment vessels, we have prepared water cannons that can be used to spray water on the damaged sections.

To control the release of contaminated water into the sea, we are preparing silt fences at water inlet channels and outlets.

(Silt fences are installed when there are concerns that contaminated water might be released into the sea.)





Silt fence for controlling the release of contaminated water (images are for informational purposes only)

(9) Take measures to prevent damage to containment vessels due to excess pressure

To keep the air pressure and temperature down in the containment vessels, we have installed equipment that can directly inject sea water into the containment vessel recirculation unit using a large-capacity pump.

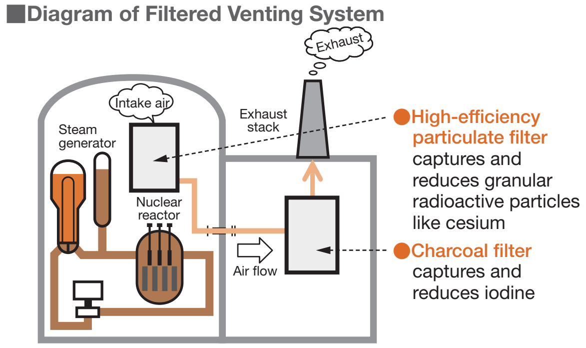
(10) Installation of facilities for handling specific severe accidents

(Application of backup measures for improving reliability is to be deferred for five years after the enactment of the new regulatory requirements)

We plan to install a filtered venting system and an emergency control room, which will be important in preventing damage to containment vessels.

(Slated for completion in FY 2017 (filtered venting system is to be installed in FY 2015).)

Diagram of Filtered Venting System



Voluntary Efforts in Organizational Strategies Include Disaster Drills Incorporating Domestic and International Best Practices and Latest Knowledge

Kansai Electric Power is educating personnel and examining countermeasures through disaster drills and other means, and is working hard to incorporate domestic and international best practices and latest knowledge. We are also striving to quickly incorporate lessons learned during our drills and opinions received from experts into our safety policies.

Confirming and Improving Response Measures through Disaster Drills

• Implementing comprehensive nuclear disaster drills and confirming our emergency response capabilities

To improve our emergency response capabilities and to strengthen the collaborative structures between relevant institutions, we have been conducting comprehensive nuclear disaster drills every year since 2000. In FY 2012, we developed a drill based on the emergency safety procedures in place at the Mihama Power Station on March 23, 2013 to secure electric power using an air-cooled emergency generator and to restore the cooling functions of a nuclear reactor. During this drill, we were able to confirm that these measures were effective and to identify the challenges that remain. In the future, we will strive to resolve these issues, move forward on evaluating and improving such drills, and continuously improve our nuclear disaster management policies.

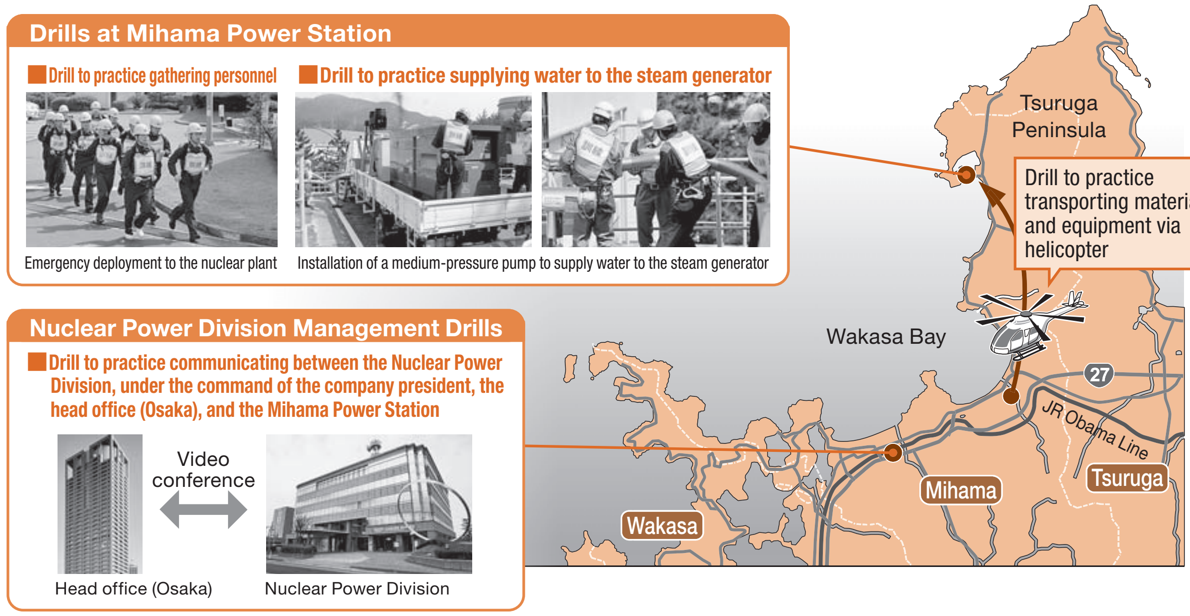
Issues and Future Response

We already have a manual that has been distributed across the Nuclear Power Division and other relevant departments and have implemented individual drills. However, having determined that we need to make even further improvements to ensure that we have robust crisis management capabilities, in the future, we will strive to improve this manual and expand individual instruction.

Hypothetical Scenarios

- An earthquake of 6+ on the Japanese seismic intensity scale occurs, causing the nuclear reactors at Units 2 and 3 at the Mihama Power Station to automatically shut down.
- All of the emergency diesel generators are rendered inoperable by a tsunami, and all AC power is lost.
- Failure of the turbine-driven auxiliary feedwater pump leads to its shutdown, causing a loss of water supply to the steam generator.

Overview of Major Drills



• Participating in Fukui Prefecture Comprehensive Nuclear Disaster Drill, and maintaining close ties with the community

The Fukui Prefecture Comprehensive Nuclear Disaster Drill, sponsored by Fukui Prefecture, the town of Mihama, and the city of Tsuruga, was held on June 16, 2013. The drill scenario assumed that an earthquake had occurred in Wakasa Bay and that all AC power at the Mihama Power Station had been lost. Each local government set up a crisis headquarters at the Mihama Nuclear Power Disaster Management Center, engaged in communications with other nearby local governments, and conducted evacuation drills for residents in target evacuation zones. Kansai Electric Power positioned this drill as its FY 2013 comprehensive nuclear disaster drill, and building on past drills, strove to achieve an even greater degree of cooperation with community residents, through drills to practice establishing and managing contamination inspection sites in the event an exclusion zone becomes necessary, and drills to practice sharing information with relevant local governments. We also confirmed plans and actions that will allow us to quickly and accurately respond to various scenarios.

By evaluating the results of this year's drill and diligently implementing improvements and measures based on that evaluation, we are striving to further bolster our nuclear disaster management policies.


President Yagi takes command at the Nuclear Power Division (right)


A contamination test using radiation detectors (Mihama)

Collection and Sharing of Knowledge from Japanese and International Experts

• Peer review by the World Association of Nuclear Operators (WANO)*

Our Takahama and Mihama nuclear power plants underwent peer reviews by WANO. Those reviews yielded the findings and suggestions outlined below. We are taking these suggestions very seriously and are voluntarily and continuously implementing changes to further improve the safety and reliability of our nuclear power plants.

* World Association of Nuclear Operators (WANO): A private organization established by the world's nuclear power companies in May 1989 following the accident at the Russian Chernobyl Nuclear Power Plant in 1986. In pursuing its mission to maximize the safety and reliability of nuclear power plants, it provides support activities for plants, such as peer review activities, and information sharing regarding breakdowns and other problems.

Key Evaluation Results

Evaluation	Employees at Kansai Electric Power nuclear power plants take appropriate action with a strong awareness of safety as a priority.
Strengths	Based on what happened during the accident at TEPCO's Fukushima Daiichi Nuclear Power Station, Kansai Electric Power has been taking thorough measures to install equipment that will ensure access to electric power and to conduct disaster response drills. Kansai Electric Power has also been adopting multiple policies to strengthen its tsunami response.
Suggestions	To further bolster the safety and reliability of its nuclear power plants, Kansai Electric Power should make effective use of the WANO guidelines, which incorporate the latest knowledge related to nuclear safety, such as the equipment and technologies in use at the world's most advanced nuclear power plants.

Peer Review at the Takahama Power Station
(Period: November 15–29, 2012)


Interview with the WANO evaluation team

Peer Review at the Mihama Power Station
(Period: January 17–February 1, 2013)


Site visit

Reflecting the Advice of the Nuclear Safety Verification Committee Composed Mainly of Outside Experts

Kansai Electric Power established the Nuclear Power Integrity Reform Verification Committee, composed mainly of outside experts, in April 2005 after the accident at Unit 3 at the Mihama Power Station. It was established to examine, from an independent perspective, the validity of the measures taken to prevent a recurrence of the type of accident that occurred there. We continuously pursue improvements based on the opinions of the committee.

We have received advice from the committee regarding our nuclear power safety culture advocacy activities since November 2008, and regarding our voluntary and continuous safety initiatives in nuclear power generation since July 2012 in response to the Fukushima Daiichi Nuclear Power Station accident. The committee was furthermore renamed as the Nuclear Safety Verification Committee. The 4th Nuclear Safety Verification Committee Meeting was held on April 26, 2013 and it has both confirmed and offered advice regarding our measures to prevent an accident recurrence at Mihama Power Station Unit 3, our safety culture advocacy measures, and our voluntary and continuous safety initiatives. We will continue pursuing improvements based on this committee's advice as we go forward.


4th Nuclear Safety Verification Committee Meeting


Visit to Ohi Power Station by Nuclear Safety Verification Committee members (December 2012)

Review Results for our Voluntary and Continuous Safety Initiatives in Nuclear Power Generation

4th Nuclear Safety Verification Committee Meeting, April 26, 2013

- **Measures for improving safety and reliability have been undertaken as planned at the Ohi Power Station, as well as at the Mihama and Takahama nuclear power plants. Kansai Electric Power has continuously undertaken activities to improve the effectiveness of its safety measures, such as conducting appropriate inspections and maintenance on its installed facilities and equipment, and performing evaluations and making improvements through educational activities and drills based on the most severe disaster scenarios.**
- **Kansai Electric Power is building frameworks that reflect the latest knowledge, is conducting its own overseas surveys, and examines and incorporates advice provided by the Japan Nuclear Safety Institute (JANSI) and WANO.**
- **This committee will continue to confirm whether Kansai Electric Power's nuclear power generation safety initiatives, which go beyond the requirements of the regulatory framework, are being voluntarily and continuously implemented, with particular attention paid to its severe accident response measures.**

Web **Nuclear Safety Verification Committee**
http://www1.kepco.co.jp/notice/mihama/08/jiko_anzen00.html