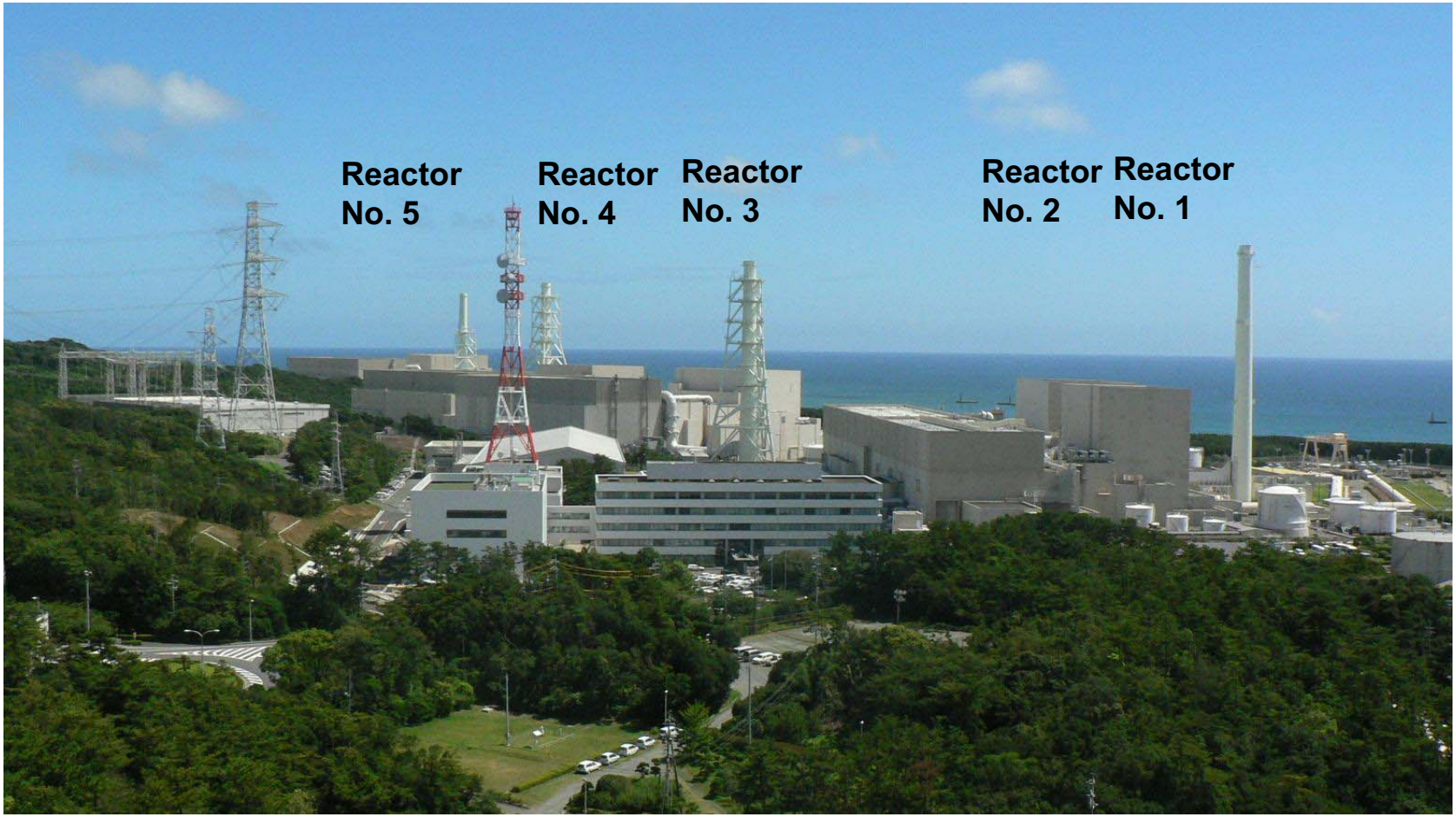
Tsunami Countermeasures at Hamaoka Nuclear Power Station

Reference

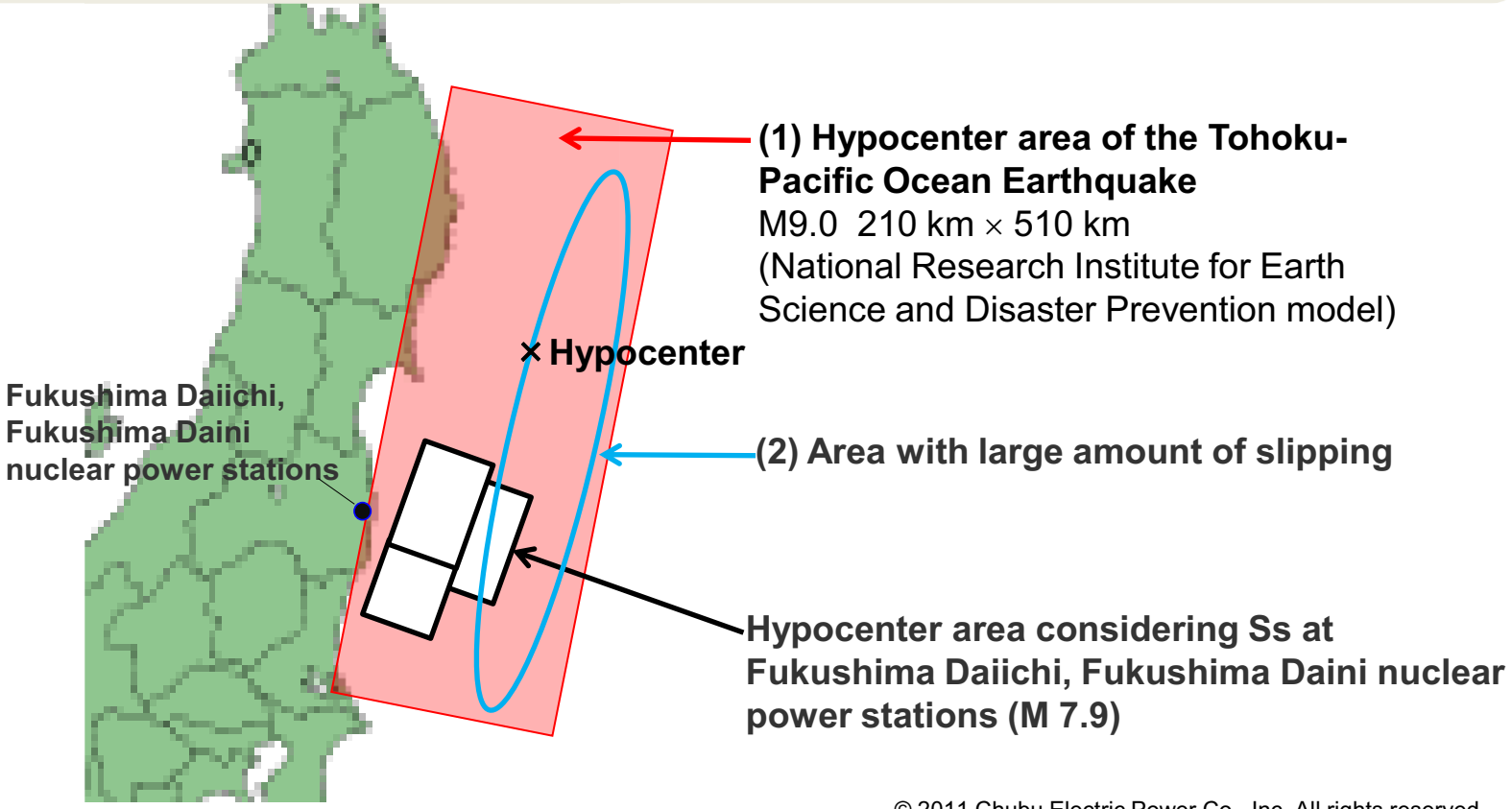


March 16, 2012

Chubu Electric Power Co.,Inc.

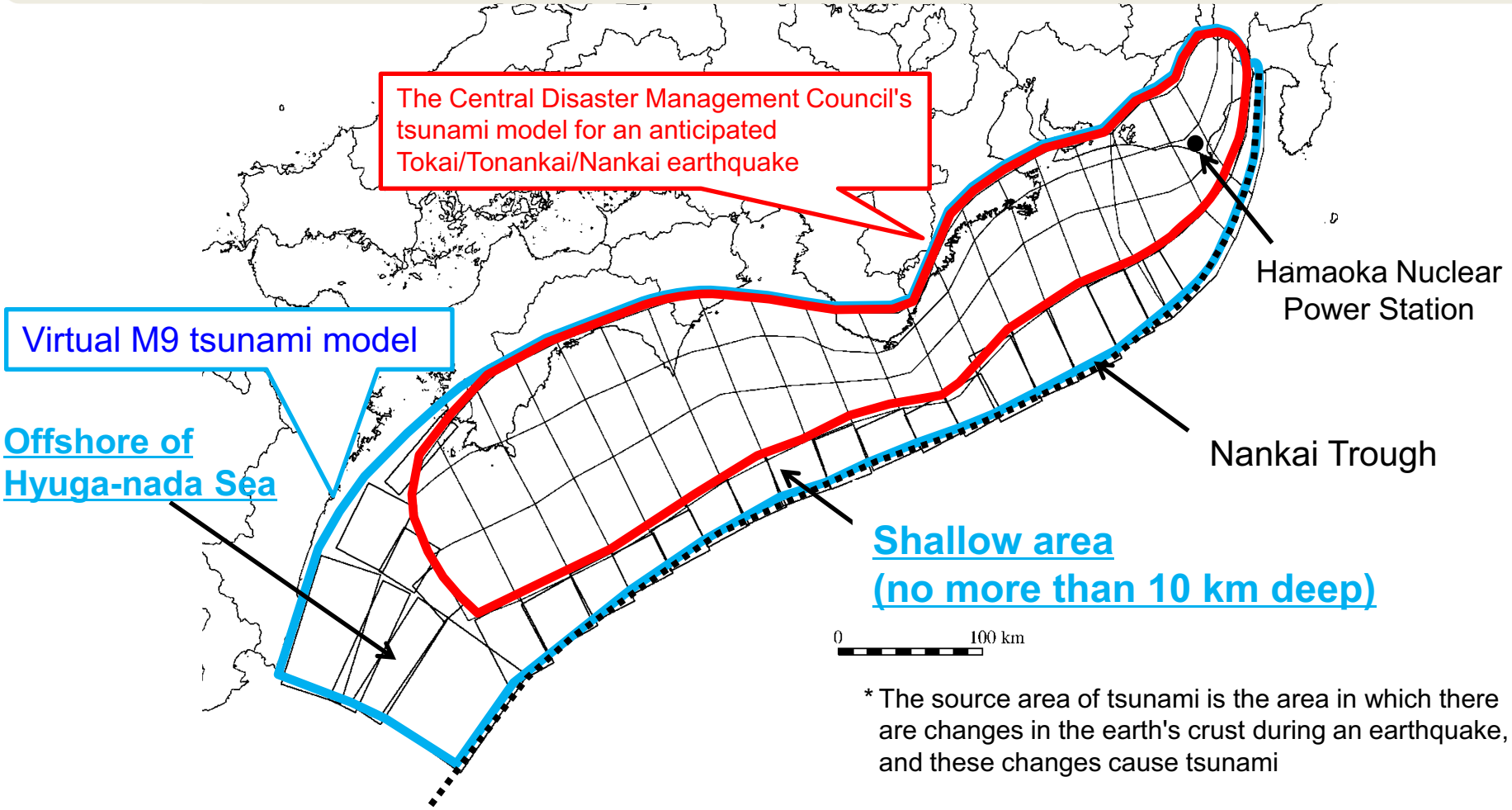
Characteristics of the Magnitude 9 Tohoku-Pacific Ocean Earthquake

The Tohoku-Pacific Ocean Earthquake is believed to have featured the simultaneous occurrence of "ordinary earthquake interlocking" and a "tsunami earthquake" that does not have strong tremors:
(1) interlocking occurred over a very wide area, from the Sanriku coast to Ibaraki Prefecture coast, causing the magnitude (M), a measure of earthquake energy, to rise to 9.0;
(2) there was a great deal of slipping in places where the plate boundaries were shallow; this made it possible for a very large tsunami to occur.



Virtual M9 Tsunami Model at Hamaoka Nuclear Power Station

- The mechanism of the tsunami from the Tohoku-Pacific Ocean Earthquake will be the subject of further study and analysis.
- In light of the accident at the Fukushima Daiichi Nuclear Power Station caused by the unexpectedly large tsunami, we looked at the triple interlocked Tokai/Tonankai/Nankai earthquake, **created a virtual tsunami model of an M9 earthquake that expanded the source area of tsunami* to the Sea of Hyuga coast and the area along the Nankai Trough**, and calculated the tsunami runup height.



* The source area of tsunami is the area in which there are changes in the earth's crust during an earthquake, and these changes cause tsunami

Calculated Results Using Virtual M9 Tsunami Model

◆ The tsunami runup height at Hamaoka Nuclear Power Station was **about T.P. + 10 m**.

*T.P.: Tokyo Peil

◆ This height **would not exceed the height of the dune embankment in front of the power station (T.P. + 10 - 15 m).**

◆ Concerning seismic resistance:

<1> Construction was performed to reinforce seismic resistance to withstand tremors as large as approximately 1,000 gal.

The station has sufficient safety against a triple interlocked Tokai/Tonankai/Nankai earthquake (M8.7).

<2> If an earthquake according to the virtual M9 tsunami model is envisioned,

- "Interlocking would occur over a very wide area," and the Sea of Hyuga would be added as a hypocenter area of a triple interlocked Tokai/Tonankai/Nankai earthquake.

  ⇒ **The Sea of Hyuga coast is located far from the Hamaoka Nuclear Power Station, so that the tremors would be so attenuated that it would be unlikely to extend as far as the station.**

- Area of "slipping in shallow areas along the plate boundaries (Tsunami earthquakes)" also would be expanded to include the area along the Nankai Trough.

  ⇒ When the sedimentation at the shallow areas along the plate boundaries slips and the seabed topography has greatly changed, an extremely large tsunami occurs.

  However, **the sedimentation at the shallow areas along the plate boundaries is relatively soft, making strong tremors less likely to occur.**

Based on the above, we believe that **the impact on the station site would be slight, so that the station can be assured of safety in terms of seismic resistance.**

◆ A Central Disaster Management Council study and other reviews are currently proceeding, and we will respond appropriately to any new knowledge learned.

Tsunami Countermeasures at Hamaoka Nuclear Power Station

Tsunami Countermeasures

- Chubu Electric Power has established tsunami countermeasures for the Hamaoka Nuclear Power Station that reflect knowledge learned heretofore, including from the recent accident caused by the Tohoku-Pacific Ocean Earthquake at Tokyo Electric Power Co., Inc.'s Fukushima Daiichi Nuclear Power Station.

- Because we take society's increased concerns about the safety of nuclear power very seriously, these tsunami countermeasures are intended to enhance the safety of the Hamaoka Nuclear Power Station.

- We had previously confirmed the Hamaoka Nuclear Power Station's safety against tsunami, taking into account tsunami that have had a major impact on the area in the past, such as those from the Ansei-Tokai and Hoei earthquakes. Additionally, we have now completed emergency safety measures that considered the accident caused by the Tohoku-Pacific Ocean Earthquake at the Fukushima Daiichi Nuclear Power Station.

Overview of Tsunami Countermeasures

<Flooding prevention measures>

Flooding prevention measures 1 : **Prevent flooding on the station site**

- Build a sea wall (T.P. + 18 m high)
- Build up embankments at a part of dunes in front of the station and on both sides of sea wall
- Place water barriers (1.5 m high) in the seawater intake pump area, etc.

Flooding prevention measures 2 : **Even if tsunami floods on the site, prevent flooding into building**

- Install emergency seawater intake system (EWS)
- Ensure the reliability of waterproof doors in outer walls of buildings
- Take measures to prevent flooding from air intakes/vents (openings) in outer walls of buildings
- Strengthen building drainage measures (install drainage pumps)
- Install new watertight doors and reinforce existing ones

<Strengthen emergency countermeasures>

Strengthen emergency countermeasures :**Ensure cooling function even if the all AC power and seawater cooling function are lost**

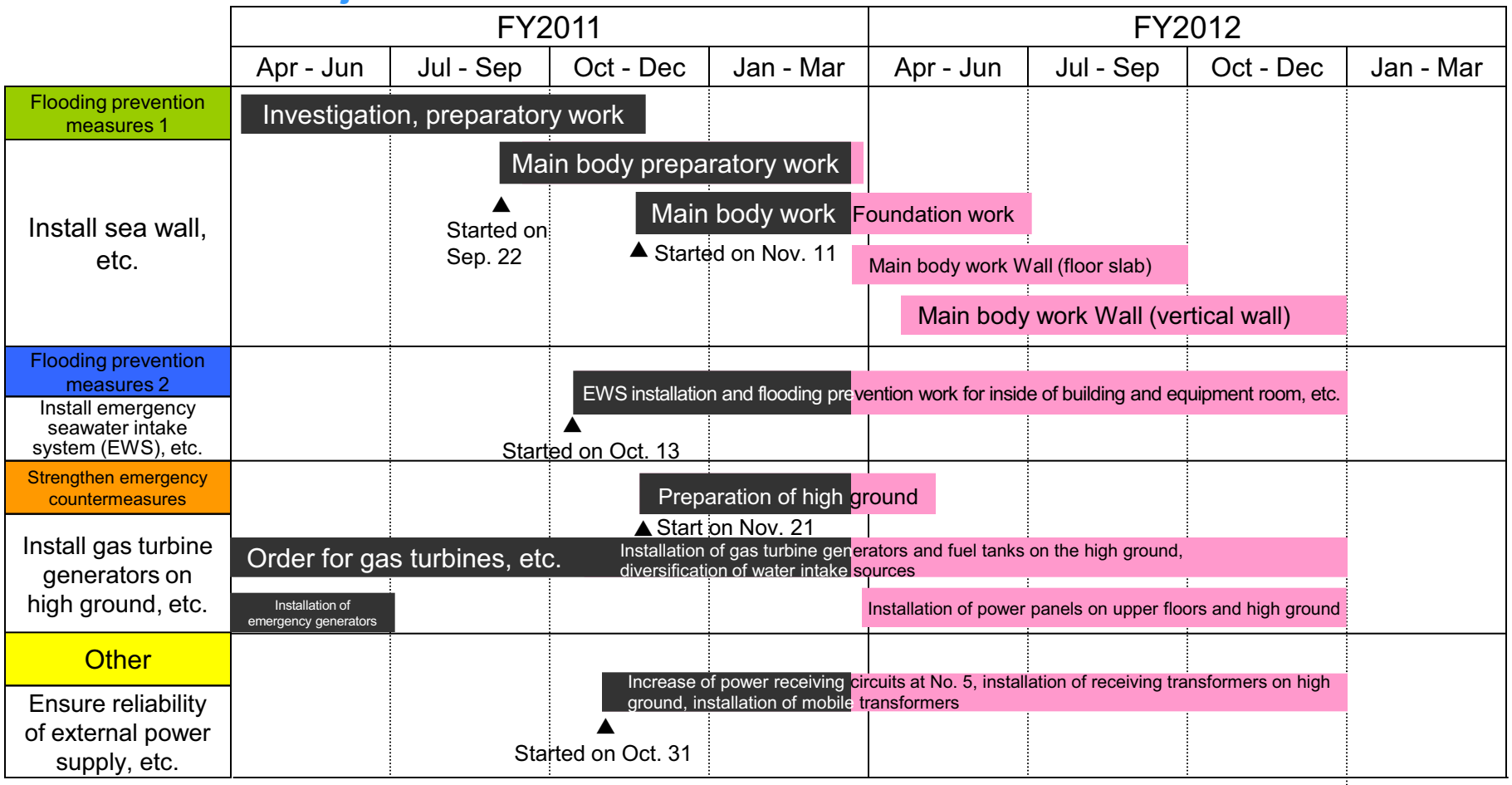
- Install gas turbine generators on high ground
- Ensure spare storage batteries
- Increase seismic durability of make-up water system, install additional water injection pipes
- Install nitrogen cylinders for operating containment vessel venting valves
- Install power panels and switch panels on upper floors or high ground
- Use remote operation of containment vessel venting valves
- Ensure portable power pump
- Ensure spare pumps and motors
- Diversify water sources (add water tanks, etc.)
- Ensure underwater pumps (as alternative to RCWS pump)
- Diversify water intake sources (intake from Niino River)
- Deploy bulldozers or other heavy equipment
- Ensure alternative reactor cooling system to make a high-pressure coolant injection system operable, etc.

Current Status of Work on the Tsunami Countermeasures

Schedule for Tsunami Countermeasure Work

■ We opened special content in our website, and published overviews of tsunami countermeasure work (installation of sea wall and emergency seawater intake systems) and progress of the work.

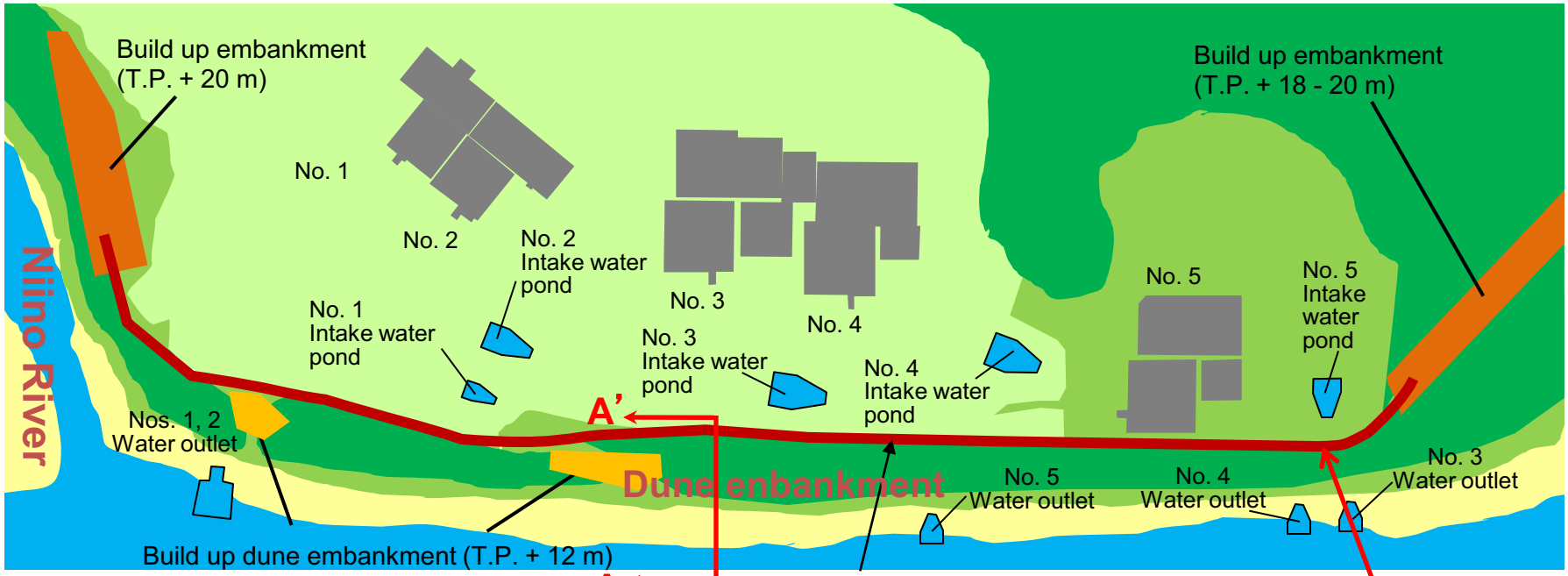
● Schedule for major countermeasure work

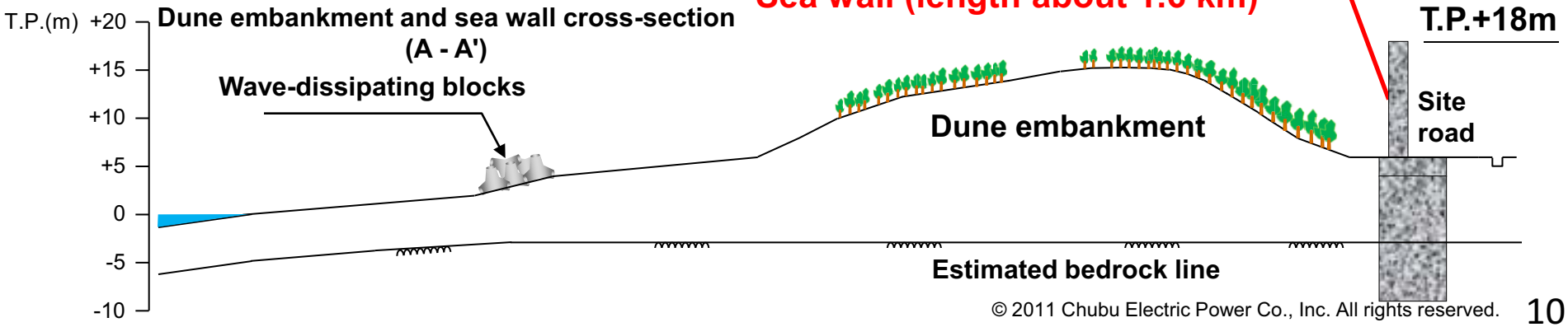


Arrangement of Sea Wall, etc.

① Building a sea wall on the seaward side of the station site
② Building up dune embankment in front of the station site and building up embankments on east and west sides

A total of 1.6 km in length of sea wall was installed to a height of T.P.+18 m on the reverse side of the dune embankment that is on the ocean side of the power station site, as well as on some parts of the side surfaces. The two ends were made with embankments to a height of T.P.+18 to 20 m. This connected the sea wall to ground that is T.P.+20 m or more in height. This prevents tsunami from penetrating from the front or side of the site and also avoids damage from water getting in from behind.





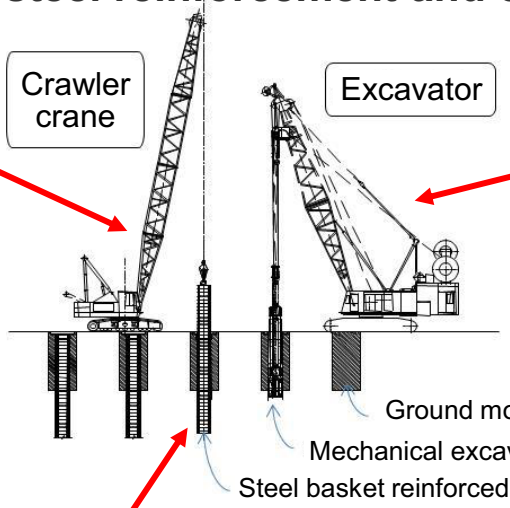
Flooding prevention measures 1

Status of Sea Wall Construction (1)

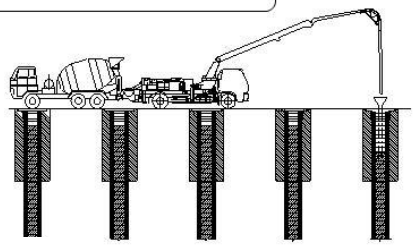
CHUBU Electric Power

94 of a total of 218 foundation sections (reinforcing steel, concrete piles) have been completed

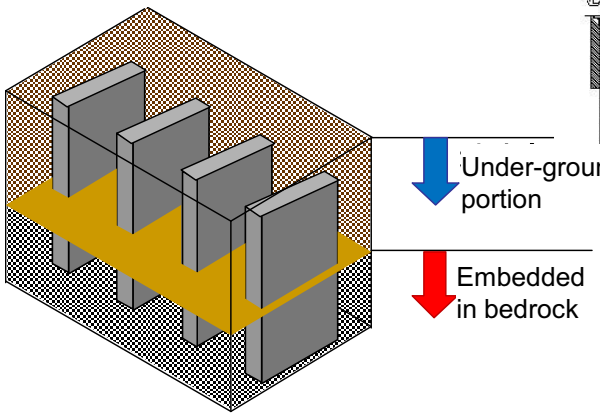
- From the sections where foundation excavation work has been finished, we have been conducting steel reinforcement and concrete piles successively.



Concrete pump vehicle



Steel reinforcement



(Image of sea wall foundation structure)

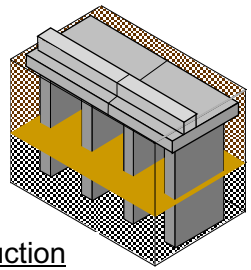
Concrete pile

Status of Sea Wall Construction (2)

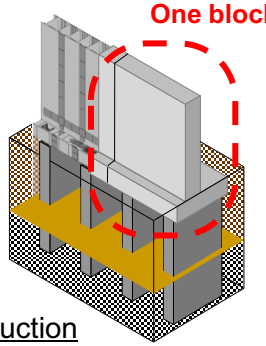
CHUBU Electric Power

Wall structures (floor slabs, vertical walls) are fabricated at manufacturing plant

- **We have been constructing floor slabs and vertical walls consisting of the wall portion of sea walls at the manufacturing plant. 15 pieces (5 floor slabs and 10 vertical walls) are combined into one block and a total of 109 blocks are made for the entire sea wall (excluding discharge channels and the west end of the site).**
  These pieces will be delivered to the station site and will begin to be installed successively.

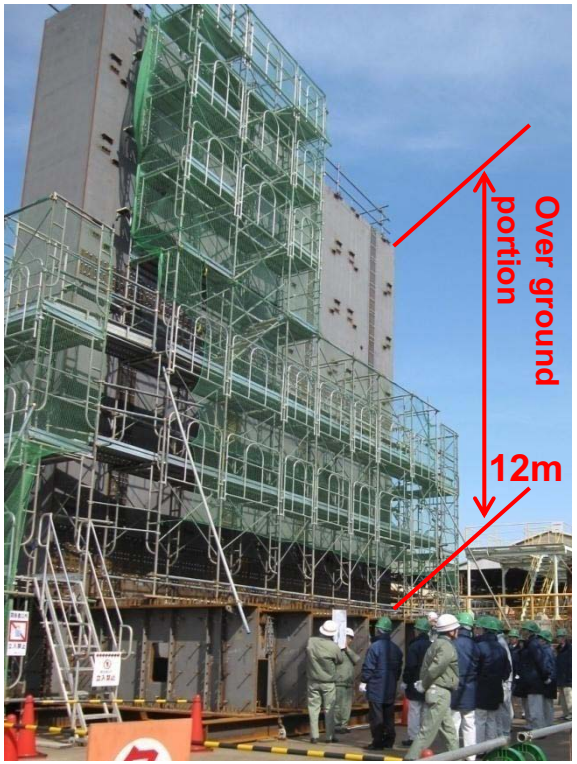


Wall construction (floor slab)



Wall construction (vertical wall)

(Image of sea wall structure)



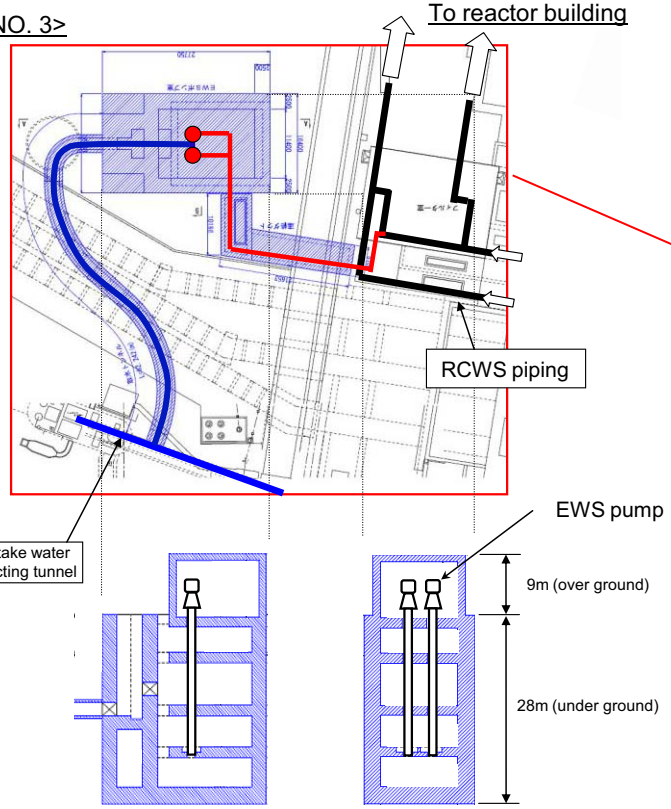
Panoramic photo of wall portion (floor slab and vertical wall) temporarily assembled (1 block)
Shot on February 28, 2012

Status of Emergency Seawater Intake System (EWS) (1)

CHUBU Electric Power

- We will install new emergency seawater intake systems (EWS) for alternative seawater cooling function on Reactors No. 3 to 5.
- By installing new seawater intake pumps in the waterproof building, we will maintain the seawater cooling function without being affected by flooding.
- We will also place connecting tunnels to link them with the intake water ponds for Reactors Nos. 2 to 5 in order to diversify our water intake sources.

<NO. 3>



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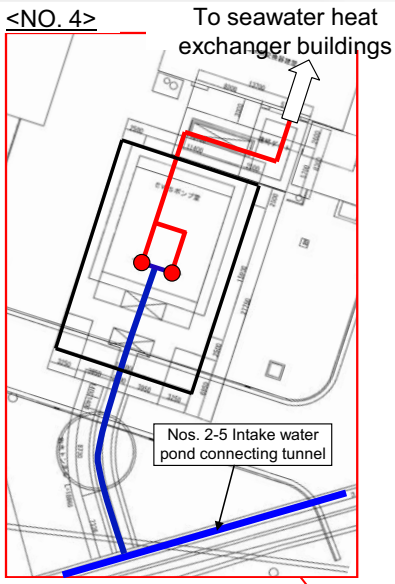

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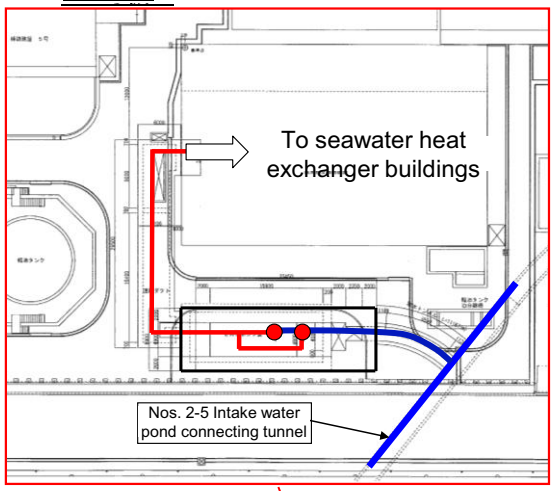
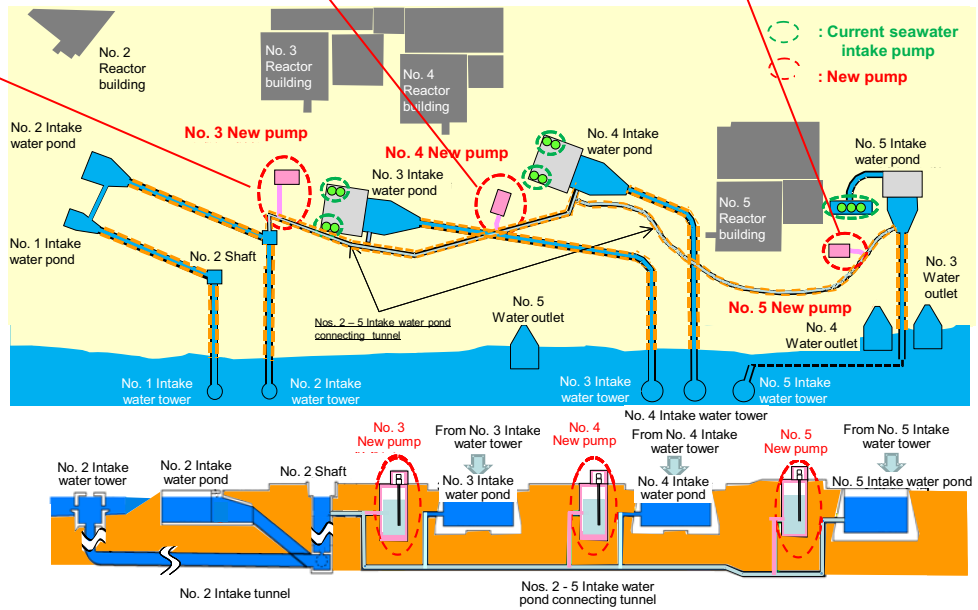
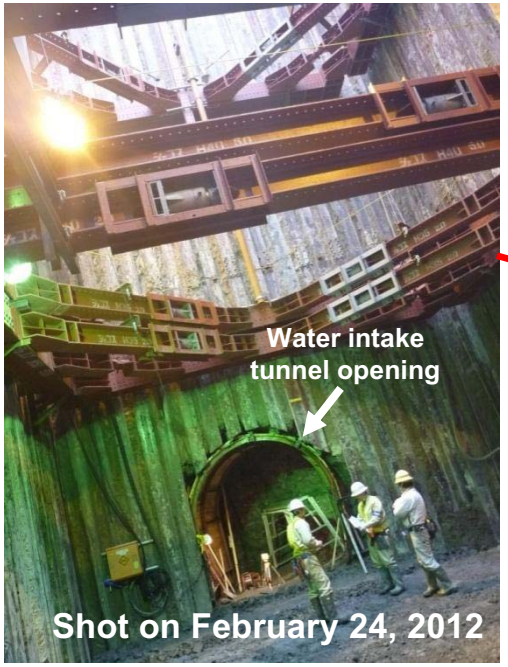


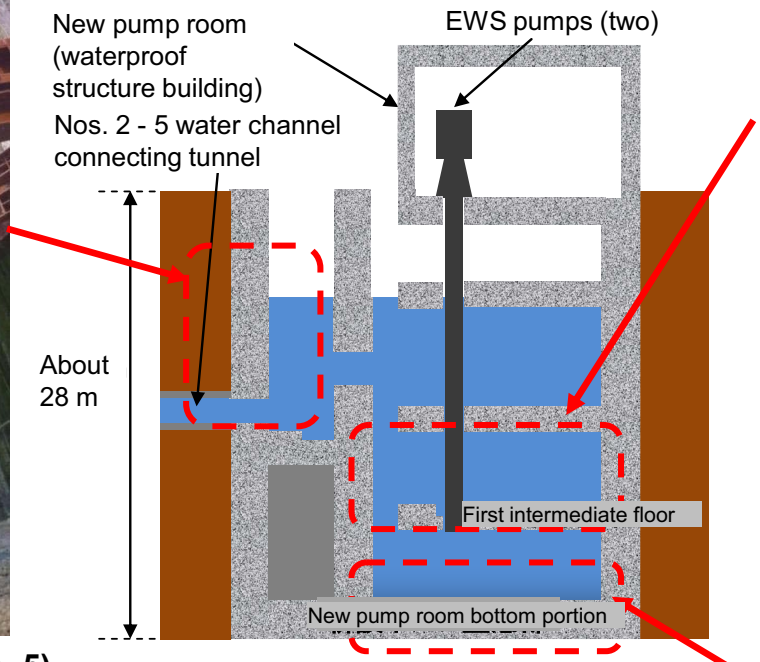


Status of Emergency Seawater Intake System (EWS) (2)

- Reactor No. 3 … Concrete piling work for bottom portion and bottom portion wall was completed on February 14, 2012 and currently steel enforcement is being placed for the wall of the first intermediate floor.
- Reactor No. 4 … Concrete piling work for bottom portion was completed on February 8, 2012 and currently steel enforcement is being placed for the bottom portion wall.
- Reactor No. 5 … Excavation work of the new pump room started on January 28, 2012 and currently the fifth excavation* is underway.



Excavation of new pump room (No. 5)



(Section image of new pump room)

Placing steel enforcement for the wall portion of the first intermediate floor of the new pump room (No. 3)

Placing steel enforcement for the bottom portion wall of the new pump room (No. 4)

* The outline of excavation work of No. 5 EWS pump room is as follows.

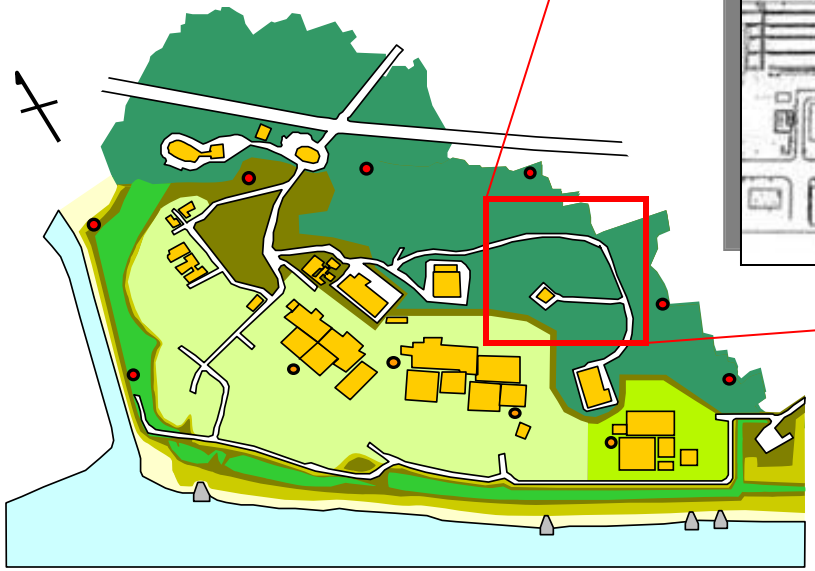
- First excavation: from the ground to about 3 m depth
- Second excavation: to about 3 - 5 m depth
- Third excavation: to about 5 - 11 m depth
- Fourth excavation: to about 11 - 17 m depth
- Fifth excavation: to about 17 - 25 m depth

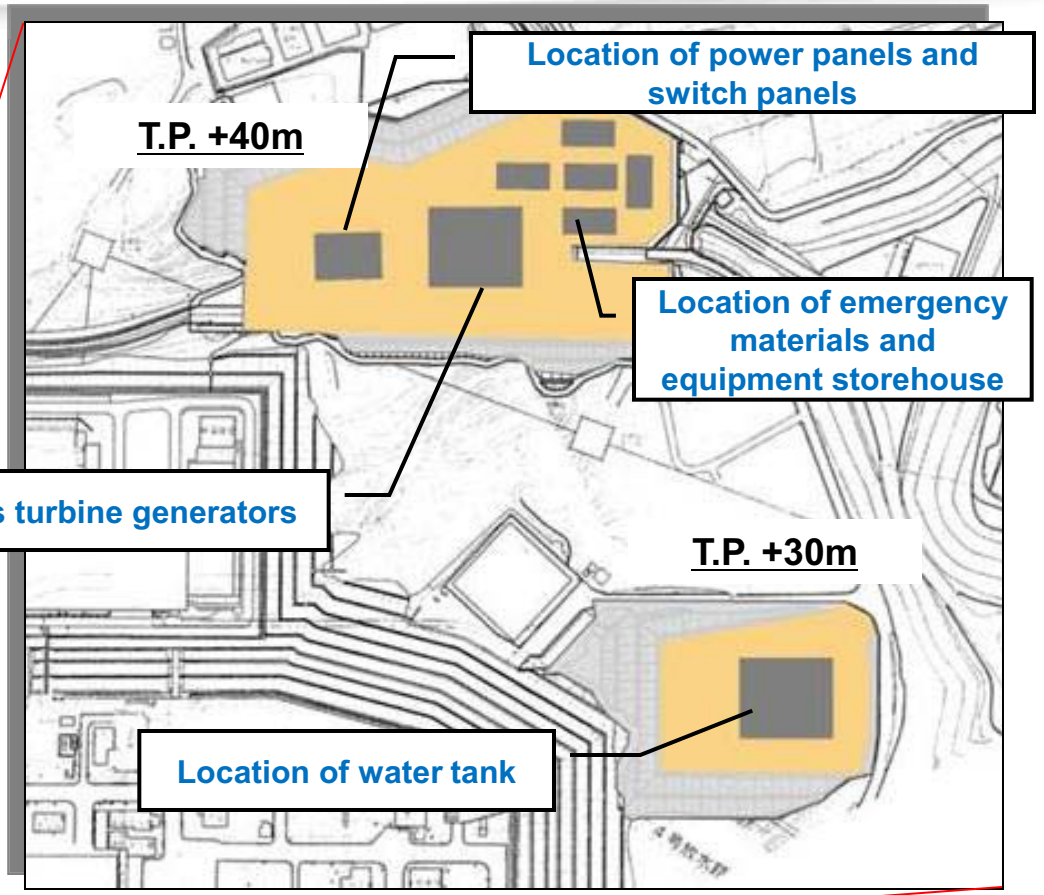
Note that beams are installed as reinforcement to withstand the earth pressure from the surrounds during excavation.

Status of Work for Preparing High Ground (1)

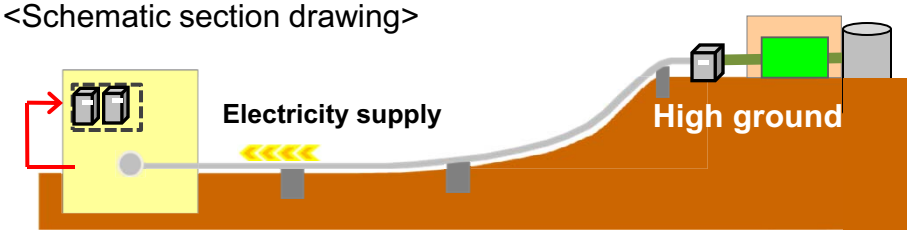
- Since November 21, we have been performing construction work to prepare high ground for installation of: gas turbine generators, power panels and switch panels to provide electric power to equipment that cools the reactor core and other such facilities; an emergency materials and equipment storehouse; water tanks to diversify water intake sources.

<Schematic of Hamaoka Nuclear Power Station site>





<Schematic section drawing>



Status of Work for Preparing High Ground (2)

Preparation work of the high ground for the station site (T.P.+40 m) (four pictures are combined)

Preparation work of the high ground for the station site (T.P.+40 m) (five pictures are combined)

Revise Disaster Management System

◆ We have begun to revise our disaster management system into one that anticipates a combined disaster with the simultaneous occurrence of earthquake, tsunami and nuclear accident.

◆ We will not just prepare an accident prevention system, but also strengthen our disaster prevention system that anticipates major accidents actually happening.

<Specific responses>
- Prepare system for responding to combined accidents and deploy the necessary materials and equipment
- Conduct training that anticipates combined accidents
- Enhance radiation control staff, prepare radiation control equipment, etc.

◆ We will take steps to strengthen our partnership with national and local governments in order to enable smoother implementation of measures to broadcast information to local communities, to conduct screening of evacuees, and so on.

<Specific responses>
- Implement closer partnership with local governments to appropriately respond
- Provide active support for revision of area disaster prevention plans by local governments.

Implementation of Hamaoka Nuclear Power Station Emergency Response Training

◆ Based on emergency safety measures prepared by considering the Tohoku-Pacific Ocean Earthquake, on March 13 (Tues.), we conducted an emergency response training that assumed the loss of all AC power so that the function of water injection into the reactor core was lost. The purpose was to have the entire disaster prevention organizations cooperate with each other and to improve our capabilities for comprehensively responding to emergency situations.

[Training details]

○ Reporting and communication ○ Evacuation guidance of on-site workers
○ Emergency restoration measures ○ Operation in emergency
○ Access control for emergency office

[Training of evacuation guidance for on-site workers]

[Training of emergency restoration measures]

Future Actions

- Chubu Electric Power aims to complete the tsunami countermeasure construction by December 2012.
- Chubu Electric Power will continue to take the necessary and appropriate measures based on new knowledge from studies of the accident at the Fukushima Daiichi Nuclear Power Station, the investigation of the Central Disaster Management Council, and so on.