

## Status of Responses to New Regulatory Requirements: Hamaoka Nuclear Power Station Units 3 and 4

New regulatory requirements have stipulated essential requirements that demand the consideration of further countermeasures and concrete responses in addition to the safety measures Chubu Electric Power has already put in place. We have therefore proceeded with an examination of these essential requirements.

Based on the results of this examination, we intend to implement the additional safety measures shown below. In the near future, we will proceed with studies in relation to standard ground motion and standard tsunami, in addition to the formulation of designs for the additional safety measures shown here. The potential effect of the area running alongside the Nansei-shoto Trench on the grounds of Hamaoka Nuclear Power Station will form part of our study in relation to standard tsunami.

Main requirements		Safety measures implemented at Hamaoka Nuclear Power Station since accident at Fukushima Daiichi Nuclear Power Station <sup>(Note)</sup> (● indicates additional safety measures based on new regulatory requirements)
Design basis	Prevention of damage caused by earthquake (No possibility of loss of safety functions due to standard ground motion)	● Earthquake countermeasures (Work to improve supports for pipes and electric circuits equipment, work to reinforce ground around Unit 4 water intake pond, work to reinforce slope within the station site (north side of Unit 4 water intake pond), work to reinforce ground around tsunami protection wall)
	Prevention of damage caused by tsunami (No possibility of loss of safety functions due to standard tsunami)	Installation of tsunami protection wall (T.P.+22m) Leveling of embankments on east and west sides of facility (T.P.+22-24m) Closure of discharge pit and discharge channel opening Flooding resistance measures for water intake pond, etc. Installation of flood protection wall around seawater pump area Etc.
	Prevention of damage caused by impacts from exterior (No loss of safety functions due to projected natural phenomena)	● Tornado resistance measures: Measures to protect seawater pumps and associated pipes from flying objects Etc.
	Prevention of damage due to fire (No decline in safety of reactor facilities as a result of a fire)	Installation of additional fire detectors Etc. ● Enhancement of measures to prevent spread of leaks from equipment containing oil ● Installation of additional fire detectors and automatic firefighting equipment, installation of fire-resistant barrier walls Etc.
	Prevention of damage due to flooding, etc. (No loss of safety functions in the event of flooding of the reactor facilities, no leakage of liquids containing radioactive materials outside controlled areas)	Additional installation and reinforcement of watertight doors Implementation of measures to prevent flooding from through-ways in equipment rooms (i.e., improvement of seals) ● Additional measures to prevent flooding from through-ways in equipment rooms, fitting of waterproof covers, enhancement of seismic resistance of low seismic-resistance equipment ● Measures to prevent flooding of turbine rooms from circulating water system (Addition of isolation function) ● Installation of watertight doors in access-ways Etc.
	Enhancement of reliability of static equipment (Ability to fulfill prescribed safety functions even assuming a single failure in static equipment)	● Guarantee of back-up filters for stand-by gas treatment system (Unit 4) and Main Control Room air-conditioning and ventilation system
	Supply of power to safety equipment (Ability to supply power necessary for safety equipment to maintain functions)	Enhancement of reliability of external power supply (Supply of power using three systems/six circuits Etc.)
	Other (Communications equipment Etc.)	Installation of oxygen meters in emergency response center Etc. ● Installation of seismic-resistant systems for recording and storage of data concerning essential parameters to enable monitoring of status of functions important to safety ● Guarantee of multiple (or diversified) routes of communication between Main Control Room and emergency response center ● Installation of infrared cameras to enable monitoring of status of situation outside reactor buildings ● Provision of mobile oxygen meters for Main Control Room Etc.

Main requirements	Safety measures implemented at Hamaoka Nuclear Power Station since accident at Fukushima Daiichi Nuclear Power Station <sup>(Note)</sup> (* indicates main accident management measures implemented prior to accident at Fukushima Daiichi) (● indicates additional safety measures based on new regulatory requirements)
Prevention of damage due to earthquake (No possibility of loss of functions essential to responding to a severe accident or other major event as a result of standard ground motion)	Enhancement of seismic resistance of makeup water system, etc. / Installation of additional water injection pipes ● Earthquake countermeasures (Work to reinforce slope within the station site (North sides of Units 3 and 4))
Prevention of severe accident or other major event due to tsunami (Implementation of measures necessary to prevent significant damage to cores, etc. caused by tsunami)	Measures to prevent flooding of buildings (to height of T.P.+15m) (Measures to increase reliability of waterproof doors in exterior walls of buildings, measures to prevent flooding from air supply and exhaust outlets in exterior walls of buildings, measures to prevent flooding from through-ways in buildings (improvement of seals) Etc.) Measures to prevent flooding of equipment rooms (Additional installation and reinforcing of watertight doors, measures to prevent flooding from through-ways in equipment rooms (improvement of seals) Etc.) Implementation of measures to prevent flotsam from entering water intake ponds ● Enhancement of measures to prevent flooding of buildings (to height of T.P.+20m) (Installation of equipment on openings in buildings to enable automatic closure, additional measures to prevent flooding from through-ways in buildings (improvement of seals), remodeling of roofs, installation of equipment on doors in external walls to enable automatic closure Etc.)
Reactor shutdown (Ability to shut down reactors even in the event of failure of the emergency shutdown system)	* Alternative control rod insertion paths Etc.
Cooling of reactors even at high pressure (Ability to cool reactors even when they are at high pressure and cooling functions have been lost)	Supply of power to reactor core isolation cooling systems by increasing capacity of storage batteries, etc. Installation of air-cooled heat exchangers to enable operation of high-pressure water injection system Etc. ● Supply of power to reactor core isolation cooling systems using DC generator trucks
Depressurization of reactors (Ability to depressurize reactors even when they are at high pressure and depressurization functions have been lost)	* Automatic depressurization of reactors via main steam r safety relief valves ● Positioning of mobile air compressors or nitrogen cylinders for operation of main steam safety relief valves ● Positioning of DC generator trucks and mobile storage batteries for operation of main steam safety relief valves
Cooling of reactors at low pressure (Ability to cool reactors even when they are at low pressure and cooling functions have been lost)	Installation of air-cooled heat exchangers to enable operation of high-pressure water injection system [Repeated] * Alternative means of water injection via makeup water systems, etc. Enhancement of seismic resistance of makeup water system, etc. / Installation of additional water injection pipes of buildings [Repeated] Availability of mobile power pumps Etc. ● Positioning of additional mobile water injection pumps, etc. (For injection of water into reactors) ● Installation of additional external connection outlets in buildings / Installation of additional water injection pipes Etc.
Heat transport to ultimate heat sink (Ability to remove heat from reactors, etc. even when heat transport functions to ultimate heat sink have been lost)	< Measures to transport heat to the ocean > Installation of emergency seawater intake system (EWS) Deployment of alternative heat exchange equipment for long-term cooling Availability of back-up pumps and electric motors (RCWS, RCCW, etc.) Availability of submersible pumps < Measures to transport heat to the air > * Installation of containment vessel vent equipment Remote control of containment vessel vents Installation of nitrogen cylinders to operate containment vessel venting valves Installation of filter vent equipment ● Positioning of mobile nitrogen gas production equipment for replacement of nitrogen in filter vent equipment
Cooling, etc. of containment vessels (Ability to cool interiors of containment vessels and reduce concentration of radioactive materials)	* Alternative sprays for containment vessels Enhancement of alternative containment vessel spray functions Enhancement of cooling functions of containment vessel top head flanges Etc. ● Positioning of additional mobile water injection pumps, etc. (Alternative sprays for containment vessels, containment vessel top head flange cooling) ● Installation of additional external connection outlets in buildings / Installation of additional water injection pipes
Prevention of damage to containment vessels due to excess pressure (Ability to reduce pressure and temperature inside containment vessels)	* Installation of containment vessel vent equipment [Repeated] Remote control of containment vessel vents [Repeated] Installation of nitrogen cylinders to operate containment vessel venting valves [Repeated] Installation of filter vent equipment [Repeated] Etc.
Cooling of melted core at bottom of containment vessel (Ability to cool melted core that has dropped to the bottom of a containment vessel)	Installation of water supply lines in containment vessel pedestals Etc. ● Installation of additional mobile water injection pumps, etc. (Injection in containment vessel pedestals) ● Installation of additional external connection outlets in buildings / Installation of additional water injection pipes

Severe accident standards

Main requirements		Safety measures implemented at Hamaoka Nuclear Power Station since accident at Fukushima Daiichi Nuclear Power Station <sup>(Note)</sup> (* indicates main accident management measures implemented prior to accident at Fukushima Daiichi) (● indicates additional safety measures based on new regulatory requirements)
Severe accident measures	Prevention of containment vessels failure due to hydrogen explosions (Ability to prevent containment vessels failure due to hydrogen explosions)	Installation of filter vent equipment (Discharge of hydrogen from containment vessels [Repeated] Etc. ● Positioning of mobile nitrogen gas production equipment for replacement of nitrogen in filter vent equipment [Repeated] ● Installation of hydrogen meters in filter vent inlet pipes
	Prevention of damage to reactor buildings, etc. due to hydrogen explosions (Ability to prevent damage to facilities to enable containment of leaks of gaseous radioactive materials from reactor buildings or containment vessels due to hydrogen explosions)	Measures to prevent hydrogen explosions (Discharge of hydrogen from reactor buildings by stand-by gas treatment systems and reactor building vent equipment, installation of hydrogen meters in reactor buildings Etc.)
	Cooling of spent fuel storage tanks, etc. (Ability to cool fuel, etc. in spent fuel storage tanks, shield radiation, and prevent criticality)	Enhancement of seismic resistance of makeup water system / Installation of additional water injection pipes [Repeated] Availability of mobile power pumps Installation of devices for monitoring of fuel pool water level and water temperature Etc. ● Positioning of additional mobile water injection pumps, etc. (Injection and spray for fuel pools) ● Installation of additional external connection outlets in buildings / Installation of additional pipes for water injection ● Installation of cameras for monitoring of fuel pools Etc.
	Suppress radioactive materials dispersion outside facility (Ability to suppress spread of radioactive materials dispersion outside facility)	● Positioning of water cannon Etc.
	Supply of water (Ability to secure water sources providing sufficient water for the containment of a severe accident or other major event, and ability to supply water)	Diversification of water sources (Installation of emergency freshwater storage tank, Etc) Diversification of intake water sources (Drawing of water from Niinogawa River) Etc.
	Power supply (Ability to guarantee the necessary power to prevent significant damage to the core, etc.)	* Power interchange between neighboring reactor facilities Installation of gas turbine generators on high ground Installation of emergency generators on rooftops Upgrading of battery capacity Availability of spare storage batteries Installation of power panels, etc. on upper floors and high ground Etc. ● Positioning of AC and DC generator trucks ● Installation of external connection outlets in buildings and installation of power cables Etc.
	Instrumentation (Ability to obtain data effective in enabling estimation of parameters that must be monitored, even when a breakdown in measurement devices makes measurement difficult)	* Accident management instruments Deployment of separate dedicated power sources for critical instruments and similar equipment Etc. ● Enhancement of instrument monitoring functions in environment following severe accident
	Reactor control rooms (Possibility for operating personnel to inhabit reactor control rooms even in the event of a severe accident)	Guarantee of livable environment in Main Control Room Etc.
	Emergency Response Center (Implementation of appropriate measures to enable the Emergency Response Center to respond to a severe accident or other major event)	Installation of radiation area monitors Etc. ● Enhancement of radiation shielding measures ● Improvement of ventilation system Etc.
	Communications (Ability to communicate with areas that must be able to maintain internal and external communications)	Availability of means of communication within the station facility in an emergency Etc.
Storage areas / Access routes (Consideration of earthquakes, tsunami and other natural phenomena, etc. in selecting storage areas for equipment and implementation of appropriate measures to ensure roads and passageways within the station site)	Construction of storehouses for emergency equipment and materials on high ground Positioning of heavy machinery for removal of rubble (Bulldozers, etc.) Etc. ● Availability of storage areas for movable equipment ● Ensuring access routes	

(Note) Some measures may be classified as voluntary measures undertaken by Chubu Electric Power.