Safety Measures etc. concerning Fuel Removal from Unit 4 in Fukushima Daiichi NPS

<Reference>
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Tokyo Electric Power Company

<Common procedure> In case of the following accidents, we stop all work and inform the group leader in Anti-Earthquake Main Building Restoration Group of the acciden

No.	Case	Safety Measures	Correspondences	Notes
1	Fuel drop	- Anti-earthquake structure against drop surviving standard earthquake ground motion - Duplexing the wires of fuel grip instruments - fuel remains held even when power/air supply is lost. - In addition, the hook does not mechanically open when hanging fuel. - Improving work procedure manual and dissemination of training for workers - Only those qualified operate the crane.	- Workers will evacuate immediately. - After confirming the situation via an area-monitor camera, and measuring the radiation dose, we look into the dropped fuel via underwater camera, and cnoduct some processing which secure the subcritical etc. and safe storage.	
2	Cask drop	- Anti-earthquake structure against drop surviving standard earthquake ground motion - Duplexing hoisting wires - Brake structure holding the cask in case of no power supply - Installation of anti-release structure in a hook - Duplexing the installation of cranes and hoisting tools, and hoisting tools and cask - Pre-use inspection for the crane and the hoisting tool - Checking the fixation after fixing, and installation of anti-release structure - Improving work procedure manual and dissemination of training for workers - Only those qualified operate the crane. - Evacuation of workers in case of cask dropping after the cask being lifted high up - Inprovement in the emergency manual and such equipments in case of cask dropping - Installation of buffer material on the point where cask is hund down	- Workers will evacuate immediately. - Confirming the cask via monitoring cameras and measuring the radiation dose - Building a shielding around the cask and lowering the radiation dose - Collecting the cask after confirming the cask	
3	Stop/leak of cooling system for the spent fuel poo	- Installation of a preliminary pump - Multiplexing and diversification of power source (On-premise diesel power generators and exclusive power generators) - Installation of emergency transferrable water injection facilities (emergency electric pump, fire-engines etc.) - Installation of leak detector and dikes against outflow	- Confirming the water level and water temerature at the spent fuel pool - Activation of preliminary pump - Switchin the power receiving source - Water injection from the emergent water injection facilities - Investigation into causes, and inspection and replacement etc conducted	We have enough time before conducting correspondence due to the lowered decay-heat, even when the cooling system stops.
4	Leak from the spent fuel pool	- Monitoring water level - Spent fuel pool has enough electorical torelance beyond standard earthquake ground motion. - Installation of water injection lines such as emergent water injection lines etc. - Already equipped with emergent transferrable facilities (emergent electrical pumps and fire-engines etc.)	- Confirming the water level and water temperature at the spent fuel pool - Water injection into spent fuel pool - Segregation of leaking point and stop of the pump - Specifying the leaking point, and conducting water-stopping processing	The heavies such a cask does not pass above the spent fuel pool and the crane has an interlock which limits its movable range.
5	Confirmation of abnormalities with fuel when handling fuel	- Checking the abnormality during handling fuel via a load indicator - Installation an interlock to limit the rise, when detecting over-load - Confirm the form of a fuel grip via underwater camera in advance, in order to ensure no obstacles for lifting up	- When leak concerned during handling fuel, we will confirm the situation via an area-monitor camera, and measue the radiation dose, and look into the dropped fuel via an underwater camera, and then take a measure such as lifting the fuel down on the fuel rack again, in order to secure the subcritical and store safely.	Fuel is covered with a channel box, and therefore collision with debris (if any) does no direct influence on the fuel clad.

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6	Handling of damaged fuels	- We have already confirmed by a corrosion test simulating seawater environment that damaged fuels will not affect outside of the plant area in case of the earthquake. - We have already confirmed by a specific jig that soundness of fuels will not be affected even if the fuels are dropped in case of the earthquake.	- As for the fuels which were found to be damaged before 2011 earthquake, we will transfer them by using a cask after safety analysis and confirmation of safety by the Nuclear Regulation Authority through Implementation Plan. - As for the fuels which were deformed heavily before 2011 earthquake, and if new leak or damage of fuel is confirmed by any chance, we will transfer the fuels under tanking measures such as prevention of critical state after detailed inspection of deformation.	The number of fuels which were found to be damaged before 2011 earthquake stored in each Unit is as follows: Unit 1: 70 assemblies Unit 2: 3 assemblies Unit 3: 4 assemblies Unit 4: 3 assemblies
7	Occurance of the earthquake during fuel (cask) handling work	[Safety measures for fuel handling machine] - The machine was designed to withstand the standard seismic ground motion Ss. - The wire for the fuel handling machine was doubled. - The machine was designed to hold the fuel if power or motive power (air) is lost. - The hook of the machine was designed not to be opened when the fuel is hanged. [Safety measures for crane] - The crane was designed to withstand the standard seismic ground motion Ss. - The wire to hang the crane was doubled. - The brake of the crane was designed to hold the cask if power is lost. - Slip-off stopper was installed in the hook.	- If the earthquake occurred, the work will be temporarily suspended until the earthquake stops. - If a strong earthquake occurred, fuel and cask will be placed on safe location after the earthquake stops. After that, the workers will get under shelter immediately. - Possibility of tsunami will be confirmed by simultaneous broadcast, and the workers will be on standby at operating floor in accordance of situation.	
8	Failure of fuel handling machine during fuel handling work Failure of crane during cask transferring work	- Design, production and inspection which are equivalent to the existing plant were performed. - Daily/monthly/annual inspection was implemented. - The machine is operated by qualified person. - Spare parts were secured.	- Failure part will be identified, and hanging load will be placed on stable location.	
9	Accident or failure of trailer during cask transferring work	- The cask was confirmed to be fixed to the trailer before cask transferring work. - The trailer is operated at reduced speed. - The workers other than those concerned is prohibited from entering the cask transfer route, and lookout was arranged. - Trailer was inspected before in use.	- Status of cask (appearance, dose rate) will be confirmed by suspending cask transferring work, and measures according to the situation will be taken. - Trailer will be repaired after suspension of cask transferring work. - In case of oil leak, we will prevent oil from spreading.	
10	Suspension of air conditioning system inside cover	- Automatic activation of standby system - Multiplexing of power sources - Monitoring of ambience by installing dust monitor equipment - Issue of alarm in case of emergency	- Automatic activation of standby system - Switch of receiving power source - The cause of suspension of air conditioning system will be identified, and inspection/replacement will be performed.	
11	Increase of radiation level monitoring by area monitor equipment	[Reduction of the exposure of workers to radiation during fuel handling work] - Interlock was installed to prevent fuel from pulling up too much from the water. - Status of hanged fuel is monitored by underwater camera. - Position coordinates of hanged fuel was monitored [Others] - Monitoring and alarming of ambient dose rate was performed by using area monitor equipment. - Each worker carrys personal dosimeter. - High-performance particle filter was installed to air supply equipment.	- The workers will be evacuated from the site immediately in case alarm indicating abnormality of area monitor is gone off.	
12	Falling of worker in the spent fuel pool	- Each worker wears safety belt. - Monitoring person was arranged.	- Float will be thrown into the pool to save the worker. - The worker will be taken to the Entrance Control Building or the Anti-earthquake Building to perform decontamination and to confirm abnormalities.	
13	Poor physical condition or injury of worker during fuel handling work	- Health condition is being confirmed by tool box meeting and danger prediction before the work. - Heatstroke countermeasures will be performed in summer season. - Local air conditioning was installed. - Work hours are being managed.	- Contact to the group leader who is in charge of health care of the workers will be made. - Contact to the emergency medical room will be made. - The worker who is sick or injured will be taken to the hospital.	
14	Fire	- Incombustible material was used in building cover. - Flame retardant cable is in use. - Fire extinguisher was installed. - Multiple water outlets of fire extinguishing water were installed, and fire hose for water discharge was prepared. - Two direction evacuation routes (south side and north side) were installed. - Web camera which can monitor the overall operating floor was installed. - As a rule, the work using a fire is being prohibited.	- Fire will be extinguished at an initial stage by fire ectinguishier, and regular practice by self defence fire brigade will be perfomed - The workers will be evacuated. - Prompt report will be made thoroughly. - Monitoring results such as monitoring post readings, etc. will be confirmed and provided.	