Unit 2 Spent Fuel Pool Internal Investigation Results

July 2, 2020

TEPCO

Tokyo Electric Power Company Holdings, Inc.

Unit 2 SFP internal investigation

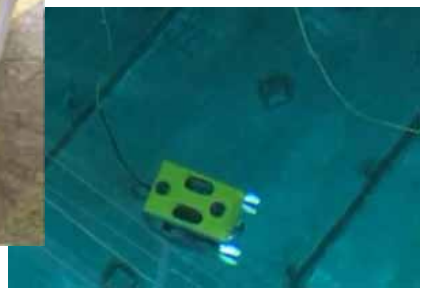
<Investigation overview>

- At Unit 2, high radiation levels on the operating floor have made access difficult and we had been unable to perform an internal investigation of the spent fuel pool (SFP).
- In preparation for fuel removal, an internal investigation of the SFP was implemented on June 10 and 11, 2020 in order to look for obstructions on the fuel and inside the cask pit, and also to check the condition of the pool gate and the skimmer surge tank.

<Investigation method>

- Equipment was carried in through the west side platform anticum, and a submersible remotely operated vehicle (ROV) was used for the investigation.
- Submersible ROV insertion/extraction and underwater lighting installation was carried out using remotely operated heavy machinery and small robots that have been used on the operating floor to clean up and remove objects/equipment that remain there.

Submersible ROV



Submersible ROV in operation (image)

Remotely operated heavy machinery (BROKK)

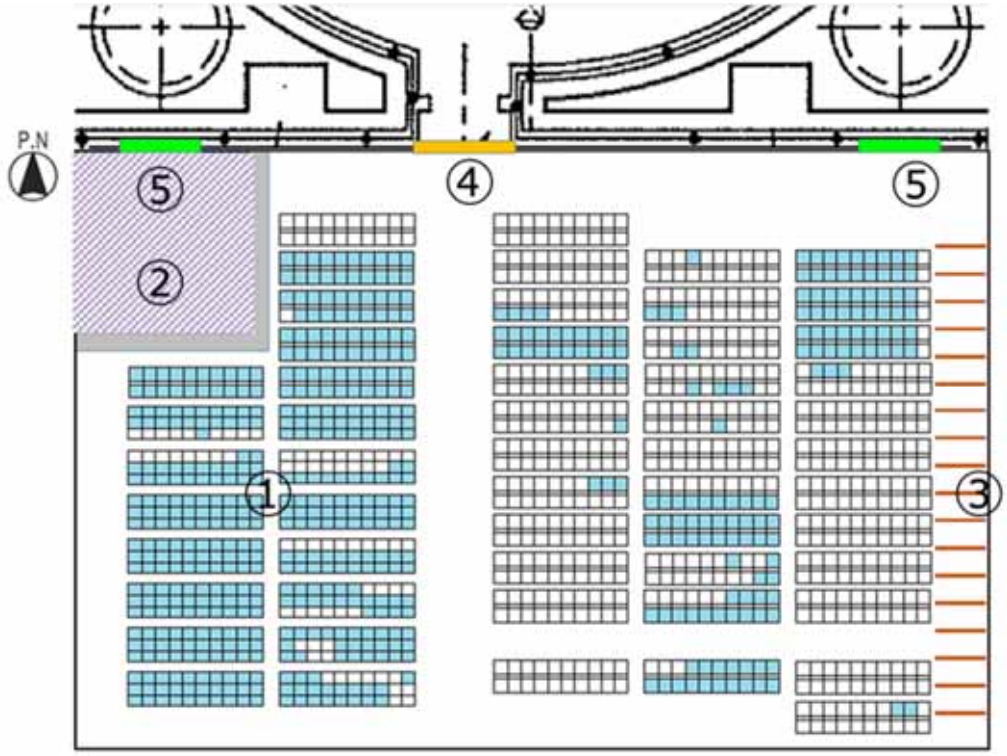
Small robots（Kobra、Packbot)

SFP internal investigation targets

The investigation focused on the following targets

June 10:①Fuel, fuel racks, ④ Pool gate, ⑤ Skimmer surge tanks entrance

June 11:② Cask pit, ③ Control rods, control rod hangers



<Investigation targets>

:① Fuel, fuel rack

(□ indicate fuel racks that do not have any fuel in them)

:② Cask pit

:③ Control rods/control rod hangers

:④ Pool gate

:⑤ Skimmer surge tank entrance

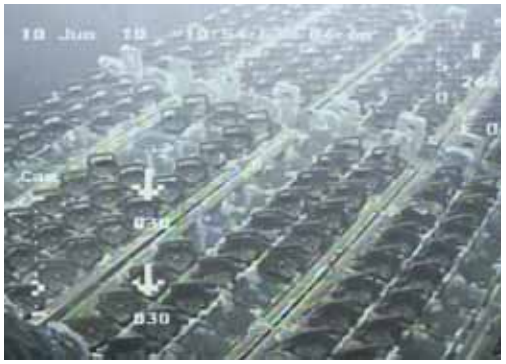
Location of investigation targets in the SFP

Overview of investigation results

- The investigation was implemented with the intention of examining the following for each investigation target in order to identify problems that may hinder future fuel removal or fuel cooling.
- The investigation identified some issues, but since these issues were anticipated no issue that was identified should hinder fuel removal.

Investigation target		Issues to examine	Results
①	Fuel	• Is there significant deformation of the fuel handles?	○ (No)
		• Are there obstructions on the fuel?	△ (Small obstructions exist)
	Fuel rack	• Is there significant deformation of the top of the fuel rack?	○ (No)
②Cask pit		• Is there a significant deformation of the cask pit girders?	○ (No girder deformation)
		• Are there obstructions at the bottom of the cask pit?	△ (There are sandy deposits at the bottom)
③Control rods/control rod hangers		• Are all control rods hanging on the control rod hangers?	○ (All the rods are on hangers as normal)
		• Is there significant deformation or corrosion of the control rod hangers?	○ (No deformation, corrosion)
④Pool gate		• Is there significant deformation or leaning of the pool gate?	○ (No deformation, leaning)
		• Are any falling of the pool gate support axis from lug used to secure the gate?	○ (No falling)
⑤Skimmer surge tank entrance		• Is there significant deformation or leaning of the movable weir at the skimmer surge tank entrance?	○ (No deformation or leaning of the movable weir)
		• Are there any obstructions that are blocking, or may block, the entrance to the skimmer surge tank?	○ (No)

【Investigation results】①Fuel, fuel rack, ②Cask pit



Fuel handles

Fuel handles (enlarged)

Obstructions on the fuel handles

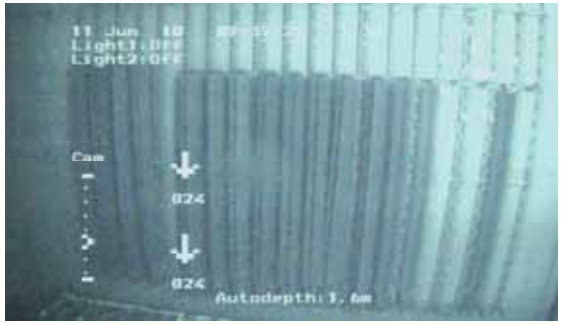
- No fuel handle deformation
- Thin paint fragments or tarps were found on the fuel but they are light and should be easy to remove, so there should be no impact on fuel removal. (Page 6)
- White deposits generated by the aluminum alloy fuel rack when seawater was injected during the disaster were found just like at Unit 3, but these deposits will not hinder removal.

Girders at the top of the cask pit

Bottom of the cask pit

- No deformation to cask pit girders
- Although sandy deposits were found at the bottom, there are no large obstructions so the impact on fuel removal should be small.

【Investigation results】③Control rod hangers, ④Pool gate, ⑤Skimmer surge tank entrance

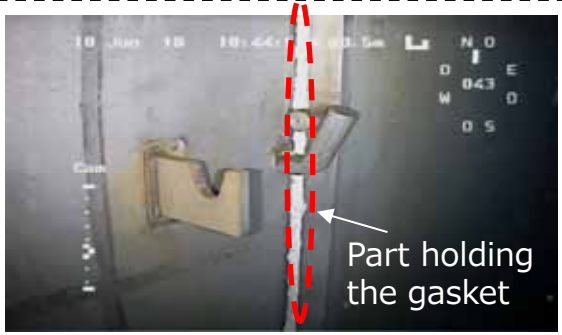


Control rods and control rod hangers

Control rod hangers (northeast side)

- Control rods are hanging on control rod hangers as normal, and no deformation or corrosion of the hangers was found

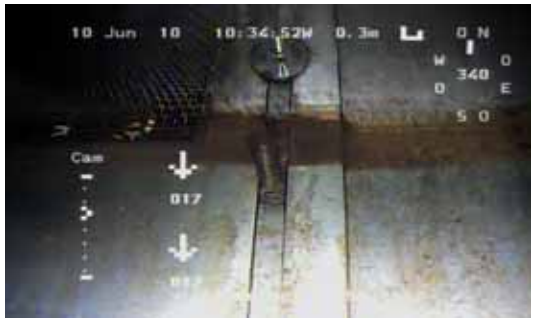
Front of pool gate



Pool gate support axis

- There is no deformation or leaning of the pool gate
- White products were found on the parts holding in the gaskets, but they are the same aluminum alloy as the fuel racks and it is assumed that they were formed the same way. Furthermore, the silicon seal that keeps the pool gate watertight has not been affected.

Front of skimmer surge tank entrance (northwest side)



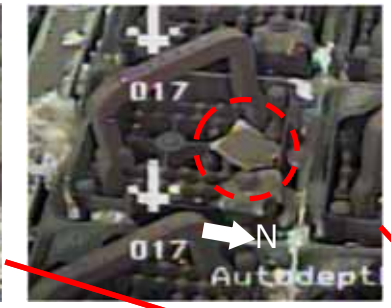
Movable weir bolts (bottom right of northwest side)

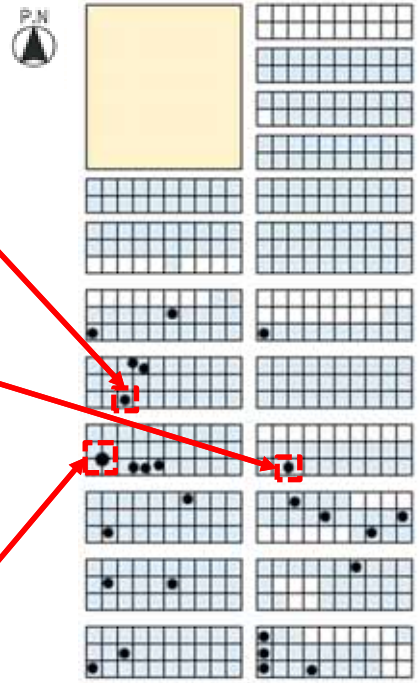
- Thin paint fragments were found floating on the top of the water by the metal screen of the skimmer surge tank entrance, but they are not blocking the flow and are not having an effect on pool cooling.
- One of the bolts on the skimmer surge tank entrance (northwest side) movable weir is deformed and the nut has fallen off, but the three remaining bolts/nuts are intact and pool water level has not been affected.

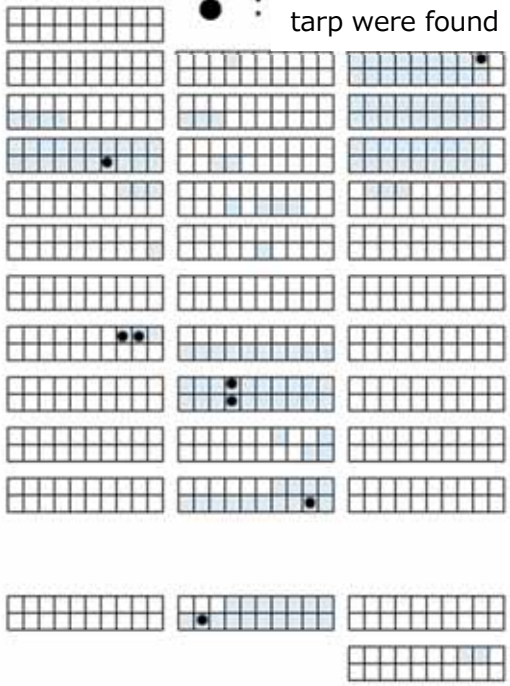
Locations were pieces of tarps and others were found above the fuel

TEPCO

<Example of paint fragments found>





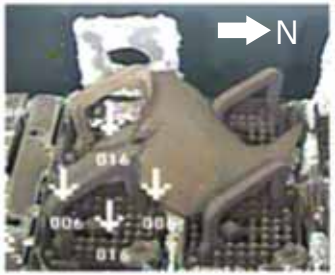


: Fuel

: Locations where tarp were found

<Largest tarp fragments found>

- Dimensions: Approx. 200x250mm
- Thickness: Approx.1.5mm



Locations were pieces of tarps were found inside the Unit 2 SFP

<Origins of tarp fragments>

- The tarps that had been attached to railings around the SFP as part of foreign material exclusion measures cannot be found and correspond in thickness to the pieces of tarp found during this investigation, so it is assumed that some of these tarps fell into the SFP during the disaster.

Urethane tarps used for foreign material exclusion

Railings around the SFP (prior to the disaster)

Operating robots during the investigation and during preparations and clean up

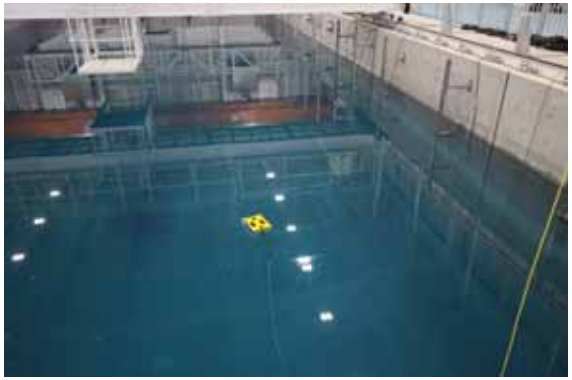
TEPCO

- ○ During this investigation, TEPCO employees operated small robots when engaging in preparations and clean up, and also operated the submersible ROV. This was done in order to improve the in-house technological capability of TEPCO employees and also to make improvements to work procedures based on the opinions of operators.
- ○ Prior to engaging in these tasks, operations training on the submersible ROV and small robots was implemented at the Fukushima robot test field in Minami-Soma City, and at the Fukushima Daiichi Nuclear Power Station, respectively.

Submersible ROV operations training at the Fukushima robot test field

Operating the submersible ROV from the west side platform (investigation)

Operating small robots from the main anti-earthquake building (preparation/cleanup work)



Operating the submersible ROV at the Fukushima robot test field

Operating the submersible ROV in the Unit 2 SFP

Engaging in preparations using small robots（Kobra、Packbot）

Initiatives to be implemented in light of the SFP internal investigation results

- Issues identified in the course of this investigation are shown below along with proposed countermeasures
- Each countermeasure will continue to be deliberated and reflected in the design/operation of the fuel handling machines as we steadily move forward with the intent of commencing fuel removal at the Unit 2 spent fuel pool between FY2024 and FY2026.

Investigation target	Issue	Proposed countermeasure
①Fuel/fuel rack	• Some tarp-like obstructions found on top of the fuel may interfere with grasping the fuel handles.	• Methods for removing the obstructions from the top of the fuel with gripping or suction tools and the like will be examined
②Cask pit	• Sandy deposits were found at the bottom of the cask pit that may make the casks unstable when put on the bottom and may also contaminate the surface of the casks.	• The sandy deposits will be removed with suction equipment and the like in accordance with how the casks are to be handled
③Control rods/control rod hangers	None	–
④Pool gate	None	–
⑤Skimmer surge tank entrance	None	–

【Reference】 Non-intact fuel being stored in Unit 2

(Wire-repaired fuel)

- One of the fuel assemblies in the Unit 2 SFP is being held together with wire. In 1981, when this fuel assembly was being handled, it was dropped thereby damaging the bottom end cap*2 of a coupled fuel rod *1 and can therefore no longer be hoisted. It was repaired with wire the following year to enable it to be handled with a fuel handling machine. An external inspection of this fuel assembly has shown that the airtightness of the cladding tubes has not been affected.
- The top of this fuel assembly was checked during this investigation and within the scope that the submersible ROV could see, no cut wires or displaced anchoring jigs were found.
- How to handle this fuel assembly is to be deliberated in light of the results of corrosion tests currently being performed on the wire that was used to repair it. A hoisting test will also be performed prior to handling this fuel assembly to ensure that it can be hoisted.

*1 This is a normal fuel rod, but the bolt at the bottom end has been cut off and the fuel rod has been coupled to the bottom tie plate. This provides a strong base for which the fuel assembly can support its own weight when it is being hoisted up. Each fuel assembly has eight coupled fuel rods.

*2 This is the bottom end of the fuel rod. It is welded to the cladding tube, which is the metal tube that contains the fuel pellets.

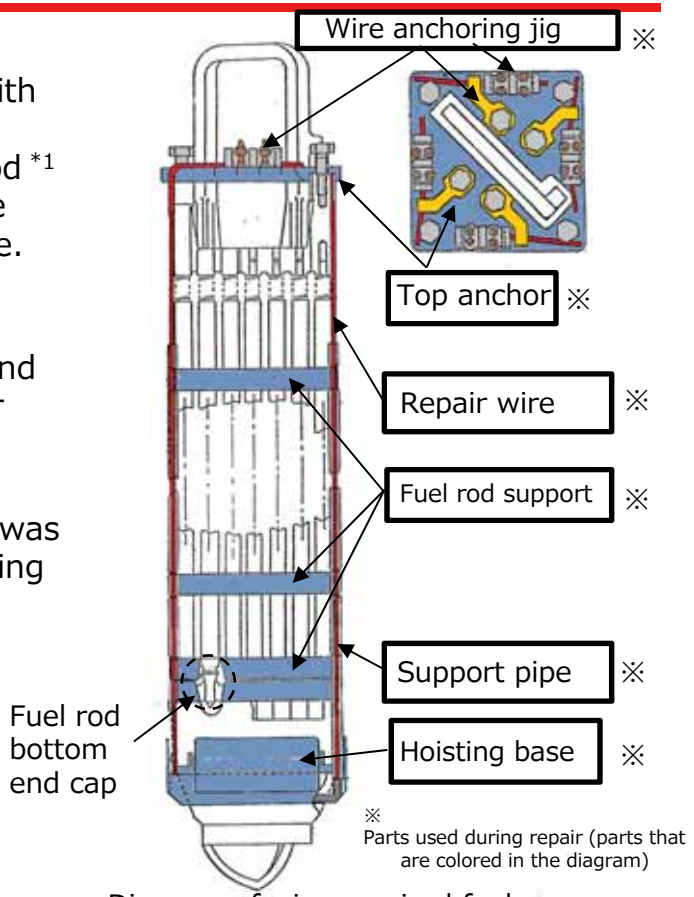


Diagram of wire-repaired fuel

(Other non-intact fuel)

- In addition, there is one fuel assembly from which fuel leaked from pinholes in the cladding tube and also a fuel assembly for which the side of a bottom tie plate is deformed. Both of these fuel assemblies have been stored in the Unit 2 SFP since before the disaster. Both of these fuel assemblies can be handled by the fuel handling machine just like other intact fuel assemblies.

TOP of wire-repaired fuel