

UK Nuclear Academics Meeting



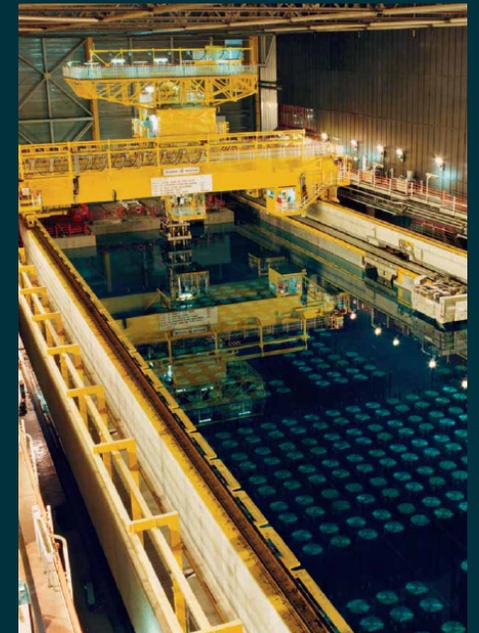
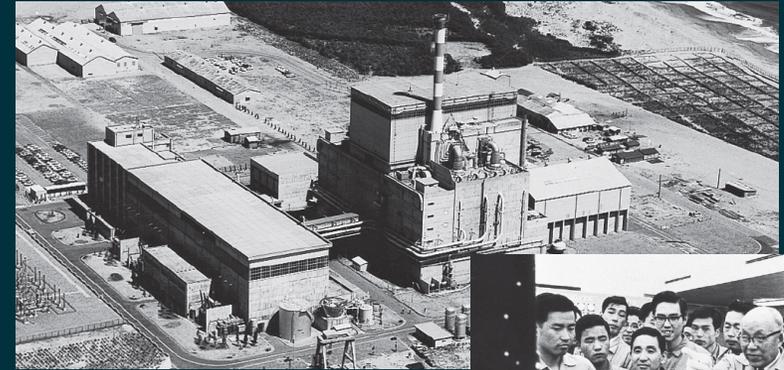
Collaboration with Japan

12th September 2019

Roger Cowton, Head of External Affairs

Sellafield and Japan

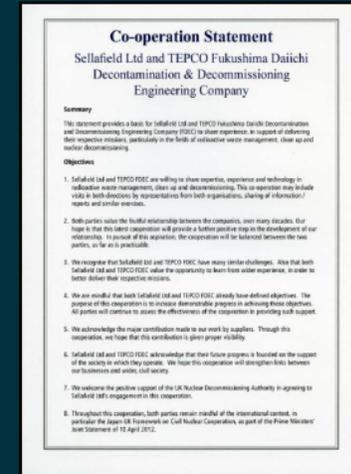
- 1950's and 1960'd
 - Tokai Unit 1 built using designs from UK Magnox reactors
 - Training of reactor operators at Sellafield
 - Fuel manufacture at Springfields
 - Spent fuel transport by James Fisher from Whitehaven, Workington and Barrow
- 1970s to 1990's
 - BNFL announces plans to build THORP
 - Significant Japanese investment behind the project based on their own domestic plans to expand nuclear power production
 - First overseas reprocessing contracts signed in 1978
 - Pacific Nuclear Transport Ltd (PNTL) develops to transport fuel around the world. This includes ships built in Japan.
- 1990's onwards
 - Reprocessing of Japanese fuel now carried out in THORP
 - Safe and secure storage of plutonium
 - Vitrification of high level waste and return to Japan's Rokkasho Mura facility
 - Evaporator technology delivery to Rokkasho Mura including significant deployment of Sellafield staff
 - Significant investment in the Sellafield MOX Plant (SMP) and MOX fuel contracts signed intending to supply to a number of reactor operators



Sellafield TEPCO Cooperation Agreement



- Non commercial agreement
 - Not intended to be a substitute for commercial arrangements between UK and Japanese organisations.
- First signed in May 2014, with formal contract in Sept 2014
- Topics covered by the Agreement
 - Site Management
 - Radiation Protection
 - Environmental Management
 - Stakeholder Engagement
 - Project Management
 - Design Engineering
- Seconded from TEPCO based at Sellafield
- Delivering real benefit to UK and Japan



Decommissioning status – Fukushima Daiichi

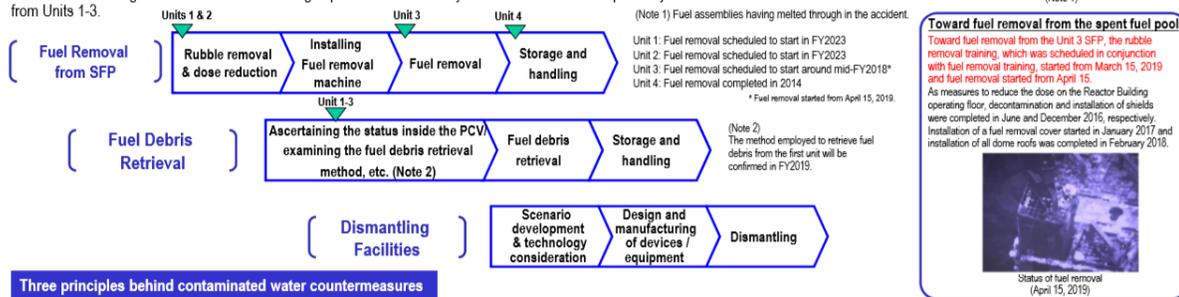
Summary of Decommissioning and Contaminated Water Management

July 25, 2019

Secretariat of the Team for Countermeasures for Decommissioning and Contaminated Water Treatment

Main decommissioning work and steps

Fuel removal from the Unit 4 SFP was completed on December 22, 2014 and removal from the Unit 3 SFP has been underway since April 15, 2019. Dust density in the surrounding environment is being monitored and work is being implemented with safety first. Work continues sequentially toward the start of fuel removal from Units 1 and 2 and debris retrieval from Units 1-3.



1 Remove contamination sources

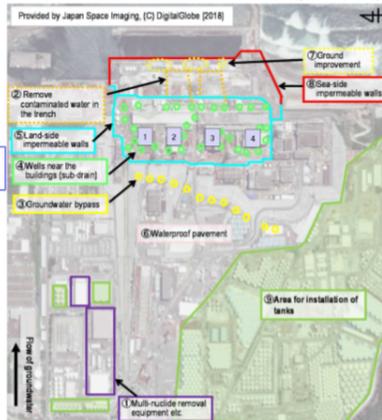
- 1 Purification by using Multi-nuclide removal equipment, etc.
 - 2 Remove contaminated water from the trench (Note 3)
- (Note 3) Underground tunnel containing pipes.

2 Redirect groundwater from contamination sources

- 3 Pump up groundwater by bypass
- 4 Pump up groundwater near buildings
- 5 Land-side impermeable walls (Frozen-soil walls)
- 6 Waterproof pavement

3 Prevent leakage of contaminated water

- 7 Enhance soil by adding sodium silicate
- 8 Sea-side impermeable walls
- 9 Increase the number of (welded-joint) tanks



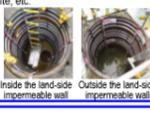
Multi-nuclide removal equipment (ALPS), etc.

- This equipment removes radionuclides from the contaminated water in tanks and reduces risks.
- Treatment of contaminated water (RO concentrated salt water) was completed in May 2015 with multi-nuclide removal equipment, additional multi-nuclide removal equipment installed by TEPCO (operation commenced in September 2014) and a Japanese Government subsidy project (operation commenced in October 2014).
- Strontium-treated water from equipment other than ALPS is being re-treated in ALPS.



Reducing the generation of contaminated water through multi-layered measures

- Multi-layered measures are implemented to suppress the inflow of rainwater and groundwater into buildings.
- Multi-layered contaminated water management measures, including land-side impermeable walls and sub-drains, have kept the groundwater level stable. The increase in contaminated water generation during rainfall is being suppressed by repairing damaged portions of building roofs, facing onsite, etc.
- Through these measures, the generation of contaminated water was reduced from approx. 470 m³/day (in FY2014) to approx. 170 m³/day (in FY2018).
- The groundwater level around Unit 1-4 Reactor Buildings will continue to be limited by steadily operating land-side impermeable walls. In addition, measures to prevent rainwater inflow, including repairing damaged parts of building roofs and facing, continue to further reduce the generation of contaminated water.



Replacing flanged tanks with welded-joint tanks

- Replacement of flanged tanks with more reliable welded-joint tanks is underway.
- Strontium-treated water stored in flanged tanks was purified and transferred to welded-joint tanks. The transfer was completed in November 2018. Transfer of ALPS-treated water was completed in March 2019.



Progress Status and Future Challenges of the Mid-and-Long-Term Roadmap toward Decommissioning of TEPCO Holdings Fukushima Daiichi Nuclear Power Station (Outline)

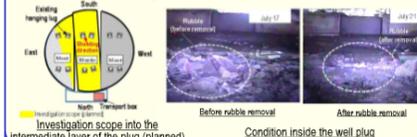
Progress status

- The temperatures of the Reactor Pressure Vessel (RPV) and Primary Containment Vessel (PCV) of Units 1-3 have been maintained within the range of approx. 20-30°C* over the past month. There was no significant change in the density of radioactive materials newly released from Reactor Buildings into the air². It was concluded that the comprehensive cold shutdown condition had been maintained.
- *1 The values varied somewhat, depending on the unit and location of the thermometer.
- *2 In June 2019, the radiation exposure dose due to the release of radioactive materials from the Unit 1-4 Reactor Buildings was evaluated at less than 0.0025 mSv/year at the site boundary. The annual radiation dose from natural radiation is approx. 2.1 mSv/year (average in Japan).

Start of investigation into the Unit 1 well plug

Toward fuel removal from the spent fuel pool, an investigation started from July 17 to examine how to handle the well plug, which was considered as having been misaligned due to the influence of the hydrogen explosion at the time of the accident.

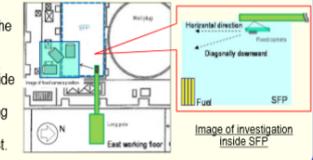
In this investigation, two robots (for investigation and monitoring) will be used to measure 3D-images, air dose rate, etc.



Investigation inside the Unit 1 spent fuel pool in August

Toward fuel removal from the spent fuel pool (SFP), the fallen roof over the SFP will be removed. To prevent the anticipated risk of small rubble, and other objects falling during removal and any influence on the soundness of fuel, the SFP will be covered before the work.

As preparation, the condition inside the pool will be investigated using an underwater camera in August.

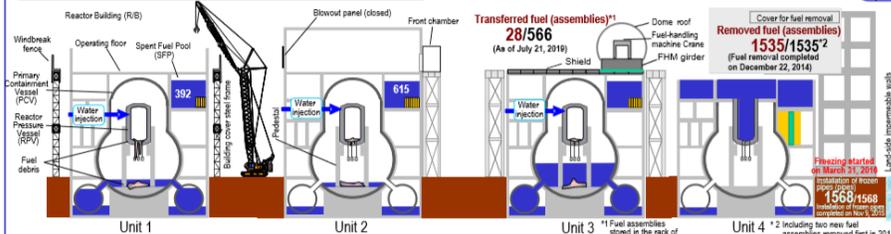


Completion of non-irradiated fuel (28 assemblies) removal at Unit 3

Fuel removal was resumed from July 4 and removal of 21 non-irradiated fuel assemblies was completed within July as planned. Up until July 21, 28 of all 566 fuel assemblies had been removed.

During the removal, no significant variation was detected in the dust density in the surrounding environment.

On July 17 and 21, leakage from the joint of a hose for working fluid of the fuel-handling facility carrying working fluid was detected. The cause will be investigated, measures implemented and similar parts checked, and other works in the facility inspection, which started from July 24, to resume fuel and rubble removal from early September.



Toward recovery of Unit 5/6 subdrain from FY2021

The groundwater level around the Unit 5/6 buildings remained high. There is a risk of important facilities being flooded by groundwater inflow due to aging building penetrations and other factors.

To eliminate this risk, examination toward recovering the Unit 5/6 subdrain from FY2021 started. Pumped up subdrain water will be transferred to Unit 1-4 subdrain purification facilities for treatment. Scope to utilize the capacity born in the Unit 5/6 building contaminated-water treatment equipment will also be examined for treatment of accumulated water onsite.

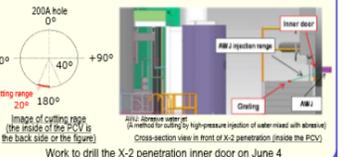
Overview of Unit 5/6 subdrain recovery

Resumption of work to create an access route at Unit 1 within July

Prior to investigating the inside of the Primary Containment Vessel (PCV), an access route was being constructed. On June 4, 2019, during drilling of the inner door of the X-2 penetration, monitoring data showed that the dust density of the temporarily-installed monitor had exceeded the criteria value set for work management.

This was considered attributable to the influence of high-pressure water during the drilling, which was poured on the grating inside the PCV and scattered dust. For future drilling and other works, the cutting scope will be changed within a range with less influence to understand the tendency of dust density during drilling.

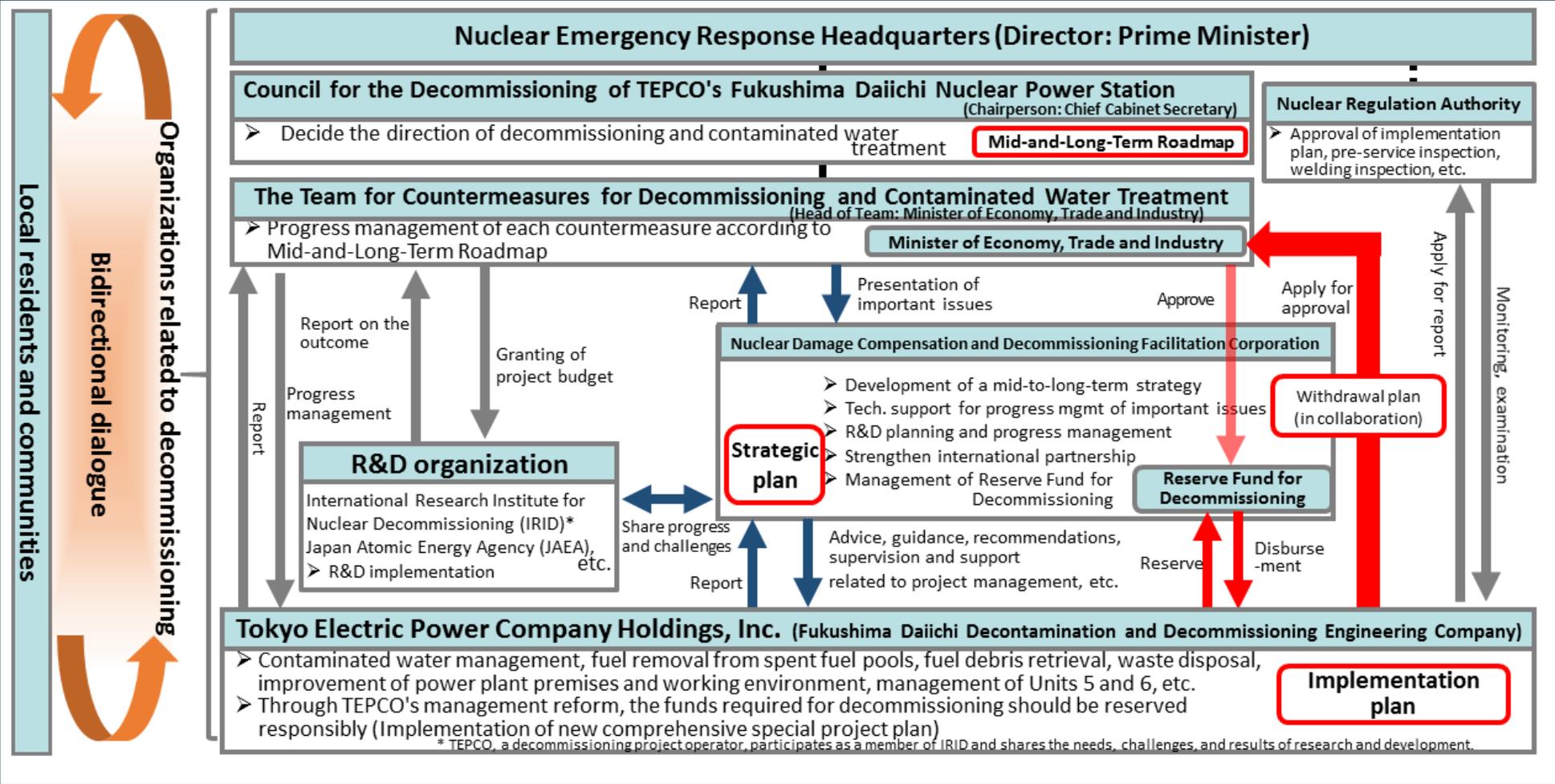
The work will resume in around late July 2019. After obtaining sufficient knowledge about dust scattering, the inner door will be drilled and obstacles inside the PCV will be cut sequentially from late August onwards.



Decommissioning elsewhere

- Other Utilities – normal decommissioning
 - 15 reactors in decommissioning or permanent shutdown (<https://www.jaif.or.jp/en/npps-in-japan/>)
 - This list will only get bigger (e.g. Fukushima Daini (4 units) and Kashiwasaki Kariwa (5 units))
- JAEA (<https://www.jaea.go.jp/english/>)
 - Over 35 facilities identified for decommissioning
 - Monju Fast Breeder Reactor
 - Team UK
 - Tokai HAS
 - NNL leading small assessment packages using skills and experience of UK SME's
 - Sellafield representation on the Advisory Panel for Tokai Reprocessing Plant

It is complicated



R&D successes and opportunities

- Avexis
 - Developed for initial use at Sellafield by University of Manchester and Forth Engineering.
- N-Visage/RISER
 - Developed by Createc and Blue Bear and trialled at Sellafield and in use at Fukushima Daiichi
- CLADS (Collaborative Laboratory Advancing Decommissioning Science) (<https://fukushima.jaea.go.jp/en/hairo/>)
 - Purpose built facility in Naraha (close to Fukushima Daiichi) (<https://naraha.jaea.go.jp/en/index.html>)
- National Institute for Technology, Fukushima College (<http://www.fukushima-nct.ac.jp/en/>)
- TEPCO have a challenges portal called CUUSOO – Open Innovation Programme (<https://tepcocuusoo.com/#about>)
- JNFL Rokkasho Mura



Closing comments

- Japan campaign group looking at business opportunities
- The Japanese business model is quite different to the UK model takes time to understand
- It takes time to build a strong relationship but once in place it lasts a long time
- Demonstrating delivery is much more powerful than talking in general terms

Other information

- What is Sellafield
 - https://youtu.be/1ZwKnYWo_nQ
- Inside Fukushima Daiichi
 - <https://www4.tepco.co.jp/en/insidefukushimadaiichi/index-e.html>
- TEPCO Treated Water Portal Site
 - <https://www4.tepco.co.jp/en/decommission/progress/watertreatment/index-e.html>
- TEPCO Latest progress video
 - https://www4.tepco.co.jp/en/news/library/archive-e.html?video_uuid=r0viqse1&catid=61795