Progress in Fuel Debris Detection Inside the Unit 2 Reactor Using A Muon Measurement Technology at Fukushima Daiichi Nuclear Power Station (Interim Report)

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The contents in this document is what TEPCO Holdings, Inc. carries out as a part of the project developed by the International Research Institute for Nuclear Decommissioning (IRID).

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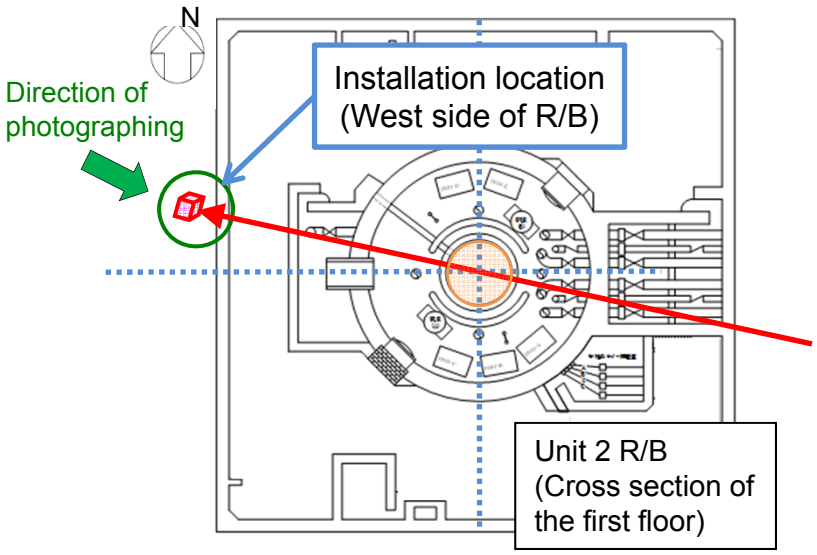
Overview

- A muon technology was developed under the government project called “the Development of Technologies for the Detection of Fuel Debris inside Reactors,” to detect fuel debris inside the reactor by measuring cosmic ray muons which pass through the reactor. The development costs were covered by the FY 2013 supplementary budget allocated for the projects of decommissioning and contaminated water management.
- From February to September 2015, measurement using the muon transmission method was carried out at Unit 1. The measurement results revealed that there was no chunk of fuel debris larger than 1 meter around the reactor core region.
- Unit 2 muon measurement started on March 22, 2016. The interim measurement results are reported in the following pages.

Installation of muon-measuring device
(downsized to approx. 1m × 1m × 1.3m(height))



Installation location

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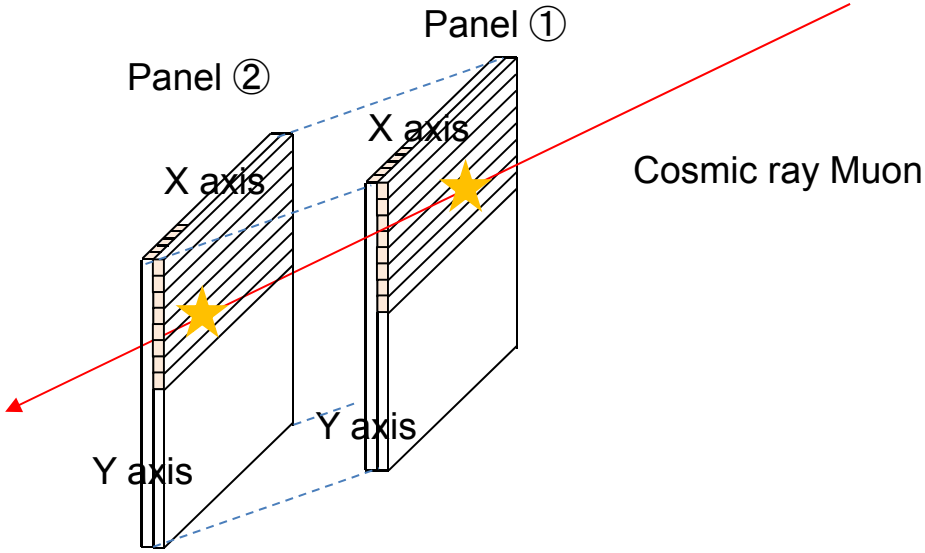
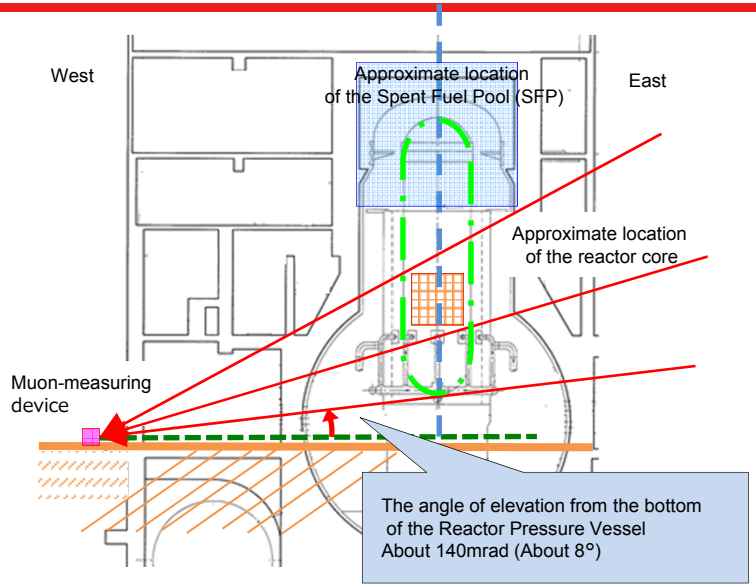
Measurement using the muon transmission method at Unit 2

- Under the measurement theory of muon transmission method, two panels in a muon-measuring device detects scattering cosmic ray muon. Movements of muon particles are then calculated from the coordinates (X and Y axis) of the panels where the particles have passed through.

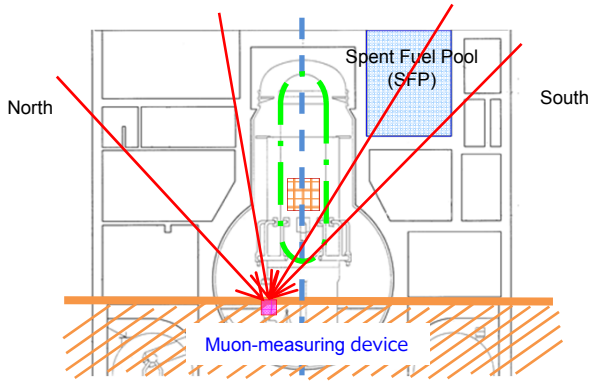


Measurement theory of muon transmission method（image）

- Reactor core and fuel debris at the bottom of the Nuclear Pressure Vessel will be photographed from the muon transmittance after measuring the number of muon particles that pass through the Unit 2 reactor building.



Measurement of muon particles that pass through the reactor building (image) (West-east cross section)



Measurement of muon particles that pass through the reactor building (image) (North-south cross section)

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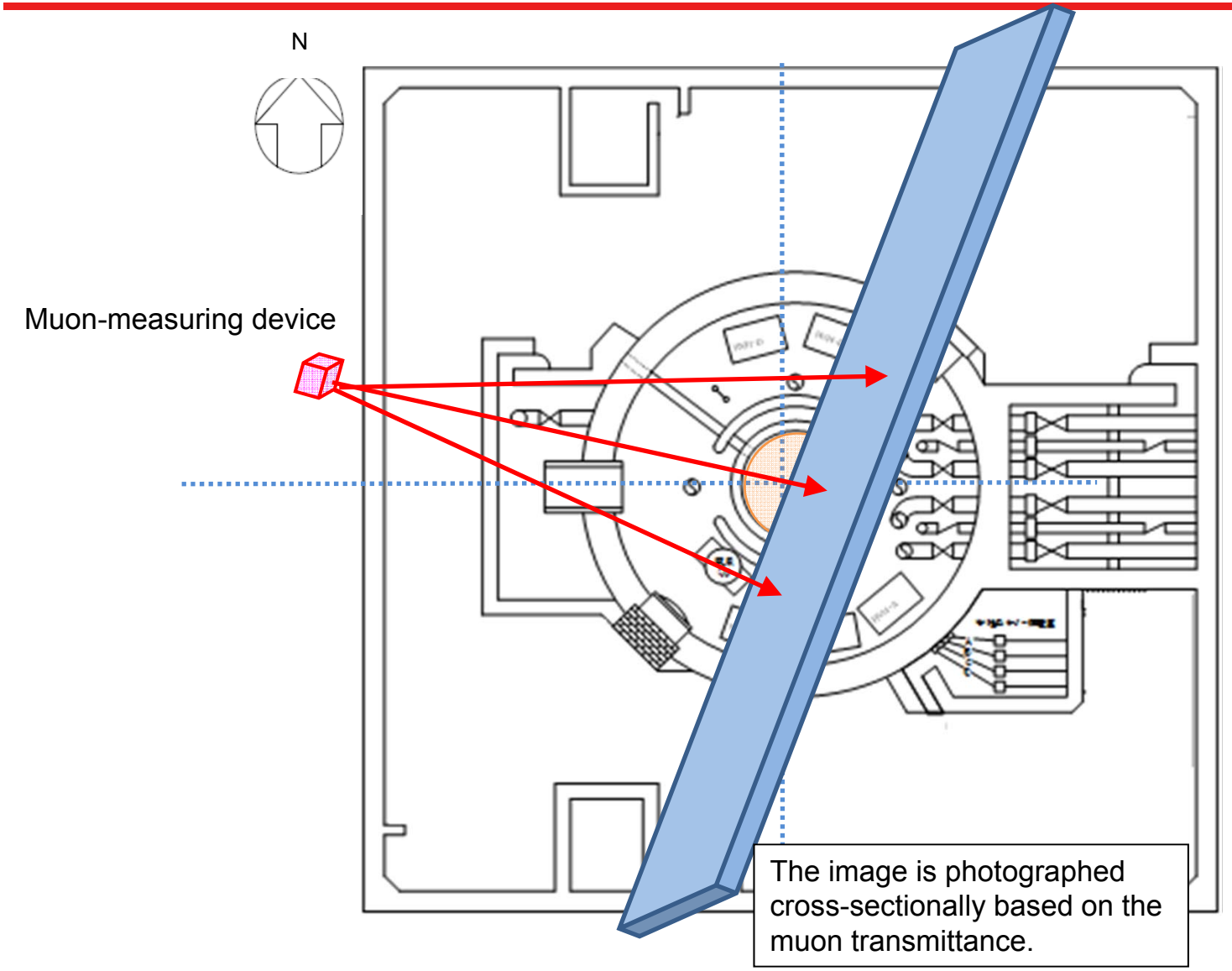
Measurable range of muon transmission method (image)



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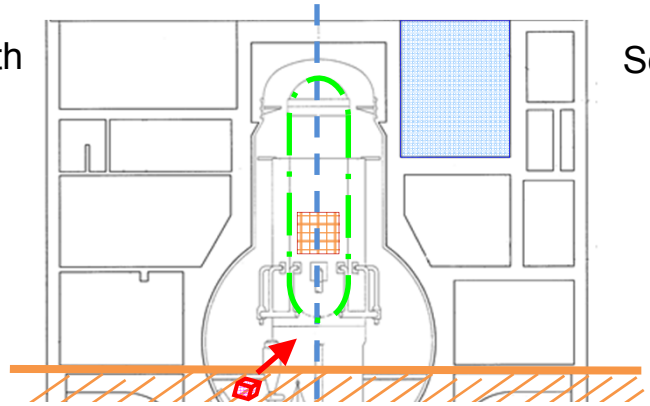
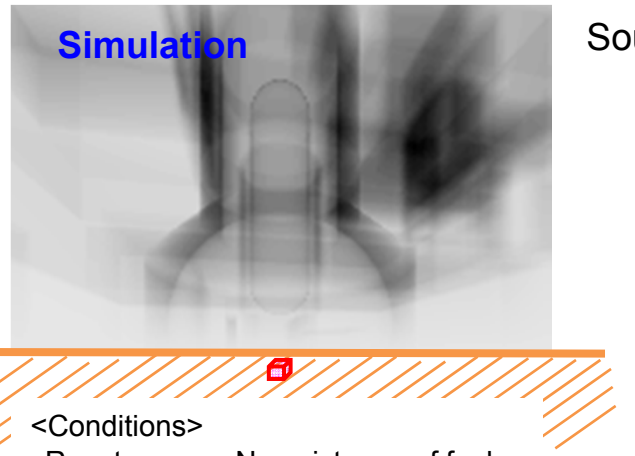
Measurement results based on muon transmission rates

North South



Based on the modelled walls and floors at the Unit 2 reactor building and main structures around the reactor, muon transmittance is simulated viewing the reactor building from where the muon-measuring device is installed.

North South

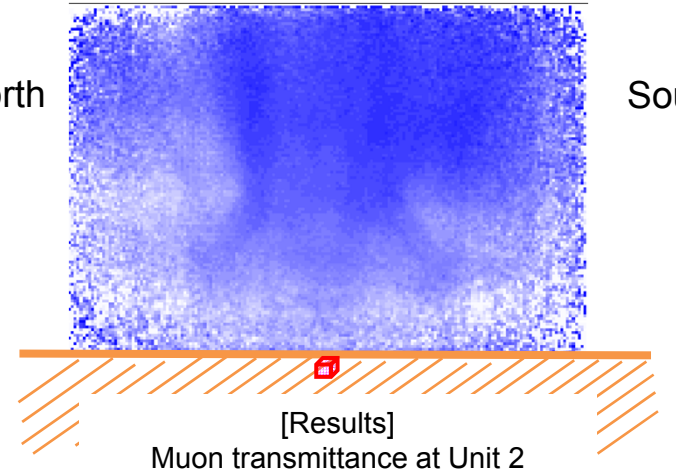


<Conditions>
・Reactor core: No existence of fuel
・Bottom of RPV: No existence of fuel
・Inside SFP: Filled with water

North South

<Conditions>
・Reactor core: Existence of fuel
・Bottom of RPV: Existence of fuel
・Inside SFP: Filled with water

North South



[Results]
Muon transmittance at Unit 2
(As of May 20, 2016)

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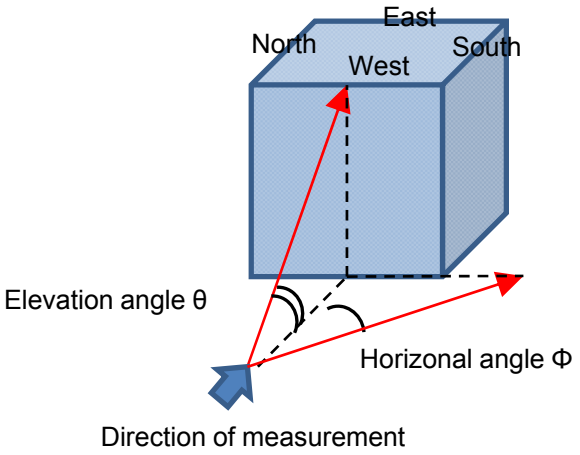
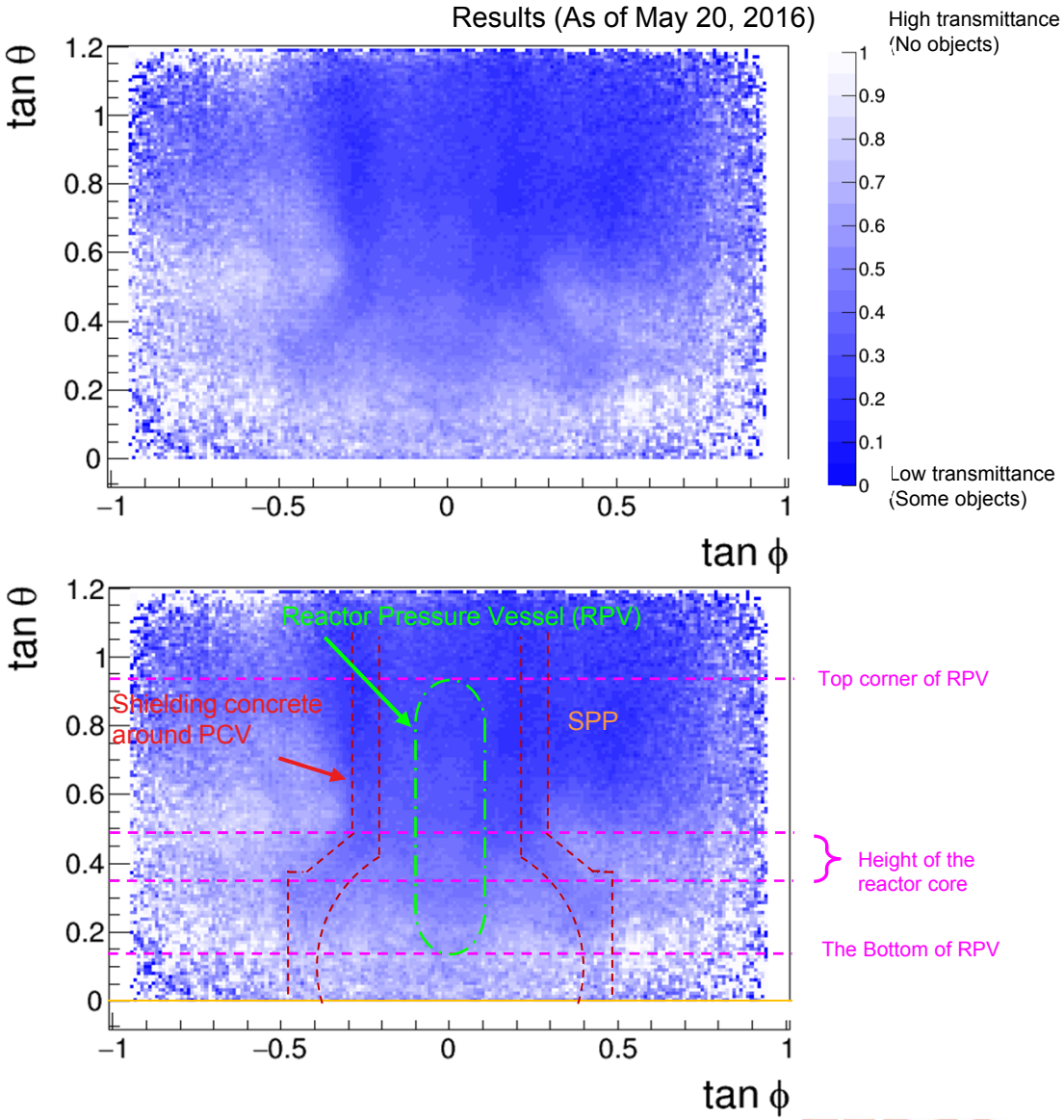
Evaluation of muon transmittance

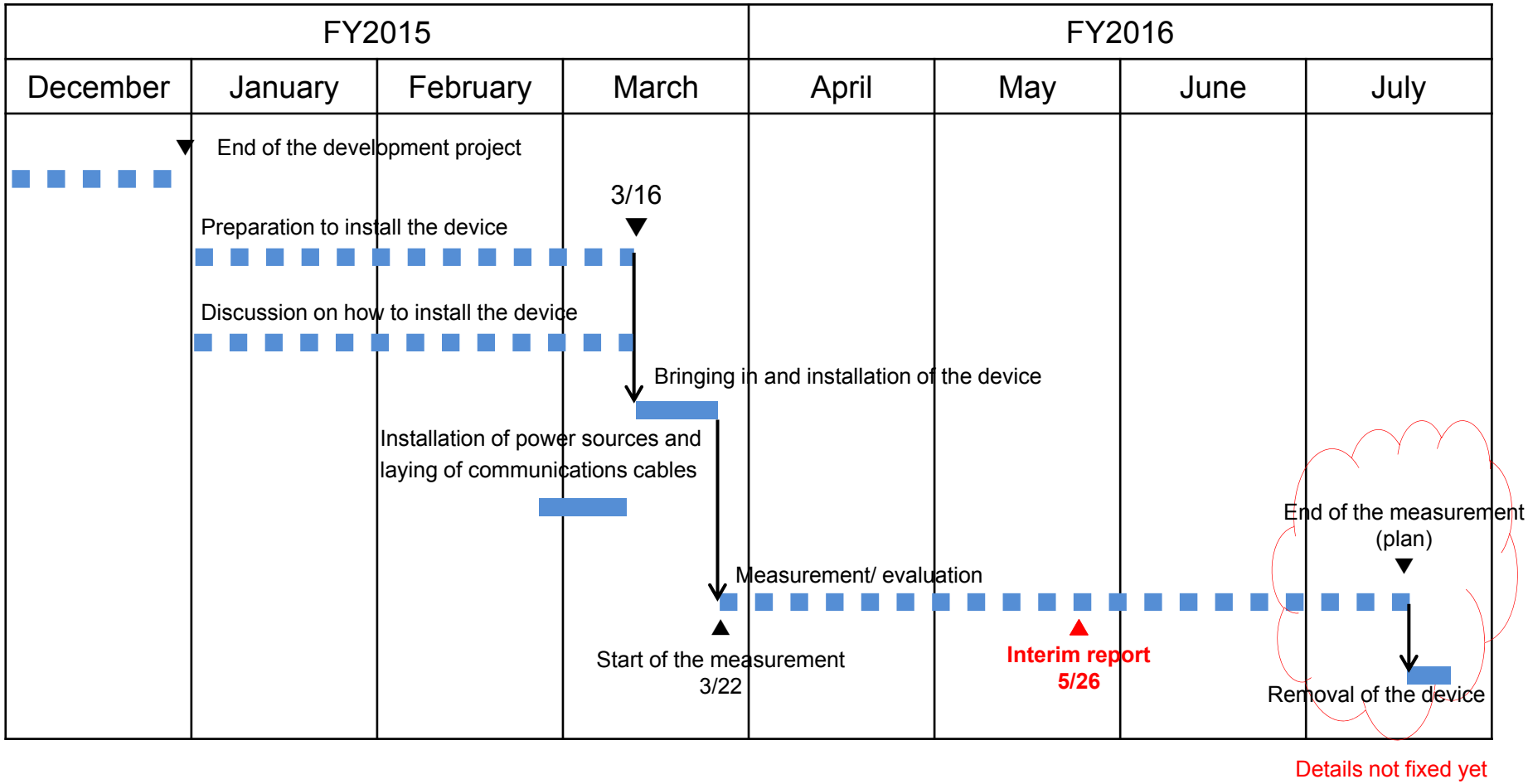


- Muon transmittance is evaluated based on the acquired measurement data.
  - High transmittance means there are no objects there.
  - Low transmittance means there are some objects there.（You can see shadows.）
- Shadows of structures such as shielding concrete around the Primary Containment Vessel (PCV) and the Spent Fuel Pool (SFP) have been photographed, which indicates that the data acquisition is proceeding smoothly.
- The data will be accumulated through continuous measurements, and continue to be organized and analyzed.



※ The two pictures are the same one picture.

Outline of schedule for the measurement



Summary

- As a result of Unit 2 muon measurements using the muon transmission method, shadows of main structures in the Primary Containment Vessel (PCV) have been photographed, which indicates that the data acquisition is proceeding smoothly.
  - The shadows show the shielding concrete around the PCV
  - The shadows show the location of the SFP
  - It has been confirmed that the bottom of the RPV is also in the measurement range.

- The data will be accumulated through continuous measurements. The accumulated data will continue to be organized and analyzed.

- The smooth progress of the measurements has again proved the effectiveness of the muon transmission method. Application of this technology to other Units will be considered.