Unit 1 Primary Containment Vessel Internal Investigation
～ Analysis of image data and dose data ～

July 27, 2017

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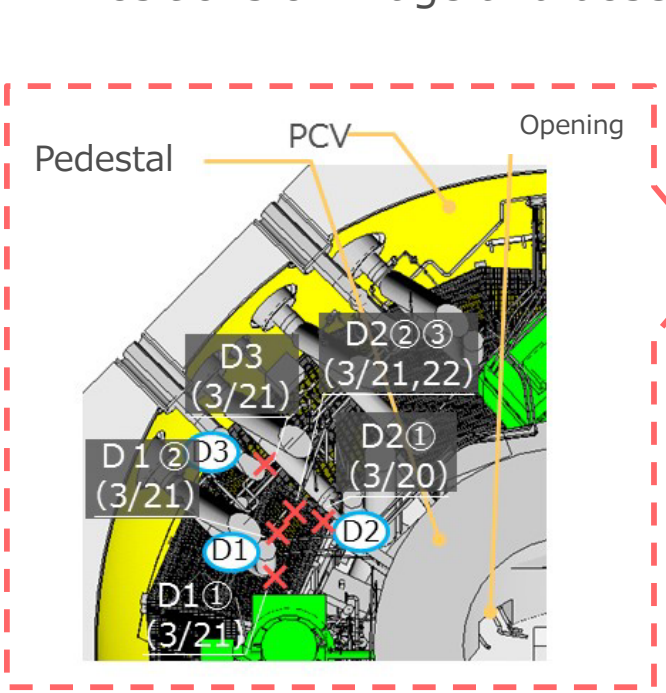
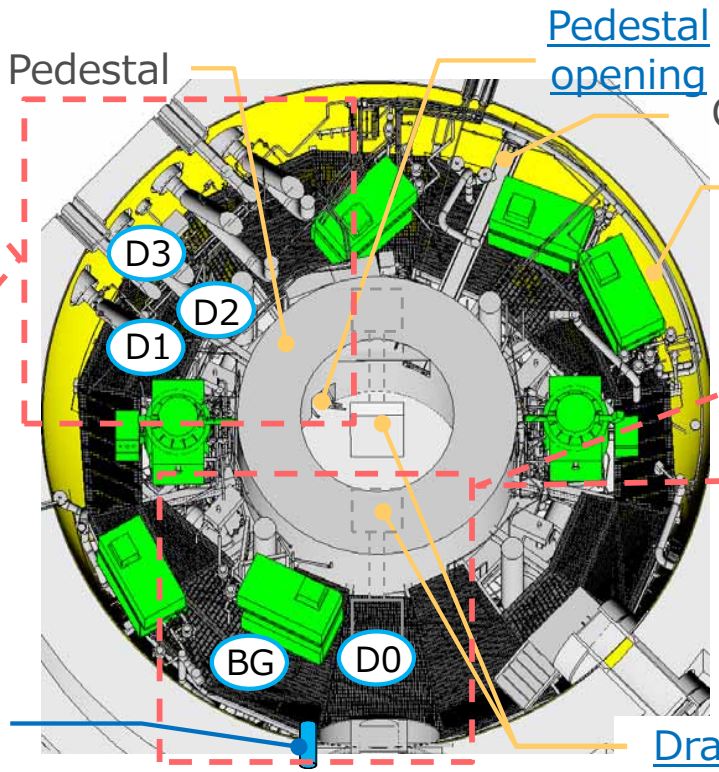
1．Outline of analysis

- We sharpened the images took in March, 2017 and re-analyzed, while examined the possibility of debris diffusion from the pedestal opening using dose data gathered in the investigation.
- Positions of image and dose data are as follows:

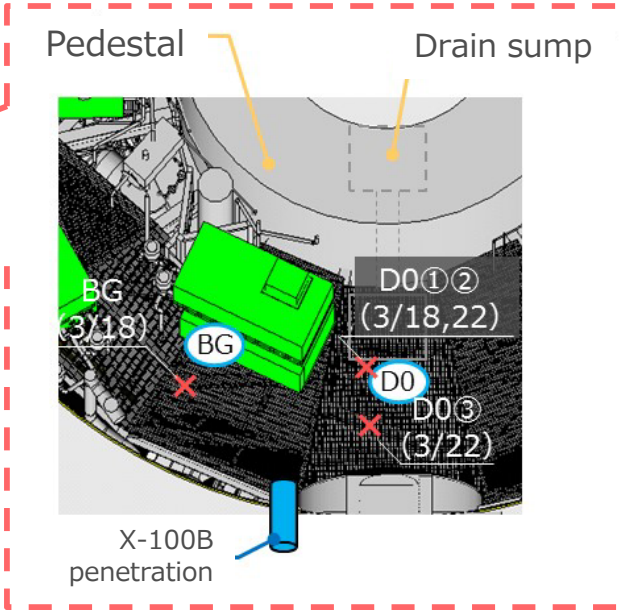


Extended figure

X-100B penetration



Cross section of 1st floor PCV



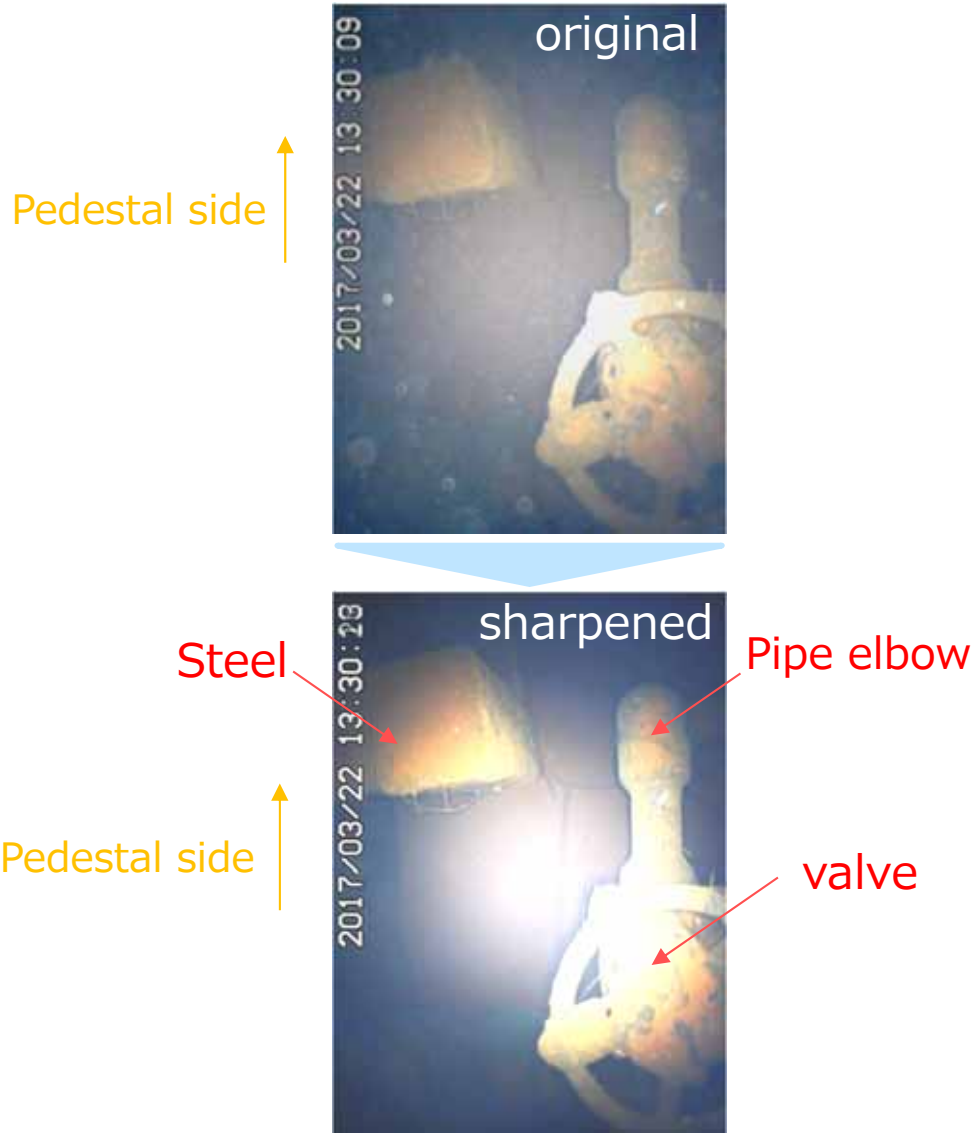
Extended figure

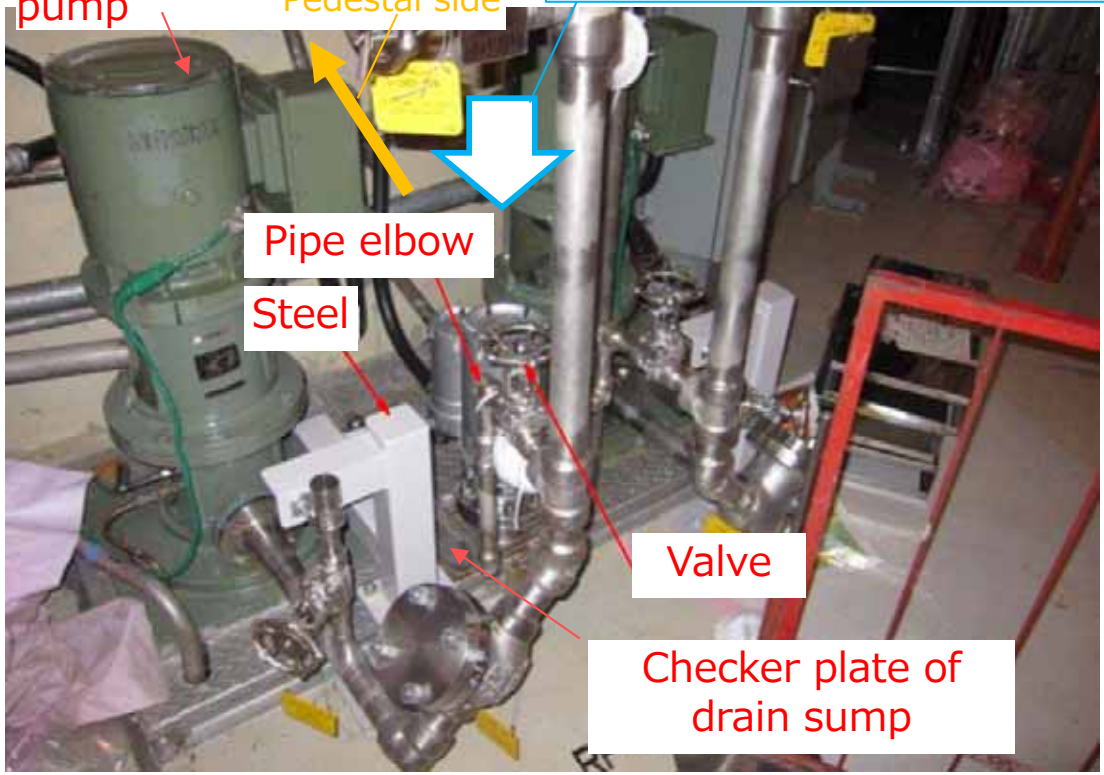
Legend : measurement date (MM/DD)

Measurement points	Purpose of measurement
D0①～③	Diffusion of fuel debris from the drain sump
BG	Background levels against D0～D3 measurement
D1①②, D2①～③	Diffusion of fuel debris from pedestal opening
D3	Possibility of fuel debris reaching to the PCV shell

2．Analysis result of image data（1/2）

- Image data of the measurement points were sharpened.
- Sharpened image of the point D0② shows no extensive deformity and damage of existing structures including valves, pipes and steels. The checker plate of drain sump was not found due to deposits.





Near point D0② before disaster

2．Analysis result of image data（2/2）

- Image data other than D0② were sharpened too.
- Fallen object was found at the point D2③. No new information at the points D0 and D1.

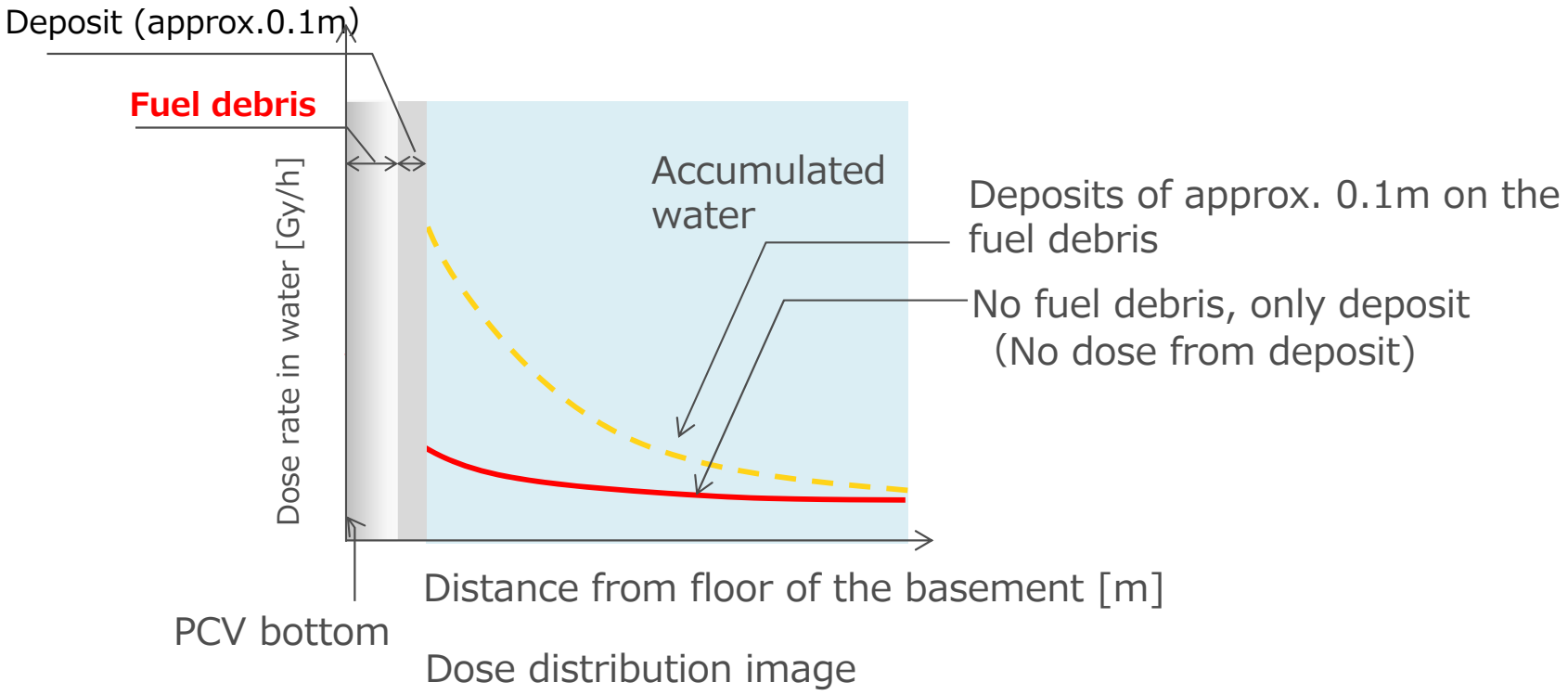
	Point D0③	Point D1②	Point D2③
Obtained images			
Sharpened images			

3．Analysis result of dose data
3.1 Estimation of possibility of fuel debris diffusion（1/2）

【Before investigation】

- In the case that fuel debris exist at the PCV bottom※ and there are deposits of less than 0.1 m (assuming concrete as deposit in analysis) on the debris, we found it possible to estimate the possibility of fuel debris under deposits.

※ It is assumed that fuel melted the structures in the reactor at the accident and fused with Co-60 in the structures.



Dose distribution image

3．Analysis result of dose data
3.1 Estimation of possibility of fuel debris diffusion（2/2）

- Possibility of fuel debris under deposits was estimated in the following steps:

Main dose source (nuclide) on the deposit surface at point BG where is less affected by fuel debris is determined.

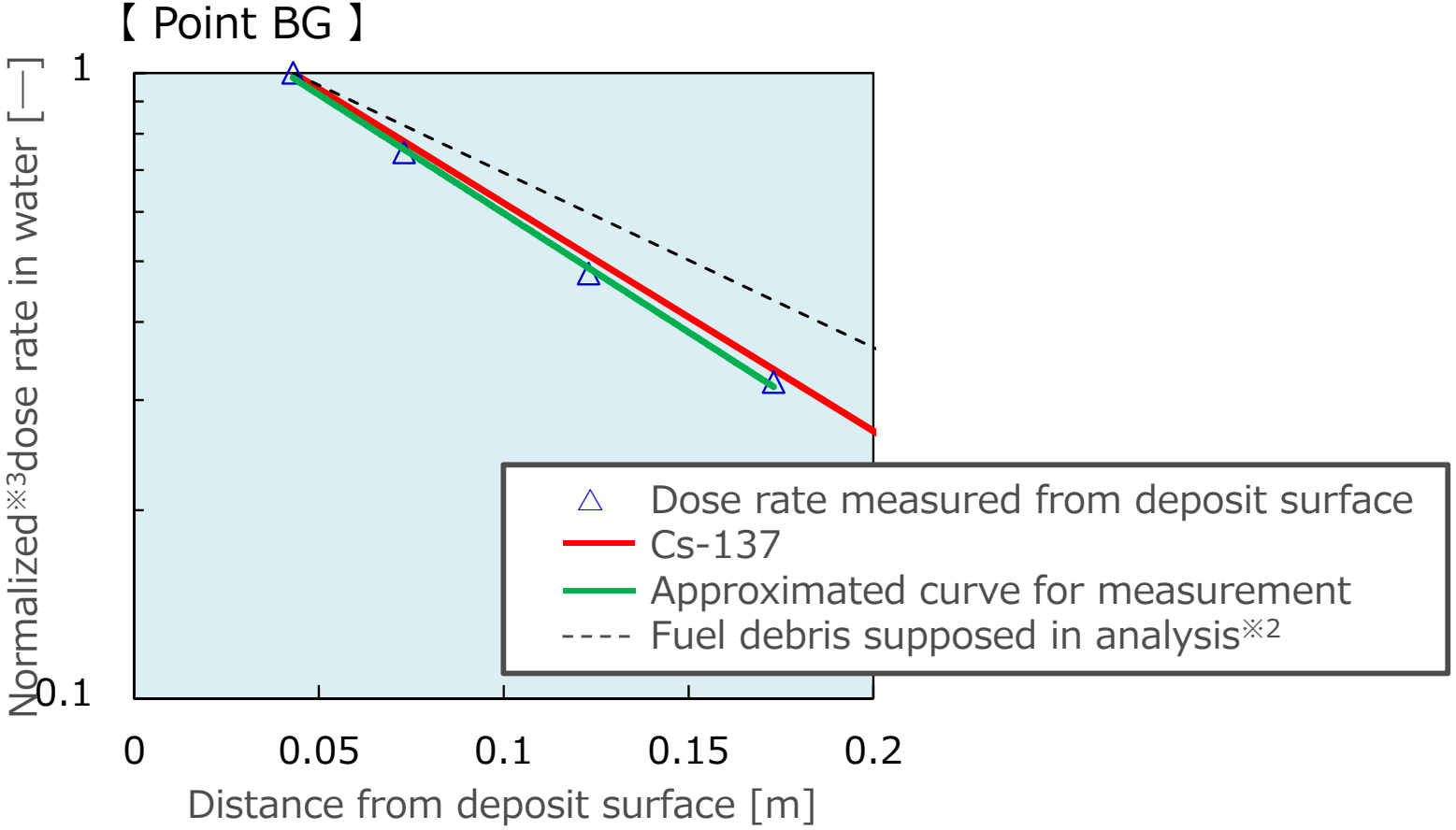
Possibility of fuel debris diffusion is estimated.

Analysis result at BG and D0③ where are considered to be less affected with fuel debris assuming there is no fuel debris and there is Cs-137 on the deposit surface as main source is to be compared with the measured dose data.

Analysis result at D1 and D2 where there are possibly fuel debris assuming there are main source and fuel debris on the deposit surface is to be compared with the measured dose data, and the possibility of fuel debris diffusion is to be estimated.

3. Analysis result of dose data
3.2 Analysis of dose distribution – BG: main source on the deposit surface

- As dose rate measured from the deposit surface※1 is almost equal to Cs-137 decay curve in decay rate by distance, main dose source (nuclide) is considered to be Cs-137.



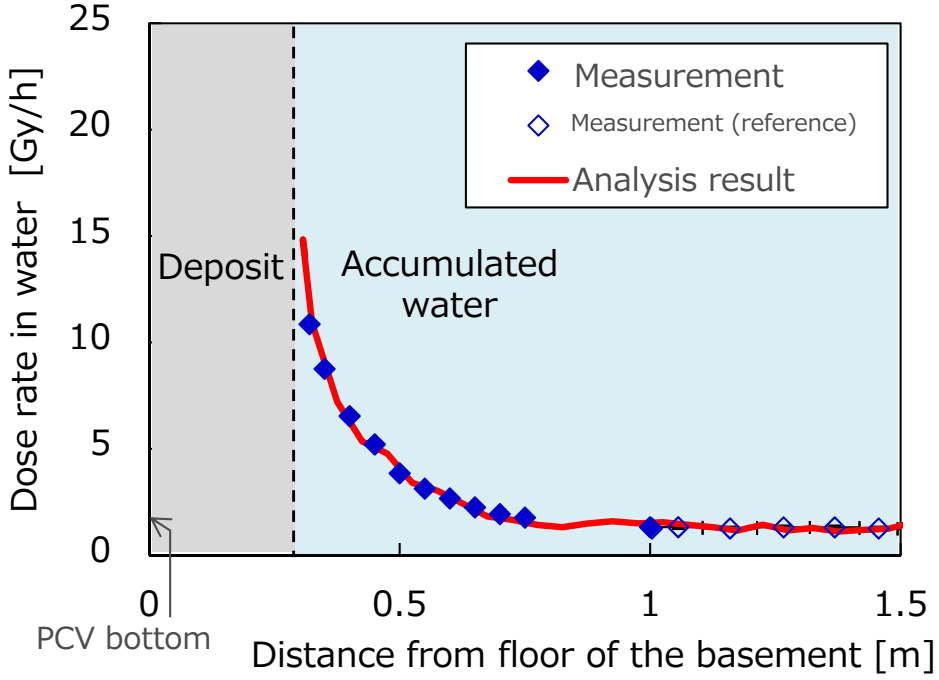
※1 : Impacts of accumulated water and structures are subtracted from the measurement.
※2 : It is assumed that fuel debris fused with Co-60 in the melted structures in the reactor at the accident.
※3 : Dose rate is normalized by treating dose rate nearest the deposit surface as “1”.

3. Analysis result of dose data

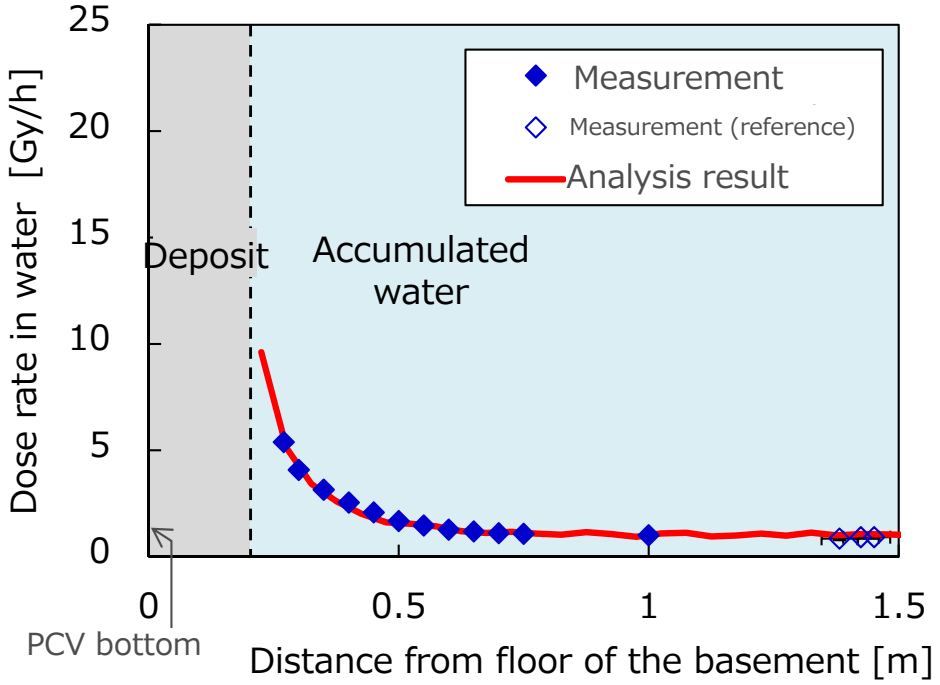
3.3 Analysis of dose distribution – Possibility of fuel debris in the deposits (1/2)

- We analyzed BG and D0③ assuming Cs-137 is main source on the deposit surface.
- It is assumed that there is no fuel debris at BG and D0③, because these points have thin deposits and enough distance from the pedestal opening.
- Analysis based on above assumption well-matches with measurement. Therefore, it is considered that there is no fuel debris under deposits at BG and D0③ or very little even if exist.

【 Point BG 】



【 Point D0③ 】

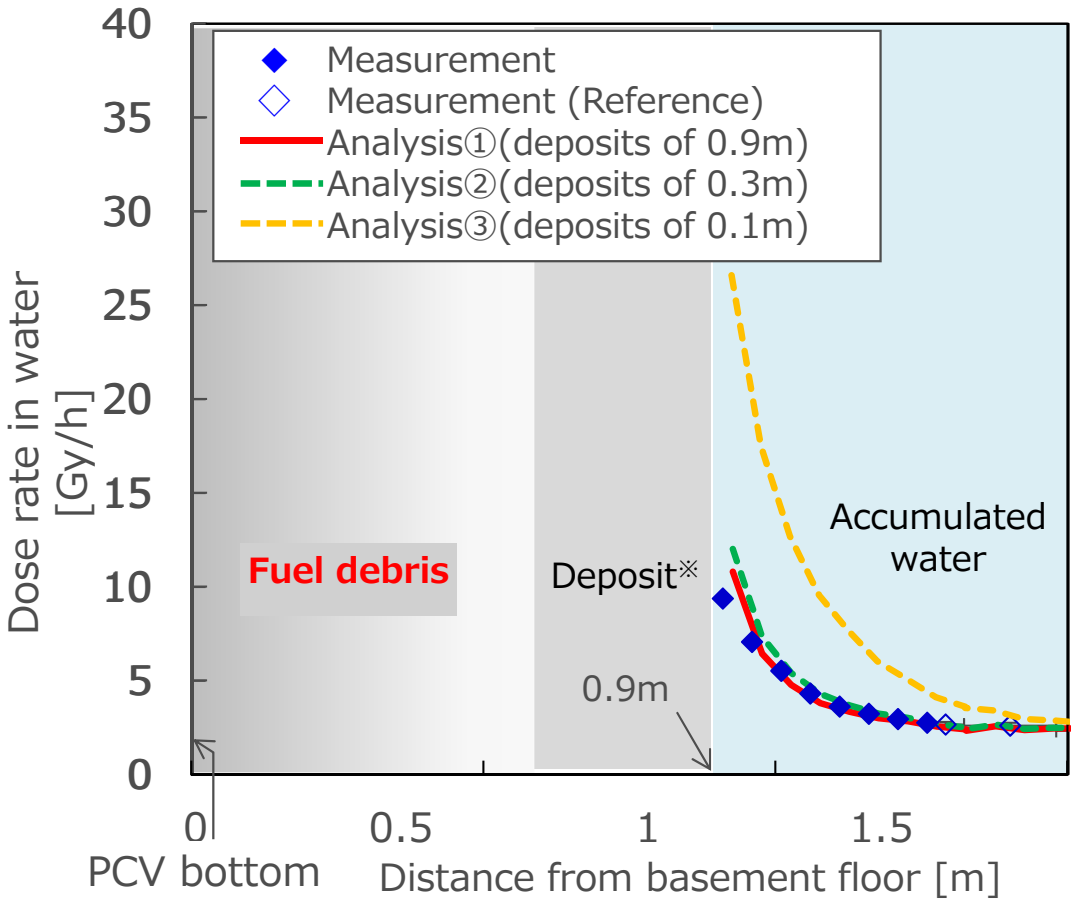


Note)
◆Measurement : Measured by halting censor
◇Measurement（Reference） : Measured by moving censor (average dose rate)

3. Analysis result of dose data

3.3 Analysis of dose distribution – Possibility of fuel debris in the deposits (2/2)

- We have analyzed dose rate in the case of fuel debris exist under deposits of about 0.9m height, in range of deposit height measured at D1 and D2.
- Analysis result for point D2③ near pedestal opening is as the figure bellow.
- Existence of fuel debris cannot be examined in the case of thick deposits due to their shield.
- The cause examination cannot be done is considered to be that there is no fuel debris, or that thick deposits and structures have profound shield effect. As the deposit thickness is currently unknown, we cannot determine it.



※ The structures might exist under the deposits.

D2③ Analysis condition
(Height of deposits is 0.9m)
① Deposit thickness : 0.9m
② Deposit thickness : 0.3m
③ Deposit thickness : 0.1m

Note)
◆Measurement : Measured by halting censor
◇Measurement (Reference) : Measured by moving censor (average dose rate)

4. Conclusion

<Analysis result of image data>

- Analysis of image data at the point D0 near the drain sump shows no extensive damage and collapse of visible structures (steel, valve) near the drain sump (X-100B side).

<Analysis result of dose data>

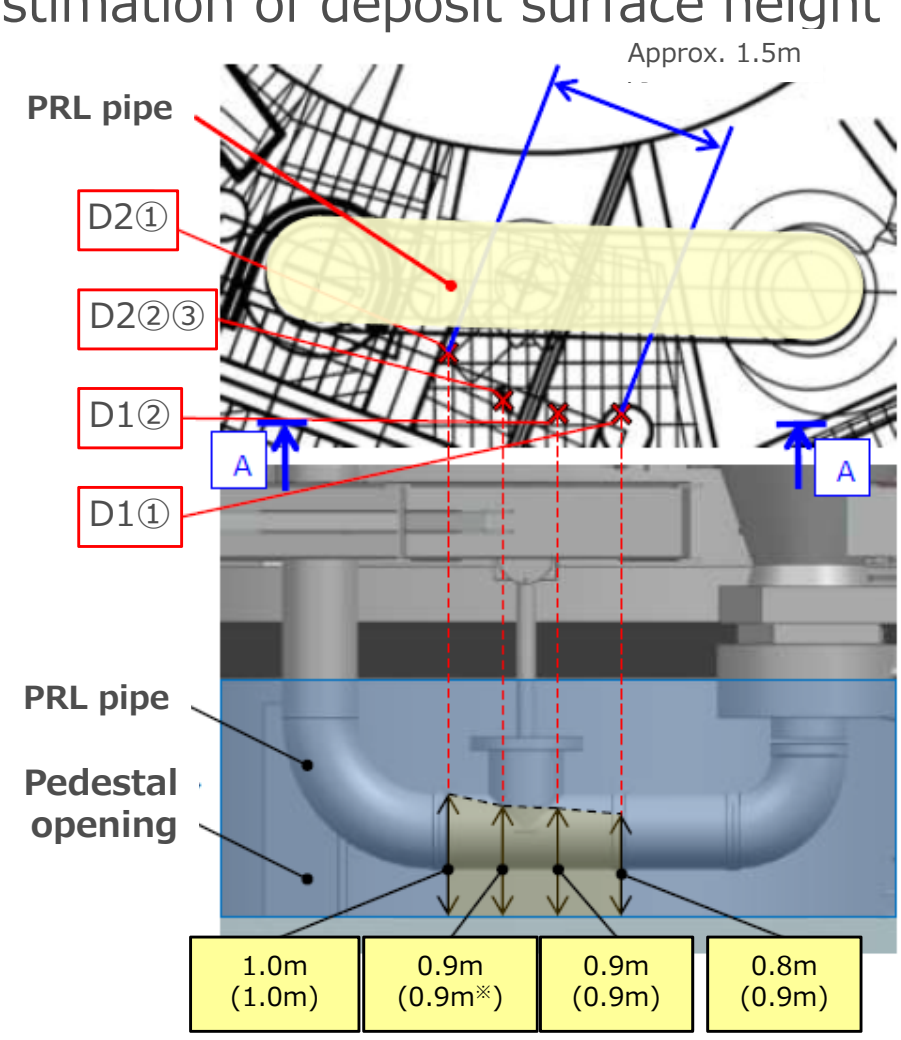
- Main source on the deposit surface is considered to be Cs-137 from analysis.
- As analysis result at the point BG and D0③ assuming that deposit thickness is thin and there is Cs-137 on the deposit surface is almost equal to measured dose rate, it is considered that there is no fuel debris or very little even if exist.
- Analysis of dose rate at the point D1 and D2 near the pedestal open did not lead any meaningful result about the possibility of fuel debris in the deposits due to high location of deposit surface.

<Future policy>

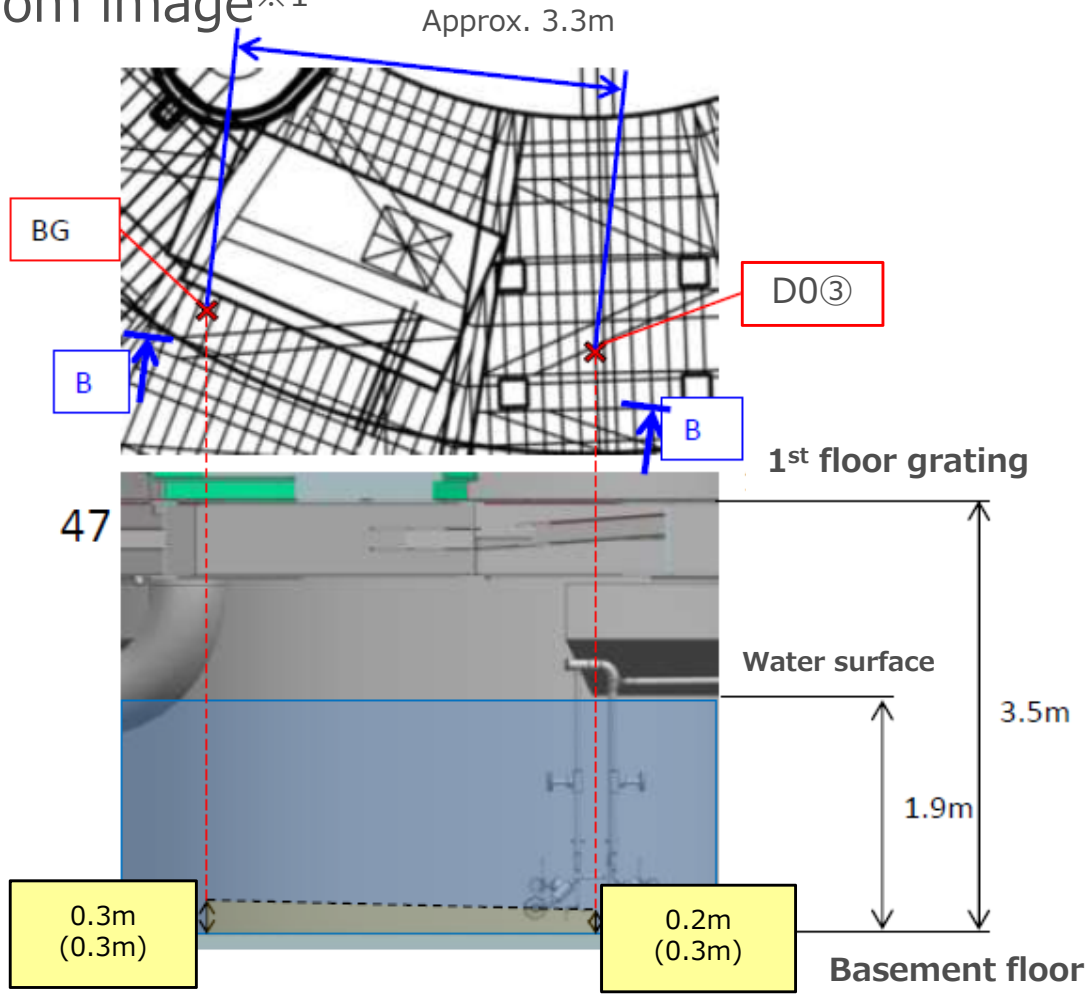
- We will discuss the range and the method of the next investigation considering this analysis result and the characteristics of deposits collected just bellow X-100 penetration.

Reference: Analysis of image data
Estimation of deposit surface height

■ Estimation of deposit surface height from image※1



A-A cross section



B-B cross section

※ **Height measured by closing censor**

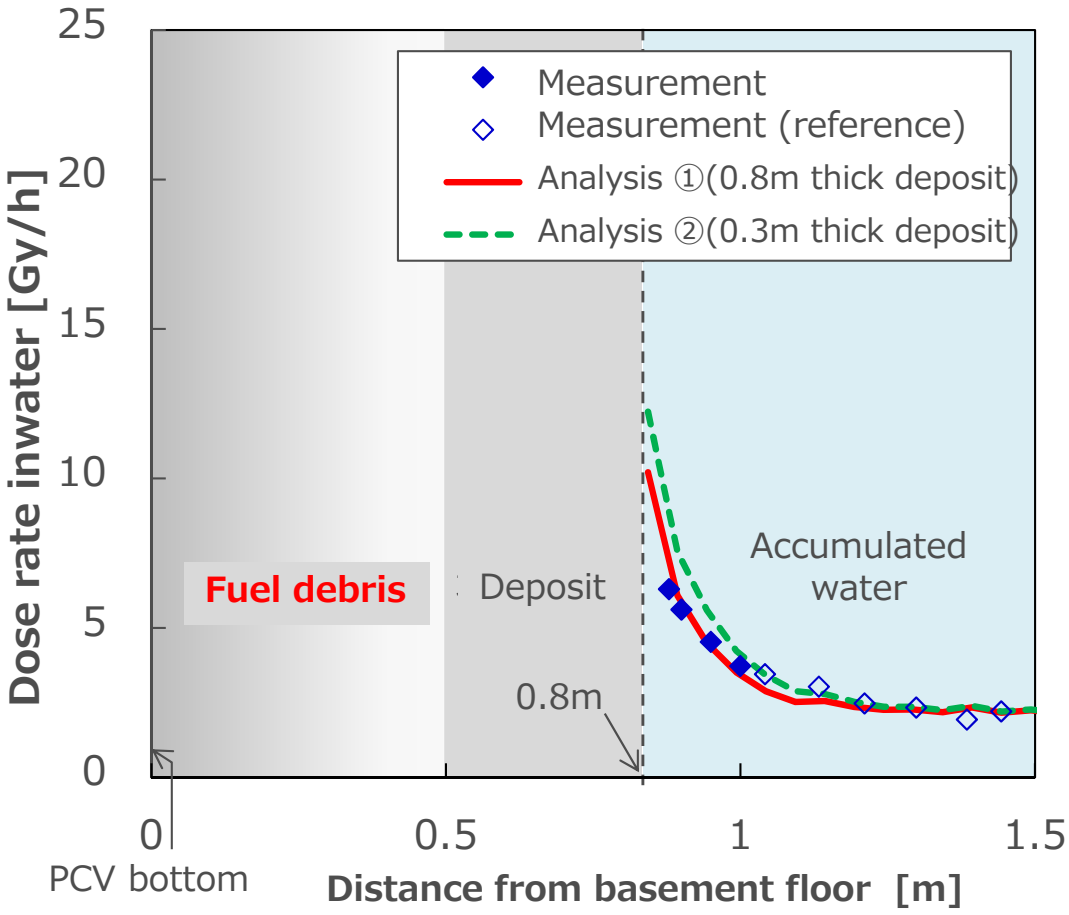
※1 Height of the deposit surface is calculated from the distance between censor and deposit surface obtained by SFM(Structure from Motion) and the dropping length of censor.

- Value in yellow box is estimated height of deposit surface calculated from image analysis.
- Value in () is lowest height of hanged censor.
- Deposit thickness bellow the deposit surface is unknown.

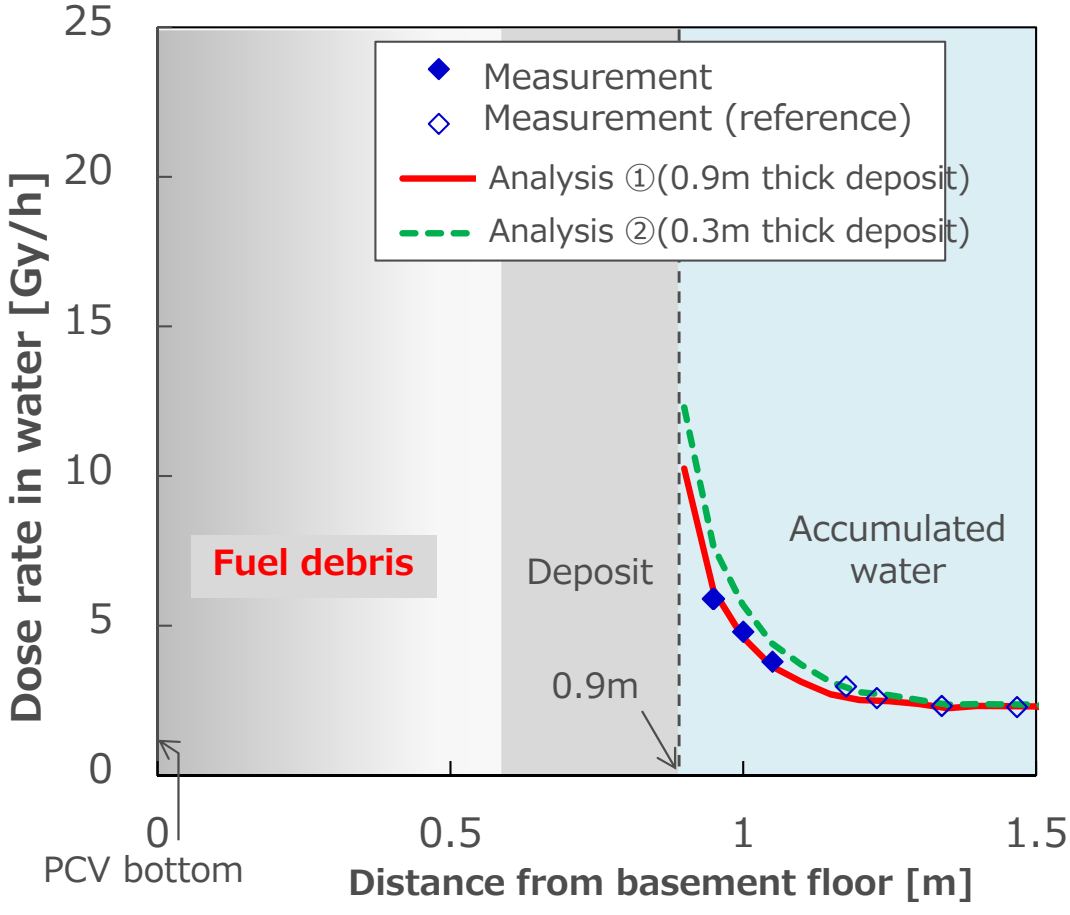
Reference: Analysis of dose data
Dose distribution analysis – possibility of fuel debris in deposit

■ Analysis for various thickness of fuel debris and deposits were carried out.

■ Point D1①
Analysis condition (Deposit height is 0.8m)
① Deposit thickness : 0.8m
② Deposit thickness : 0.3m



■ Point D1②
Analysis condition (Deposit height is 0.9m)
① Deposit thickness : 0.9m
② Deposit thickness : 0.3m

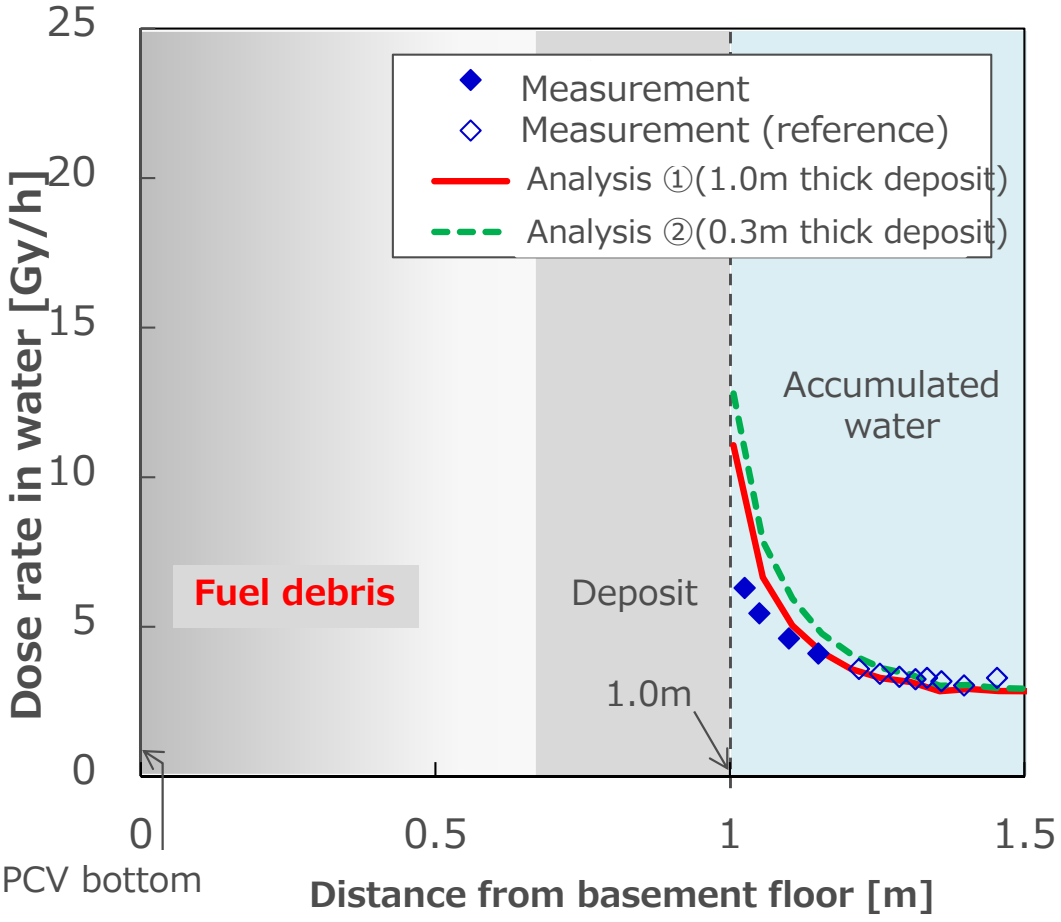


Note)
◆Measurement : Measured by halting censor
◇Measurement (Reference) : Measured by moving censor (average dose rate)

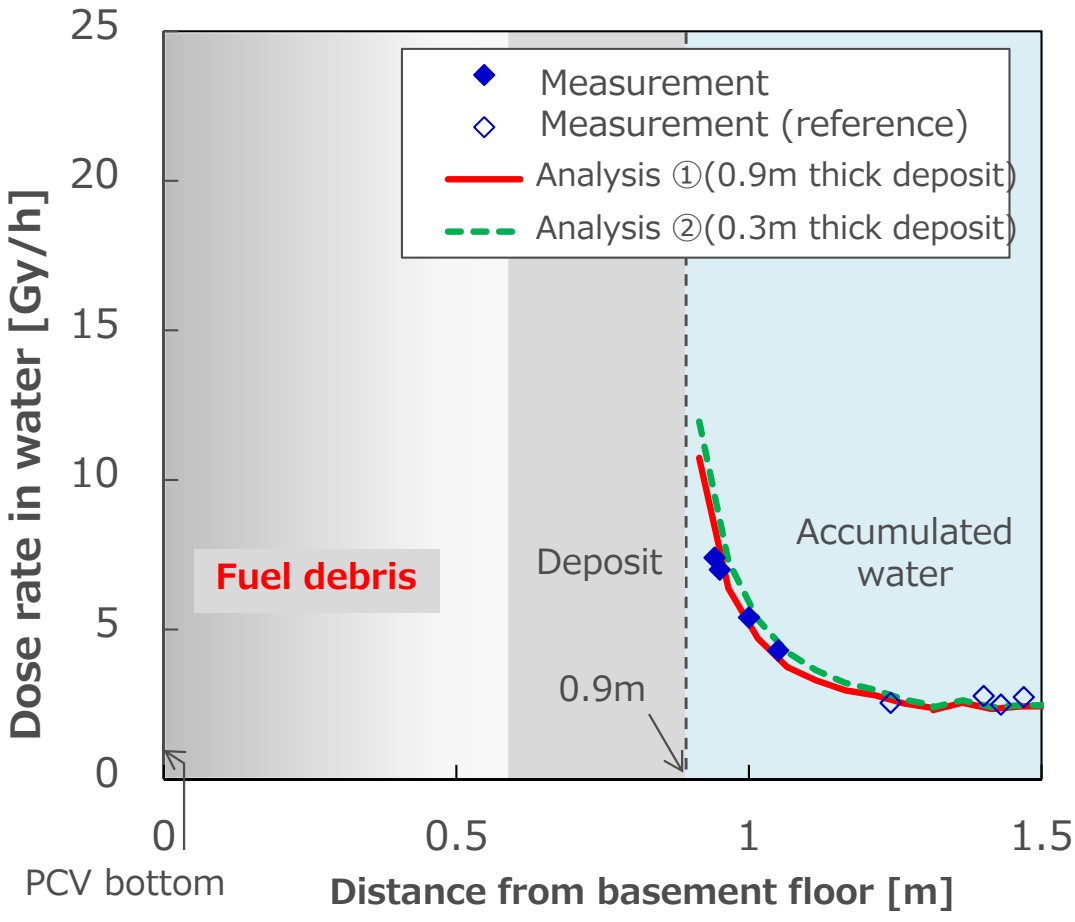
Reference: Analysis of dose data
Dose distribution analysis – possibility of fuel debris in deposit

■ Analysis for various thickness of fuel debris and deposits were carried out.

■ Point D2①
Analysis condition (deposit height is 1.0m)
① Deposit thickness : 1.0m
② Deposit thickness : 0.3m



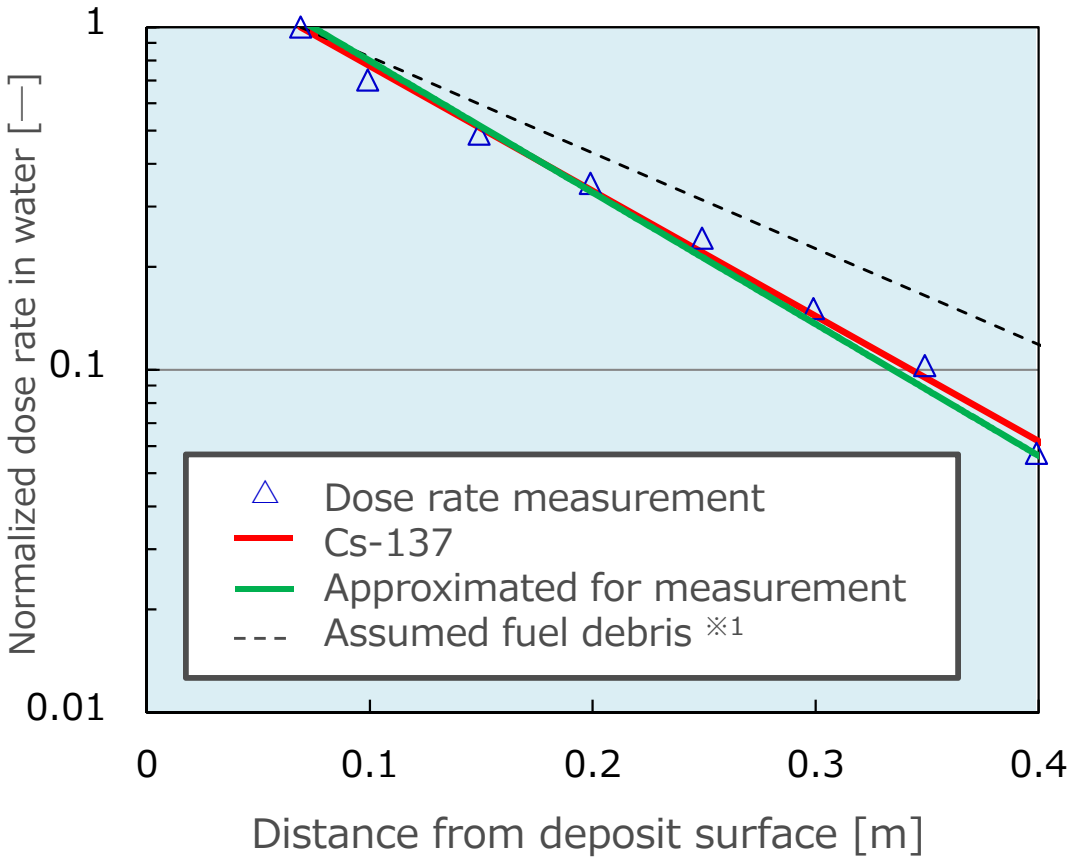
■ Point D2②
Analysis condition (deposit height is 0.9m)
① Deposit thickness : 0.9m
② Deposit thickness : 0.3m



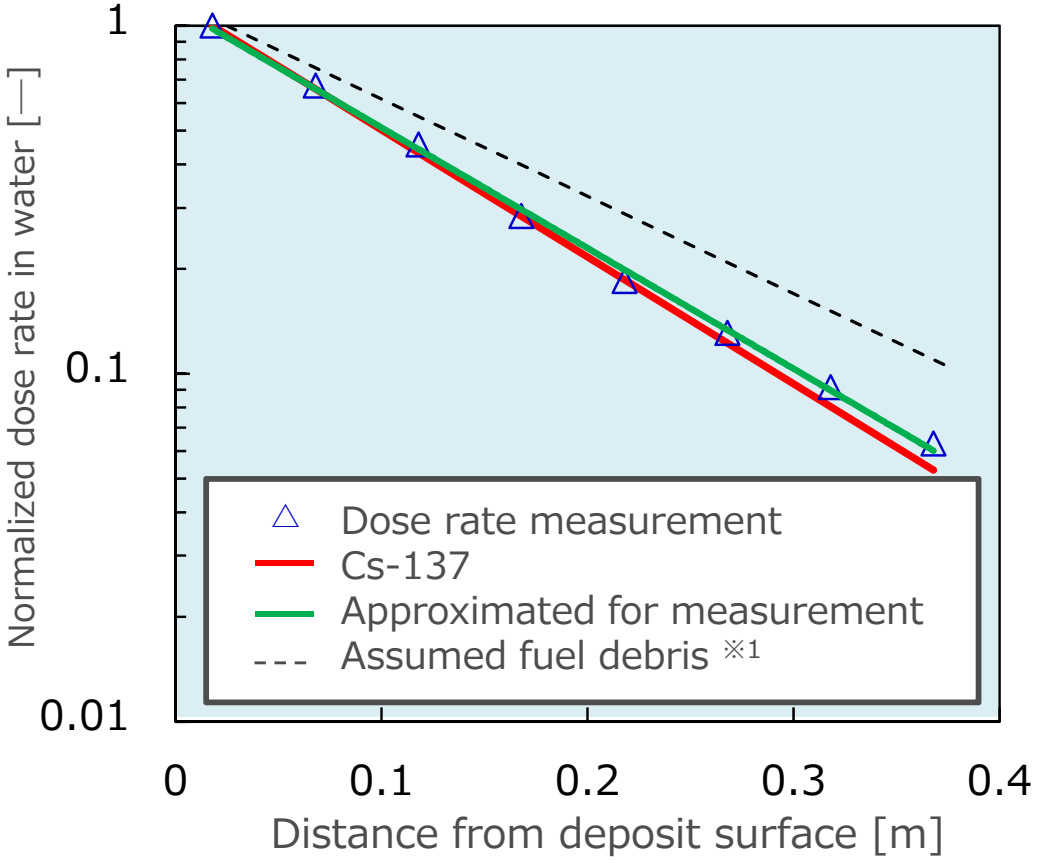
Note)
◆Measurement : Measured by halting censor
◇Measurement (Reference) : Measured by moving censor (average dose rate)

Reference: Analysis of dose data
Main source on the deposit surface－D0③,D2③

【 Point D0③ 】



【 Point D2③ 】



※1 It is assumed that fuel melted the structures in the reactor at the accident and fused with Co-60 in the structures.