Sharp increase of CAMS readings on March 15th at Unit-2

1. Introduction

The Unit-2 CAMS was restored at about 12:00 on March 14th, and the gamma dose became measurable again in the containment vessel (D/W and S/C). The Unit-2 accident progression is estimated as: the reactor was successfully depressurized at about 18:00 on March 14th; and the core damage and melting started after fire engines started injecting water into the reactor. As a result, the serious progression of the accident could be monitored by the CAMS at Unit-2. This was impossible at Unit-1 and Unit-3. In particular, the CAMS read a record high of 138Sv/h. But it has not been clarified what situation in the containment vessel caused this sharp dose increase (Unit-2/Issue-12).

This Attachment examined changes of the CAMS readings at Unit-2.

2. Observed CAMS readings

Figure 1 shows the observed CAMS readings, plotted in a logarithmic scale from 12:00 on March 14th to 00:00 on March 16th. The following are the interpretations of features in each time period.

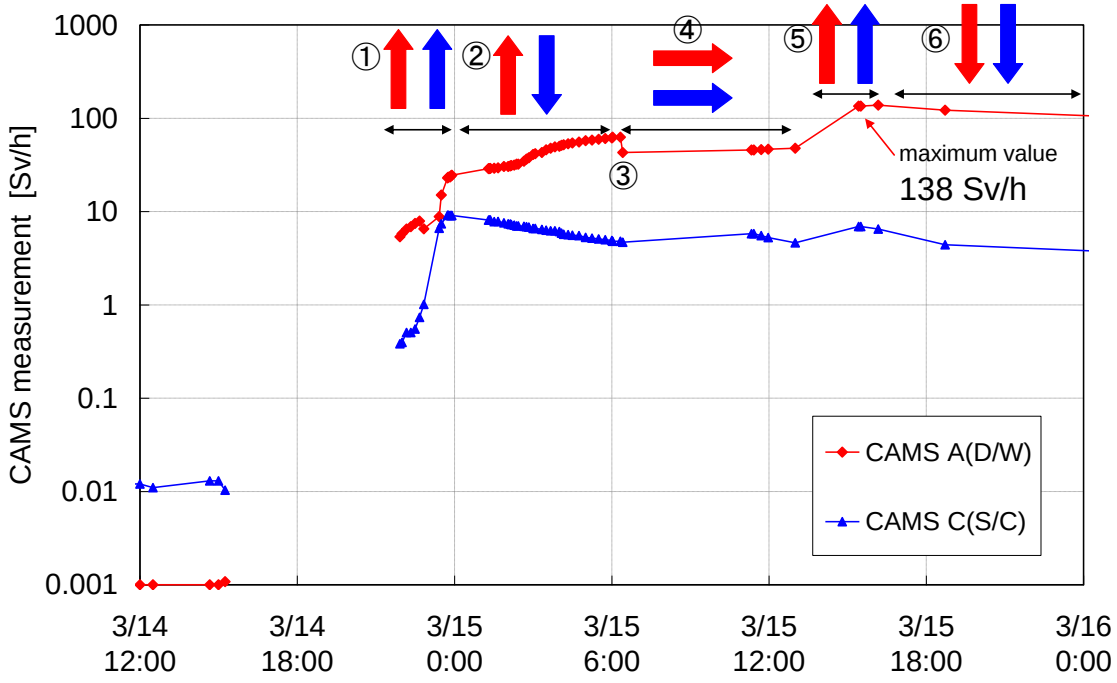

Figure 1 Observed CAMS readings at Unit-2

2.1. From 12:00 to 18:00 on March 14th

The CAMS readings at about 12:00 on March 14th, when the CAMS restoration was completed, were very low both in the D/W and S/C, showing that the fuel integrity had been maintained. The measurement was halted for a while thereafter.

2.2. From 21:55 on March 14th to 00:00 on March 15th (① in Figure 1)

The measurement was resumed at 21:55 on March 14th and readings in both the D/W and S/C increased almost monotonically over this time period ①.

2.3. From 00:00 to 06:00 on March 15th (② in Figure 1)

After midnight, the dose in the D/W continued to increase, while the dose in the S/C tended to decrease.

2.4. From 06:00 to 13:00 on March 15th (③④ in Figure 1)

The dose in the D/W dropped sharply from 62.7Sv/h to 43.0Sv/h in a limited time from 06:20 to 06:25. Thereafter no big changes were observed in the D/W and S/C.

2.5. From 13:00 to 16:10 on March 15th (⑤ in Figure 1)

The dose in the D/W increased sharply, reaching 135Sv/h at 15:25 and 138Sv/h (maximum) at 16:10. Since the measurement was interrupted from 13:00, when 47.7Sv/h was observed, to 15:25, it is not clear exactly when this sharp increase occurred. But it is clear that this sharp increase occurred in a limited time.

2.6. From 16:10 on March 15th to 00:00 on March 16th (⑥ in Figure 1)

The dose observed decreased monotonously after it had shown the maximum. Figure 2 shows the CAMS readings, including those after 00:00 on March 16th. The dose decreased monotonously over an 8-month period after it had the maximum on March 15th.

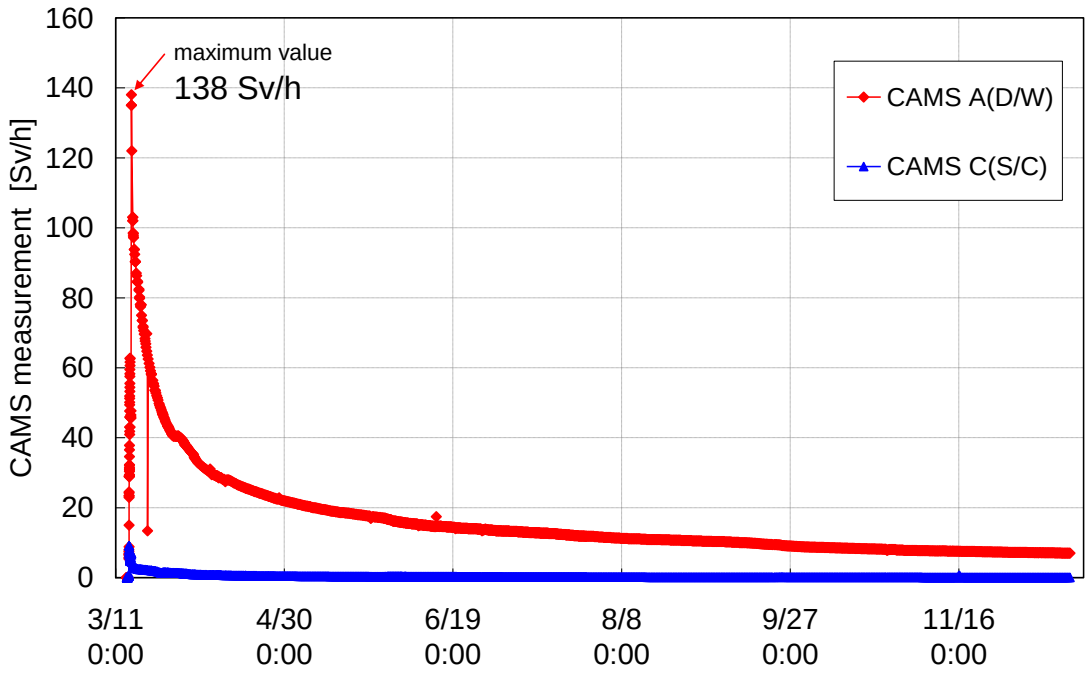

Figure 2 CAMS readings from March to November 2011

3. Deliberations on the dose observed

From the data above in Section 2, the following items are to be noted.

Time period ①:

At Unit-2 the core damage is estimated to have started after the water injection by fire engines had started at 19:54 on March 14th. The dose increasing trend over this time period is therefore consistent with the estimated accident progression. Meanwhile, both the D/W dose and S/C dose increased. It can be understood that this shows the fission products (FPs) in the reactor were being transferred to the S/C via the SRVs and further to the D/W via the vacuum breakers.

Time period ②:

This time period is considered to have been when the core damage and melting were in progress. Therefore, the continued dose increase in the D/W is consistent with the accident progression scenario. But the S/C dose did not increase. This may indicate a possibility that the FP transfer to the S/C via SRVs ceased and the FP transfer directly to the D/W from the RPV started due to gaseous leaks from the RPV. Further examination is needed, since this may be relevant to Unit-2/Issue-11 “Leaks in gaseous phase from the Unit-2 PCV”

Time period ③:

This time period corresponds to approximately the time of the explosion at Unit-4 (06:14 on March 15th). On the other hand, steam leaks from a Unit-2 blowout panel were confirmed in the morning of March 15th. The dose decrease in this time period may have some relevance to such events, but the reasons remain unknown.

Time period ④:

This time period corresponds to the time when the number of plant workers at the Fukushima Daiichi NPS was at quite a low level. Although the measured data are limited, it may be possible that the reactor was fairly stable, because no big changes are seen in the data.

Time period ⑤:

The data do not show how soon this dose increase occurred, but certainly the dose increased fairly rapidly. It is likely that this dose increase was caused by some situation changes. Although quantitative evaluation is incomplete, at Unit-2 it is estimated that the RPV was eventually damaged and part of the fuel debris fell down to the containment vessel. It might be in this time period that the dose increase occurred if the RPV was really damaged.

Time period ⑥:

The dose decreased monotonously over a long time after the maximum dose had been recorded. It can be estimated therefore that, as far as Unit-2 is concerned, no such situation changes took place after the evening of March 15th to cause the additional release of radioactive materials such as fuel reheating, fuel melting, fuel debris movement, etc.

4. Summary

The dose data observed by CAMS at Unit-2 were reviewed and the accident progression scenario was examined. Following possibilities were identified for Unit-2.

- The reactor vessel might have lost its integrity even before its lower head was damaged and direct gaseous phase leaks from the RPV to D/W could have occurred.
- The RPV lower head is estimated to have been damaged, letting fuel debris fall down to the containment vessel. It is possible that this RPV lower head damage occurred in the afternoon of March 15th and a large amount of FPs was released to the containment vessel.
- No situation changes such as reheating, re-melting or fuel debris movement, etc. took place after the evening of March 15th.