Updating control units around the AVF cyclotron

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We report on the update of the control units around the AVF cyclotron to reduce the difficulties caused by radiation and implement a new beam interlock system under construction (hereafter, AVF-BIS). The beam diagnostic equipment like a beam profile monitor or a Faraday cup on the AVF cyclotron and its beam transport line has been controlled by DIM[1)] since 1989, and the equipment on the beam transport line around RILAC2 has been controlled by N-DIM[2)] since 2012. They were installed in 19-inch racks (hereafter, rack) at two place: the floor on which the AVF cyclotron is placed (hereafter, AVF floor) and the floor that is one level below (hereafter, AVF-M2 floor). Recently, as the performance of the AVF cyclotron has been improved and the beam intensity accelerated by the AVF cyclotron has been increased, there have been frequent issues such as the control unit becoming unresponsive toward the remote control suddenly. In the most frequent case, it occurred three times in 4 h while accelerating a 12 MeV/nucleon deuteron beam with an intensity of 4 pμA at the C03 target. Because this frequently occurs during accelerating a deuteron in the AVF cyclotron, we speculate that the cause of the trouble is the influence of radiation, especially the neutrons coming out from the AVF cyclotron and its beam transport line during beam transport. Therefore, we measured the dose of neutron around the installation location of the control unit using the TL badge. Figure 1 shows the measurement locations and results of the two measurements. At the AVF-M2 floor, several racks are placed along the south wall for the control unit. Among them, the control unit where this issue frequently occurs is located at No. 1 in Fig. 1. The results clearly show that the neutron dose at this point is higher than other places. This might be occurring because No. 1 is close to the open hole under the AVF cyclotron (No. 9). However, it has not been specified yet. As the best measure at present, we moved the control unit to a place where the neutron dose was low based on the results.

Simultaneously, we updated the control unit from old DIM to N-DIM. This update was made because the DIM in use was old and the DIM-based existing beam interlock system for the AVF cyclotron needed to be renewed along with its low-energy experimental facility to AVF-BIS.[3)] AVF-BIS stops a beam by outputting signals to a beam chopper and Faraday cup for various interlock signal inputs. In this system, the Faraday cup needs to be controlled by N-DIM.

The updating work was conducted during the summer maintenance period in 2018 as follows:

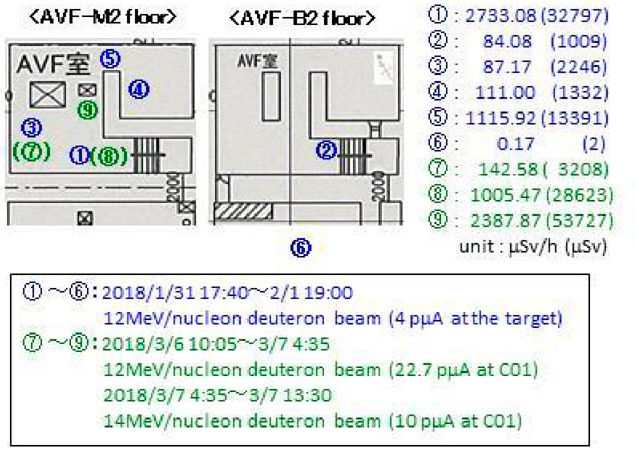

Fig. 1. Neutron dose measurement. The AVF-B2 floor is one floor below the AVF-M2 floor. The data written on the right side shows the average dose (integrated dose).

(1) To move one of the racks from No. 1 to No. 3 with the N-DIM inside.
(2) To move some N-DIMs mounted on the rack next to the rack to be relocated to the gap between the existing racks near No. 3.
(3) To set up some new N-DIMs on the existing racks near No. 3. Remove the signal and control cable from the DIM at No. 3 and AVF floor, and reconnect them to the newly set up N-DIMs.

Consequently, we moved and set up 28 N-DIMs in total. Currently, they control the beam diagnostic equipment on the beam transport line around RILAC2, and the beam diagnostic equipment and vacuum system on the beam transport line downstream of AVF cyclotron. This indicates that approximately 60% of the DIMs under operation at the AVF and AVF-M2 floors have been updated. Because DIM still controls the various equipment attached to the AVF cyclotron and the beam diagnostic equipment of the beam transport line in E7 experimental vault, we are planning to sequentially update the control to N-DIM.

After the summer maintenance, the occurrence of this issue in the control unit was reduced to 0% while accelerating the 12 MeV/nucleon deuteron beam with an intensity of 1.5 pμA at the C03 target for more than one month. Thus, it is evident that this maintenance has had certain effect.

References
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