Responding to the Question PS3 Q3.1.2, we would like to introduce Keystone Japanese Coordinate system, which started 2021 to increse interaction among Japanese utilitiess to enhance balancing of both capacity deficit areas and capacity surplus areas.

The reserve market was started in Japan in 2021. The main purpose was to enable the procurement and operation of power reserve across areas in order to ensure the stability and cost efficiency. Figure 1 shows an overview of the market. Previously, there used to be only the wholesale market without a reserve market, so T&D companies could not procure power reserve across Japan. They were therefore ordered to procure power reserve in their own areas. However, after the introduction of the reserve market, power reserve is procured from the entire Japanese market through cross-regional interconnection lines. In addition, power reserve is procured across areas so as to minimize the total amount and cost, making the new system cost-effective.

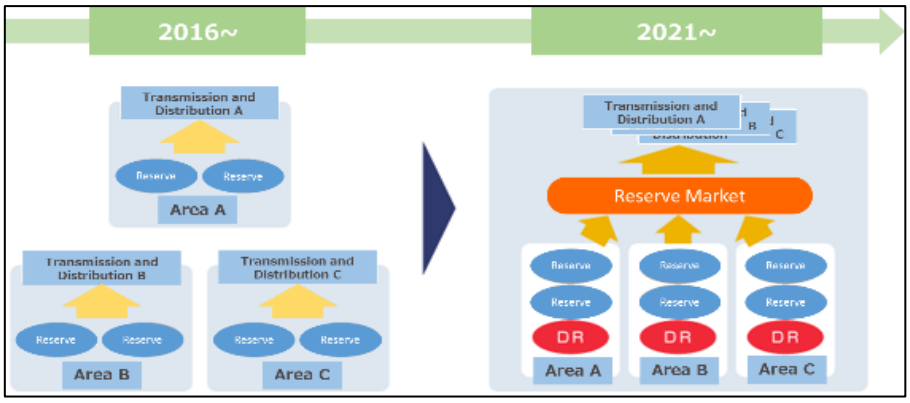

Fig. 1 Overview of the reserve market

Along with introduction of the reserve market, the Keystone Japanese Coordinating (KJC) system has also been introduced to enhance the efficiency of operation of the reserve market. An overview of KJC is shown in Fig. 2. KJC receives an estimate of the amount of imbalance from each area up to 90 minutes ahead and a merit order list reserved for each area. After receiving the results and calculating the wide-area supply-demand adjustment, KJC informs the adjustment amount of the interconnection lines to the central control centers in each area. Based on these results, each central control center allocates power supplies in economic load dispatching (ELD) order.

This approach is described in detail below. There are two stages in KJC operation. The first step is imbalance netting. This function offsets the amount of imbalance between supply and demand, and reduces the total potential amount of use of power reserve. The second step is cross-regional merit order. This function uses power reserve in economic order and in a cost-effective manner through interconnection lines. The less expensive the power reserve that can be procured in the market, the more cost-effective the power reserve that can be used in power system operation. Through these operations, highly cost-effective power system operation can be achieved, and T&D companies can reduce the cost of producing power reserve compared to the previous system.

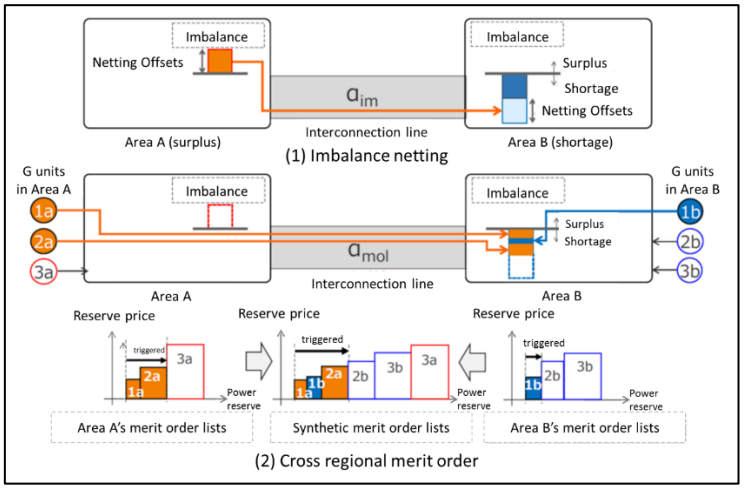

Fig. 2 Overview of KJC

On the other hand, by adjusting the power flow,Kansai T&D used High Voltage Direct Current (HVDC) interconnection lines to maintain trunk line voltages. However, after the introduction of the reserve market, operation of the power system became less flexible and these conventional measures could no longer be used becouse the power flow is determined by the market. In this case situation, the most severe condition is a minimal power flow in the HVDC interconnection line. When the HVDC system is used, harmonic filters must be used at the same time, but these also have a capacitive effect. Therefore, the more harmonic filters are used, the more an excessive trunk line voltage is likely to occur.
Figure 3 shows an overview of the trunk lines in the Kansai area and the result of voltage simulation. Given the situation, excessive voltage higher than the criterion in our 500-kV system was predicted especially in the southern area under the most severe condition.
To solve the voltage violation, we decided to install additional shunt reactors. This countermeasure will help maintain voltage and procure power reserve more efficiently and reliably in the reserve market condition.

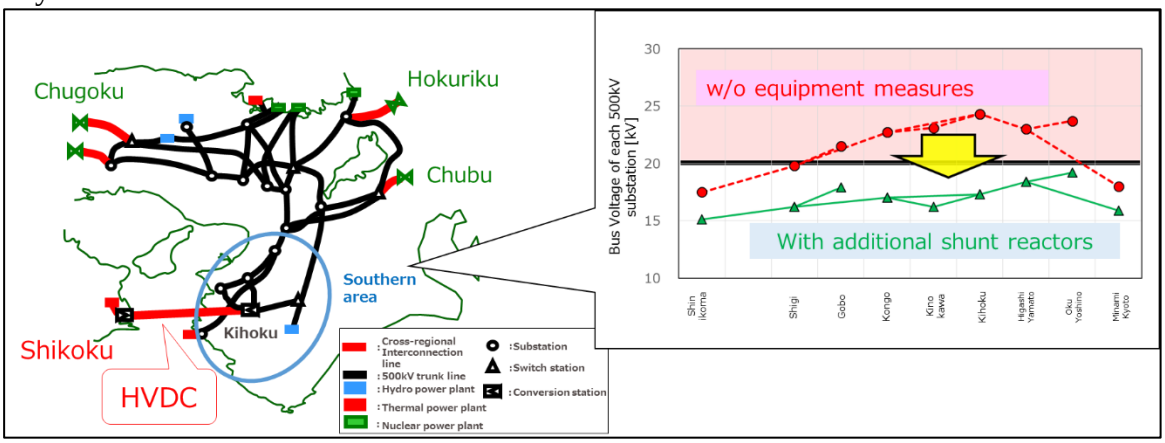

Fig. 3 Trunk and interconnection lines in the Kansai area and 500kV voltage profile