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Comparison of several types of fault current limiter introduction into frequency converters of Shinkansen

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The Tokaido Shinkansen travels through both 50 Hz and 60 Hz electric power system regions, and the trains run on 60 Hz. Therefore, the Tokaido Shinkansen has equipped frequency converters to convert electric power from 50 Hz into 60 Hz in eastern area of Japan. There are two types of frequency converters, rotary frequency converters (RFCs) and electronic frequency converters (EFCs). RFCs have mainly been used and, recent years, the replacement from RFCs into EFCs is progressing, due to merits in maintenance. However, the EFCs have no overcurrent (such as fault current) tolerance and this problem has to be solved to replace all the RFCs into the EFCs. One of the solutions is introduction of fault current limiters (FCLs).

There are various types of FCLs, such as resistive type, saturated iron-core type, bridge type and so on, and each of those has different advantages and disadvantages. The FCLs for frequency converters of Tokaido Shinkansen have to reduce fault current less than 2.2 p.u. And this low allowable current brings difficulties for FCLs to protect EFCs. Therefore, there is a need to discuss which type of FCLs is suitable for this severe condition.

In this research, the Shinkansen systems which equipped various types of FCLs for EFCs were analyzed by using Psim. And fault current reduction effect, size, loss, fail safe and recovery time of each FCLs were compared.

The resistive type is smaller in size, lower loss and fail safe. However, it cannot reduce fault current less than the maximum allowable current and its recovery time is long. The bridge type can reduce fault current less than the maximum allowable current and its recovery time is short. However it tends to be bigger, larger loss and lower fail safe.

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