Investigation of Interaction during the parallel operation of Line-Commutated Converters and Self- Commutated Converters

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Abstract

HVDC (High-Voltage Direct Current) links including FC (Frequency Converters) are usually equipped with Line-Commutated Converters (LCC) in Japan. In the future, it is expected that a new HVDC link with Self- Commutated Converters (SCC) will be installed in parallel to the existing HVDC link with LCC.

The HVDC link with SCC and the existing HVDC link with LCC may affect each other, which may pose some problems in the stable operation. Out of these problems that need to addressed are harmonic resonance phenomena, Sub-Synchronous Torsional Interaction and Voltage variation due to resonance in the power system. For example, the voltage waveform distortion due to the emergency start of the HVDC link with SCC may lead to commutation failures of the LCC.

On the positive side, when these two HVDC link types are operated in parallel, the power system stability is enhanced and the HVDC link with LCC may operate more stably. For example, only the HVDC link with LCC is blocked or operated in by-pass pair mode during AC system faults and is restarted several hundred milliseconds after the faults. As such, no power is transmitted during the fault and is restarted only after the recovery from the fault. However, the HVDC link with SCC is utilized to restrain the AC System voltage variation by controlling of the reactive power. When these two HVDC link types are operated in parallel, the HVDC link with LCC maintains the stable operation with no gate-blocks due to the voltage variation.

In this study, the problems and effectiveness of two types parallel operation were investigated. EMTP based instantaneous value simulation was performed to verify the stable operation of the two HVDC link types. As a result of this analysis, when two HVDC link types are operated in parallel, the AC System voltage waveform distortion was reduced in comparison with the individual operation of the HVDC link with LCC.