8 Main Disadvantages of HVDC Transmission

Edvard

8 Main Disadvantages of HVDC Transmission (Picture taken near to Cascavel – PR – Brazil. Detail of the HVDC Line of Furnas (600kV) by Fernando Hidalgo Molina via Flickr)

High Voltage Direct Current (HVDC)

Few weeks back I posted an article about advantages of HVDC over HVAC transmission systems. Advantages of HVDC are numerous and very well recognized, but like everything on this earth this system has other side too.

The eight main disadvantages of HVDC transmission systems, including DC links connecting HVAC systems area, are summarized and briefly explained below:

Disadvantage #1 (expensive)

Converter stations needed to connect to AC power grids are ***very expensive***.

Converter substations are more complex than HVAC substations, not only in additional converting equipment, but also in more complicated control and regulating systems.

Costs of such stations may be offset by lower construction costs of DC transmission lines, but offsets require DC lines of considerable length.

Disadvantage #2 (complex)

In contrast to AC systems, designing and operating multi-terminal HVDC systems is complex.

Controlling power flow in such systems requires ***continuous communication between all terminals***, as power flow must be actively regulated by the control system instead of by the inherent properties of the transmission line.

Disadvantage #3 (expensive again)

Converter substations generate current and voltage harmonics, while the conversion process is accompanied by reactive power consumption. As a result, it is necessary to install ***expensive filter-compensation units*** and ***reactive power compensation units***.

Disadvantage #4 (power faults)

During ***short-circuits*** in the AC power systems close to connected HVDC substations, power faults also occur in the HVDC transmission system for the duration of the short-circuit.

Inverter substations are most affected.

During short-circuits on the inverter output side, a full HVDC transmission system power fault can be caused. Power faults due to short-circuits on the rectifier input side are usually proportional to the voltage decrease.

Disadvantage #5 (capacities)

The number of substations within a modern multi-terminal HVDC transmission system can be no larger than ***six*** to ***eight***, and large differences in their capacities are not allowed. The larger the number of substations, the smaller may be the differences in their capacities.

Thus, it is practically impossible to construct an HVDC transmission system with ***more than five substations***.

Disadvantage #6 (radio noise)

The high-frequency constituents found in direct current transmission systems can cause radio noise in communications lines that are situated near the HVDC transmission line.

To prevent this, it is necessary to install ***expensive “active” filters*** on HVDC transmission lines.

Disadvantage #7 (dificult grounding)

Grounding HVDC transmission involves a complex and difficult installation, as it is necessary to construct a reliable and permanent contact to the Earth for proper operation and to eliminate the possible creation of a dangerous “step voltage.”

Disadvantage #8

The flow of current through the Earth in monopole systems can cause the

electro-corrosion of underground metal installations, mainly pipelines.

Conclusion

Some of the above-listed disadvantages can be eliminated with the use of ***new technologies***. In particular, disadvantages such as a complete power fault of the HVDC transmission system during short-circuits inthe AC power system and reactive power consumption can be eliminated completely, or mostly, with the use of turn-off thyristors.

Several research centers are working on improving high-capacity turn-off thyristors and also on new types of converter devices for high-capacity HVDC transmission.

Finally, there are several new techniques for the perfection of grounding devices, providing for decreased electro-corrosion impacts and the formation of so-called "***metal return***", which precludes the working current from flowing through the ground. Other techniques aimed
at perfecting HVDC technology are also being developed (Koshcheev 2001).

Reference: *Argonne National Laboratory – The design, construction and operation of long-distance high voltage electricity transmission technologies*