

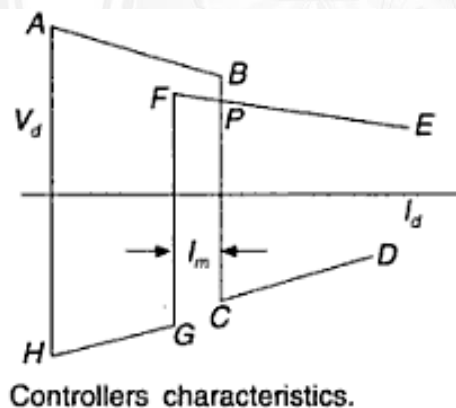
3.2 Converter control characteristics

Basic Characteristics:

The intersection of the two characteristics (point A) determines the mode of operation-Station I operating as rectifier with constant current control and station II operating at constant (minimum) extinction angle.

There can be three modes of operation of the link (for the same direction of power flow) depending on the ceiling voltage of the rectifier which determines the point of intersection of the two characteristics which are defined below

- 1) CC at rectifier and CEA at inverter (operating point A) which is the normal mode of operation.
- 2) With slight dip in the AC voltage, the point of intersection drifts to C which implies minimum α at rectifier and minimum γ at the inverter.
- 3) With lower AC voltage at the rectifier, the mode of operation shifts to point B which implies CC at the inverter with minimum α at the rectifier.



Types of Station Control Characteristics

Station-I	Station-II	Controller type
AB	HG	Minimum α
BC	GF	Constant current
CD	EF	CEA (minimum γ)

Figure 3.2.1 Converter control characteristics

[Source: "HVDC Power Transmission Systems" by K.P.Padiyar, page-87]

The characteristic AB has generally more negative slope than characteristic FE because the slope of AB is due to the combined resistance of $(R_d + R_{cr})$ while the slope of FE is due to R_{ci} .

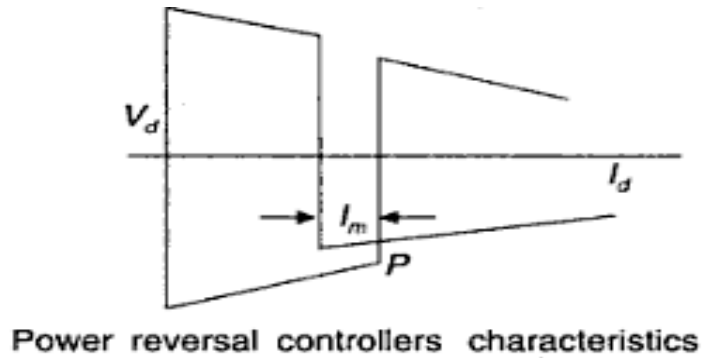


Figure 3.2.2 Converter control characteristics for negative current margin

[Source: "HVDC Power Transmission Systems" by K.P.Padiyar, page-87]

The above figure shows the control characteristics for negative current margin I_m (or where the current reference of station II is larger than that of station I). The operating point shifts now to D which implies power reversal with station I (now acting as inverter) operating with minimum CEA control while station II operating with CC control.

This shows the importance of maintaining the correct sign of the current margin to avoid inadvertent power reversal. The maintenance of proper current margin requires adequate telecommunication channel for rapid transmission of the current or power order.

Voltage Dependent Current Limit:

The low voltage in the DC link is mainly due to the faults in the AC system on the rectifier or inverter side. The low AC voltage due to faults on the inverter side can result in persistent commutation failure because of the increase of the overlap angle. In such cases, it is necessary to reduce the DC current in the link until the conditions that led to the reduced DC voltage are relieved. Also the reduction of current relieves those valves in the inverter which are overstressed due to continuous current flow in them.

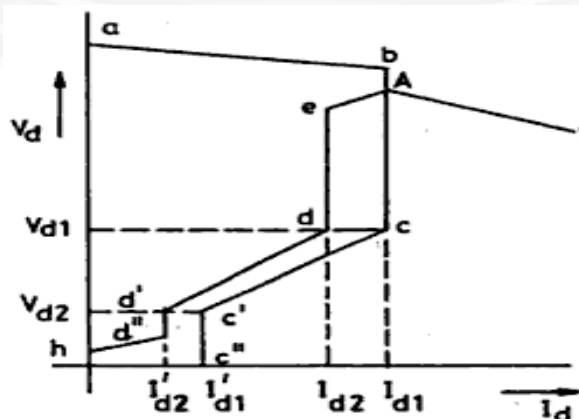


Figure 3.2.3 Converter control characteristics including VDCOL

[Source: "HVDC Power Transmission Systems" by K.P.Padiyar, page-84]

If the low voltage is due to faults on the rectifier side AC system, the inverter has to operate at very low power factor causing excessive consumption of reactive power which is also undesirable. Thus, it becomes useful to modify the control characteristics to include voltage dependent current limits. The figure above shown shows current error characteristics to stabilize the mode when operating with DC current between I_{d1} and I_{d2} . The characteristic c^l and c^h show the limitation of current due to the reduction in voltage.

