4.3 Proposed Relay Actions

Table 2 summarizes the fault simulation results for the studied system and the relay action of the proposed protection scheme. The results indicate that the values of autocorrelation (σ*)* for forward faults are positive and negative for external faults.

Table 2: Different HVDC system faults and the corresponding relay action

Faults	location	σ	Relay action
DC one pole	F1,Cable	0.16	Tripping
DC two- pole	F1 ,Cable	0.2	Tripping
AC-3 -phase	F2,Inverter	0.35	Tripping
AC-3 -phase	F4,Rectifier	0.14	Tripping
AC-3 -phase	F3, Wind	- 0.7	Blocking

5. Conclusions

A new directional one-end protection technique against DC and AC side faults was developed for HVDC transmission system fed by offshore wind farm. This technique based on continuous tracing of the current patterns autocorrelation for two successive current patterns measured at the AC bus. The proposed scheme is cost effective as it can implemented without any need of any extra signal measurements or communications between the HVDC line ends. The Non-communication scheme enhances the relay response by avoiding communication delay and signal attenuation in foggy offshore regions of the two end protection schemes. As the proposed algorithm depends on autocorrelation of continuous current windows of the same current signal at same end side, it is able to perform efficiently the fault detection under different loading levels, fault resistances, harmonics and fault inception angle. These are the main advantages and the added values for the proposed one-end autocorrelation protection algorithm. The fault direction as forward or backward had been verified based on the autocorrelation sign, while the fault detections are based on the magnitude of the autocorrelation coefficients. The obtained results indicate that the proposed protection scheme for HVDC system is reliable and can be implemented for digital protection of similar real offshore wind-HVDC system without extra measurements or communication links.

6. References

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