The proposed fault identification scheme was investigated under different external fault scenarios within a MV /HV grid that integrated with the PV-feeder (see Fig. 2). Simulation results are described in Table 1. Taking a phase to ground fault in phase-R at the middle of TL2 line, as example, the *F-II* of faulty phase for both voltage and current waveform is not close to unity ($F\text{-}II_{iR}$ **=0.368**, $F\text{-}II_{vR}$ **=0.616)** and one of them is less than the threshold β-value ($F\text{-}II_{iR}$ **=0.368 <β,** $F\text{-}II_{vR}$ **=0.616>β).** According to the proposed fault identification scheme, these results indicate to finding external fault, compared with the healthy case of the power system test, the values of F-II for the measured signals at the PV-feeder are very close to zero ($F\text{-}II_{iR=}$ **0.061**, $F\text{-}II_{iS=}$ **0.082**, $F\text{-}II_{iT=}$**0.046**, $F\text{-}II_{vR=}$ **=0.052**, $F\text{-}II_{vS=}$**0.076**, $F\text{-}II_{vT}$**=0.046**). Therefore, the possibility of identifying external fault conditions from internal faults is illustrated in Table 1, and it is evident that the proposed scheme has a superiority to discriminate between internal and external faults. Furthermore, different external fault scenarios that are carried out on midpoint of TL3 line and bus 2 show the capability of proposed scheme to recognise the external fault condition from internal one within PV-feeder. Thus, from Table 1, it can be concluded that in the case of external fault with varying fault parameters, the behaviour of *F-II* for all phases is completely different from the case of internal fault, and therefore an external fault is not affected in the proposed scheme compared to existing schemes that are reported in the literatures.

5. Conclusions

Based on the usage of approximation-alienation coefficients for both voltage and current signals, this paper presents an effective fault identification scheme for a smart grid integrated with PV-system through the available power electronics facilities. An accurate, efficient, and fast fault identification scheme has introduced considering the dynamic fault current response for the grid interfaced with PV-system. In this scheme, once the DWT is employed to extract the approximation components for measured signals, cross alienation coefficients are computed based on these approximation components. Then, the differential faulty energy is calculated and defined as a fault identification index that is used to discriminate between internal and external fault. The simulation results reveal that the fault identification scheme can differentiate between internal and external fault with high selectivity performance. Moreover, after internal fault is declared, the scheme can classify the fault type and select the faulty phase within half cycle moving window.

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