System and Customer Impact: Considerations for Series Custom Power Devices

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System Power Quality

Source Side Considerations

- The SD is an additional energy source in the system.
  - The waveshape of the sag may be altered by the additional energy source.
- The current path for the SD must be continuous.

- Most sags are single-phase events (approximately 66% in distribution)
- The location of faults and protective devices which operate is random.
- The waveshape of the resulting sag will be complex due to a number of factors: impedance of the fault, location of the fault, type of fault, load and transformer connections, mutual coupling, etc.

Upstream Open Circuit

- If reclosers or circuit breakers operate upstream of the SD, the current path becomes uncertain.
- Current may flow through upstream parallel-connected loads.
- These loads may experience reverse voltage or power flow.

Solutions

- Determine if an upstream open-circuit has occurred; if so then remove SD from the system.
- This will prevent ‘backfeeding’ the system.

Voltage disturbance waveshapes: How are they affected?

- The voltage waveshape seen by the SD will be different than if the SD were not in the circuit.
- Disturbance monitoring may not accurately predict the disturbances that will be present with the SD in place.

How will the SD affect these disturbances?

- If the load is a nearly pure impedance, then the SD might make the sag worse.
- If the SD cannot fully correct the disturbance, the effect is unknown.

Load-side Considerations

- Fast transients (high dv/dt) will be difficult to correct.
- Large phase shifts will be difficult to correct (may require ratings in excess of 1.0 voltage injection).

What is the impact to the customer's equipment?

- A detailed study of the customer's equipment must be made to determine what is acceptable.
- rms values taken from recorded sag data does not convey sufficient information about the required SD performance.

What is important?

- Load-dependent.
- Rectifier type loads require consistent peak voltage (most AC motor drives, computer power supplies).
- Thyristor (SCR) based loads need accurate zero-crossing information.

Recovery Problems if Sag is not Fully Compensated

- Large inrush currents from motors and transformers, and other energy-storage loads.
- The SD may go into current limit, sustaining the sag, or may bypass.

Conclusions

- There are both source and load side effects due to the addition of an SD.
- Upstream recloser operations must be examined for current path.
- The SD cannot correct for every anomaly, but can improve many routine disturbances.

- Load requirements must be matched to the SD’s controls (phase shift or peak compensation).
- SD transformer sizing is critical.
- RMS and durations are not adequate to properly ‘size’ a SD.