Fault Response of Distributed Energy Resources Considering the Requirements of IEEE 1547-2018

Rasel Mahmud, Andy Hoke, David Narang
National Renewable Energy Laboratory
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Background

• An analysis of IEEE 1547-2018 is presented in regard to DER responses for abnormal voltage conditions.
• Traditional utility protection schemes assumes conventional synchronous generators as the main fault feeding sources.
• However, large scale integration of distributed energy resources (DERs) is likely to change the fault levels and characteristics.
• Fault responses of inverter interfaced distributed generators (IIDG) is not well understood.
• One option would be to analyze the grid code or standards that the IIDGs conform to, while also considering inverter physical limits. For example, IEEE 1547-2018.
Allowable Current Ranges After Voltage Disturbance

Category-I DERs

Notes:
- Green = range of expected S.S. fault current
- Yellow = range of expected temporary current prior to cessation of export
- The charts assume a maximum steady-state current of 1.2 pu for illustrative purposes

Category-II DERs

Category-III DERs
Experimental Results

Test Setup

Fault Current after an asymmetrical fault

Fault response
Conclusions

IEEE 1547-2018 compliant inverters will have the following responses:

• IIDGs will behave as constant power sources in a narrow band of voltage excursion around the nominal voltage. Outside that narrow band, IIDGs can act like constant power sources or constant current sources for a wide range of voltage disturbances.

• Under the largest voltage excursions, IIDG fault current is limited by software-defined current limits.

• Though dynamic voltage support is mentioned in IEEE 1547-2018, it is not mandated or defined. So, IEEE 1547-2018 compliant IIDGs will most likely generate positive sequence current only for both symmetrical and asymmetrical faults.

• In addition, post-fault current magnitudes of IIDGs will be constrained to a narrower range (but not fully defined) by IEEE 1547-2018.

• For fault voltages in the momentary cessation and cease-to-energize regions, IIDG fault current is expected to be zero after a short RMS voltage detection time, potentially easing utility protection coordination.