CONNECTING SOLAR TO THE GRID





Approximately

Solar projects across the US representing more than 166 GW of capacity

IEEE STANDARD 1547

and and it is called the state of Supplement

This **Standard for Interconnection & Interoperability of Distributed Energy Resources (DERs) with Associated Power System Interfaces (2018)** universally defines the technologies and operational concepts to integrate DERs effectively into existing grids.

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Section 7.2.2

"When the interconnection is at medium voltage, the DER shall not cause step or ramp changes in the RMS voltage at the PCC exceeding 3% of nominal and exceeding 3% per second averaged over a period of one second."



UTILITY INTERCONNECTION CHALLENGES

- Connecting DER transformer to weak distribution systems
- Transformer no-load losses at night
 - High transformer inrush resulting in unacceptable <u>**RVC</u>** or <u>voltage sags</u></u>

What are RVC events?

RVC (*rapid voltage change*) **events** are quick changes in RMS voltage, during which the voltage does not exceed the sag/swell thresholds (10%). This occurs during energization of the DER transformer and can lead to premature failure, power quality concerns, and interconnect compliance issues with the utility.

What are voltage sags?

A **voltage sag** is a short duration reduction in RMS voltage of more than 10% caused by high inrush currents when a DER transformer is energized. A voltage sag is a serious power quality problem and can result in the misoperation of sensitive loads.



WHAT ARE THE BENEFITS OF RELIABLE, DAILY SWITCHING?



\$\$7,500

It has been estimated that, even a small 3 MVA transformer (0.001 PU NLL) deenergized 8 hours per day can result in a savings of \$7,500 assuming a 20 year service life and 10% required rate of return.



SWITCHING TECHNOLOGIES

CONTROLLED SWITCHING

utilizes independent pole operation and electronic controls in the attempt to close the switching device at a specific points on the voltage waveform

relies on many variables such as residual flux in the transformer core, ambient temperature, control voltage, & mechanism wear

requires periodic maintenance by qualified personnel to maintain timing

costly relative to other switching methods such as the use of a closing resistor

SOUTHERN STATES TRANSWITCHER®

mitigates inrush current via a **closing resistor** which inserts resistance into the circuit prior to the vacuum interrupter's main contacts being closed.





provides a soft energization of the transformer, limiting the inrush currents and resulting voltage dips



mechanical, highly reliable, and repeatable switching solution that does not require maintenance to maintain timing



significantly more cost-effective than other common switching methods such as controlled switching

