

Low Voltage Ride Through (LVRT) Testing in Solar PV Inverters & Grid-Tied Systems



What is Low Voltage Ride Through Testing?

Low Voltage Ride Through (LVRT) is a critical function in solar PV inverters and grid-tied Distributed Energy Resource (DER) systems that helps to stabilize the grid and prevent power outages. LVRT improves the system stability to make sure that the grid-tied inverter is capable of remaining operable for a certain period of time when an abnormal event occurs on the electric grid. A grid fault such as a short-circuit, or a large load change in the grid can cause a temporary voltage sag or dip.



All grid-tied devices need to follow regulatory standards which include LVRT testing. The LVRT test verifies the ability of the DER to ride through voltage sags without tripping in accordance with the requirements of IEEE 1547.1, UL1741 and similar global standards. Testing to these standards ensures reliable LVRT performance and safe operation in grid-tied products.

Selecting the Right Test Solution for LVRT Testing and Validation

Using the right tools to simulate LVRT test patterns effectively and accurately can reduce test time, eliminate errors, and optimize performance. LVRT tests typically involve very quick voltage drops and precise simulation of irregular patterns in real-time, as shown in **Figure 1**. Key considerations for selecting test equipment include regenerative power, fast slew rate, wide operating envelope, and precise waveform simulation tools.

Test to Grid-Tied Standards Worldwide

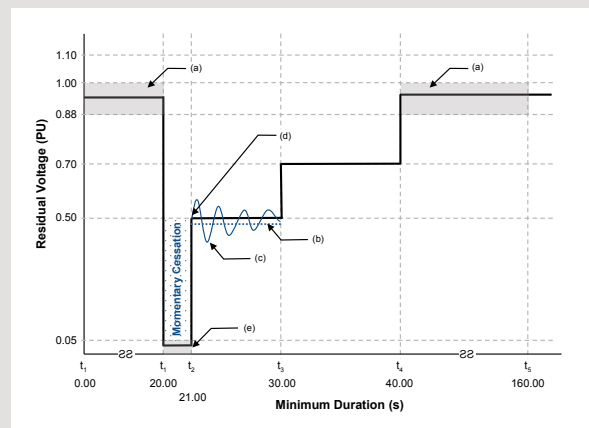


Figure 1: LVRT as per 1547.1:2020, Section 5.4.4.

Key Considerations for Selecting Test Equipment



Regenerative Power:

NHR's Regenerative Grid Simulators regenerate energy from the solar PV/grid-tied inverter to the grid system. This allows you to simulate the voltage drop down all the way to 0-5% for category III momentary cessation test condition as required by the IEEE 1547.1 standard.



Fast Slew Rates: Rapid Rise and Fall Times

Our grid simulators have fast response times with a fast slew rate $1V/\mu S$ and rapid rising/falling times from 10-90% of full power. This capability allows you to accurately simulate very quick voltage drops and rises to emulate real world conditions



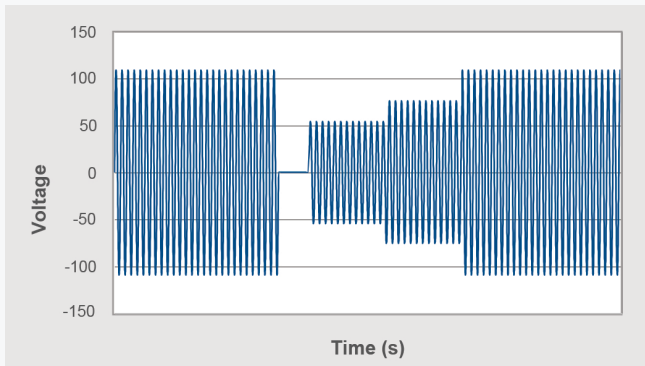
Wide Operating Envelope

The wide operating envelope of our test systems allow you to test under different voltage conditions required at full power. The system's wide range of power, frequency, and phase configuration options provide the ultimate flexibility to test the broadest selection of grid-tied products.

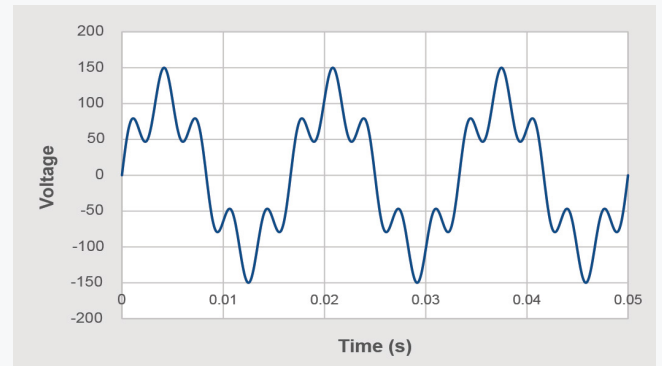


Precise Waveform Simulation Tools

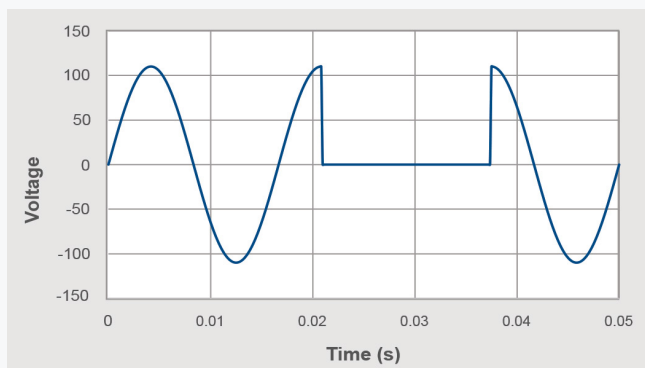
NHR's Regenerative Grid Simulators can directly simulate common power line disturbances, such as LVRT test patterns, through a combination macros and user-definable wave shapes. Macros are pre-programmed sequences that can be entered through a user-friendly menu, downloaded, and executed to provide precise control of the output(s). This convenient method is used to generate LVRT test patterns, sub-cycle, and multi-cycle changes to the output covering nearly every condition. User-definable wave shapes extend this capability by permitting the generation of outputs including transient anomalies, voltage harmonics, or any other irregularity which can be drawn as a single cycle (**Figure 2.**)



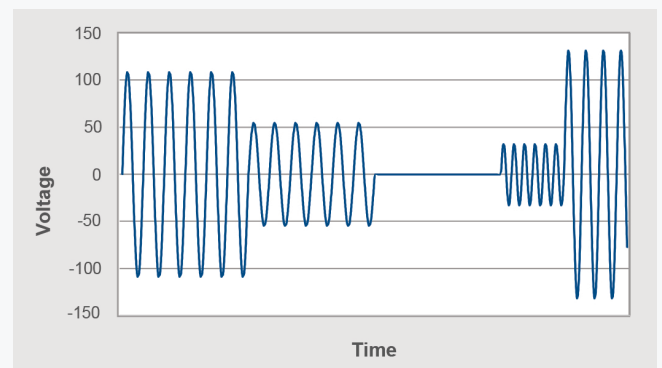
LVRT Profile



Distorted Waveform with Harmonics



Sub-cycle Transient



Voltage/Frequency Variation

Figure 2: Examples of Waveform Simulations

Next Generation Grid Simulators

NHR's Regenerative Grid Simulator is the industry leading solution for testing and verification of grid-tied applications in compliance with regulatory testing standards, worldwide. In addition to LVRT testing, the 9510 and 9410 Regenerative Grid Simulator can test to IEEE 1547, UL 174.1, and similar grid-tied standards across the globe. As your partner in test, our application experts are here to help. Contact us at sales@nhresearch.com for project consultation.

