Reducing Noise in PV Power Plants

Comprehensive testing points the way to significantly reducing noise from central inverters

Typically, PV power plants are spread out over several acres of land far from residences, towns or cities. Up until now, central inverter manufacturers have not had to deal with noise emissions from the central inverters in and near such large industrial PV farms. In collaboration with the Rheinisch-Westfälischen Technischen Hochschule Aachen (RWTH University Aachen), SMA Solar Technology AG carried out comprehensive and complex testing to identify the sources of noise and ways to reduce it. We found that because noise emissions behave logarithmically, a 10dB reduction will cut the central inverter’s noise emissions by half.

“We’ve been asked to look into reducing the noise generated by our central inverters, especially those in the more densely populated regions in Japan,” said Aaron Gerdemann, Global Product Manager at SMA Solar Technology AG and expert for the Japanese market.

As more and more major PV power plants are operating near residential areas, villages and towns, there is a growing demand for quieter central inverters. The findings of the tests have already lead to implementing the first noise reduction measures, and a retrofit kit is available now for central inverters already in operation.
Test Scenario for Extensive Inspection

The experts from RWTH Aachen have extensive experience in industrial noise emission testing for machines and machine systems. However, this project was the very first time that inverters had been the focus of noise emission tests. Using extensive test equipment, the team performed a multitude of different acoustic tests to identify and classify all sources of noise in the central inverter during operation.

They performed a number of assessments and analyses including:
- Investigation of structure-borne noise transfer paths
- Transfer of airborne noise and its effects
- Analysis of noise caused by vibrations
- Resonance frequency testing

To visualize from exactly which sources noise is generated, an acoustic camera was used to closely examine a stock Sunny Central 500 CP-JP central inverter during normal operation up to full load.

Once the test team was able to identify the choke as the main source of noise, it was removed and went through the same testing.
Measuring Airborne and Structure-Borne Noise

They intentionally produced structure-borne vibrations inside the central inverter with a shaker unit in place of the choke, and closely observed how individual components reacted.

Using an omnidirectional loudspeaker inside the central inverter, the test team was able to identify where structure noise and airborne noise occurred.
Considerable Reduction in Noise

Taking into account all the test results, the Sunny Central CP central inverter can now be operated with considerably reduced noise emissions. The actual noise of the central inverter depends on different parameters and varies individually in for example power class, installation (concrete base or plinth), optional equipment, and component tolerances.

The Sunny Central CP inverters underwent extensive hardware and software modifications to reduce noise. For example, the inverter’s modulation process has been changed and the air exhaust equipped with a specially designed splitter silencer. The internal structure of the splitter silencer was configured specifically for wave lengths resulting from the inverter bridge’s 3 kHz cycle frequency. Also, other inverter components have been acoustically improved by adding base paneling and an air baffle. On average these measures lead to a reduction to half of the perceived noise level in a 10 meters distance.

These noise reducing measures are available for central inverters as an option but can also be used to retrofit existing installations. Long term, plans are underway to find a choke manufacturer to produce a “quieter” choke.