Experiencing problems on backup supply?

Case Study – Major EV Charging Site:

The graphs below show the same **EV charger loads** being supplied from the grid (top) and generator (bottom).

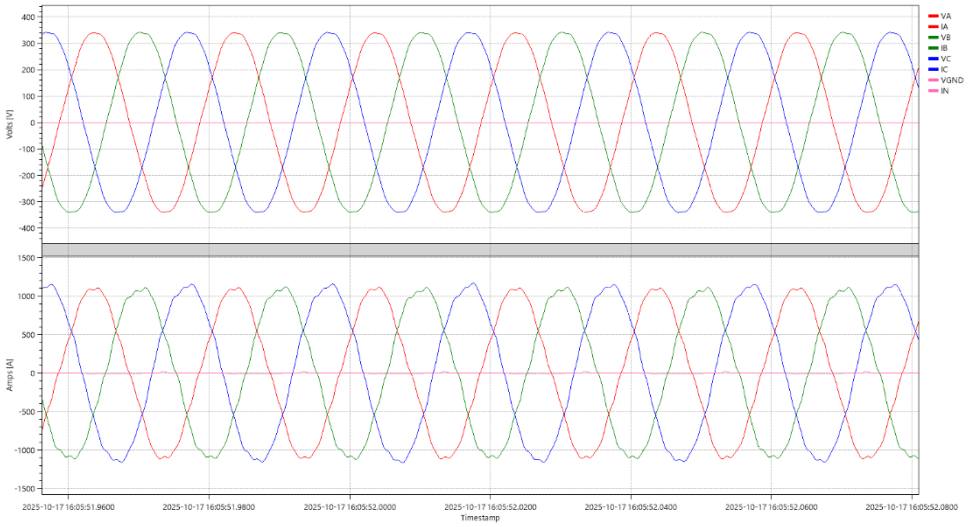

Figure 1: Grid Supply (Voltage & Current)

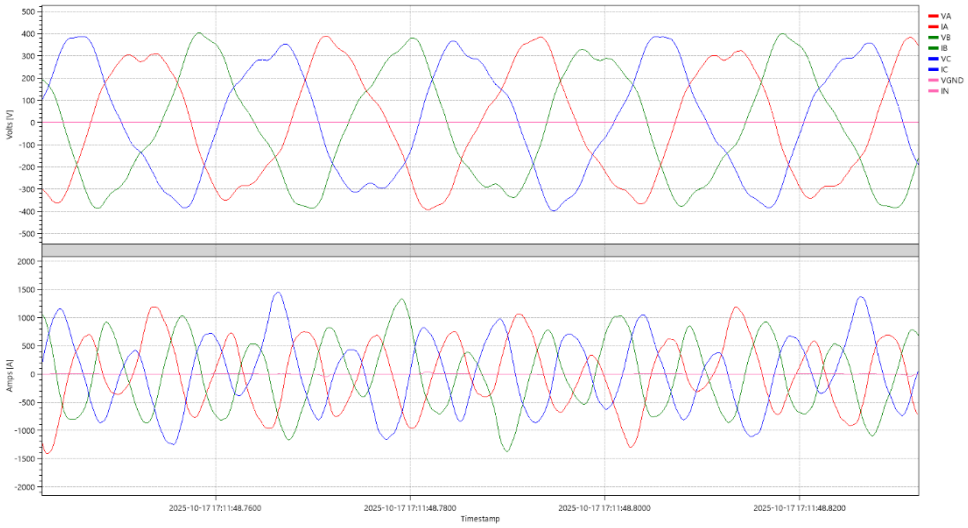

Figure 2: Generator Supply (Voltage & Current)

At this site, the incorrect sizing of the generator caused equipment to fault and shut down due to THD_V exceeding 15%. This led to **delays** in site commissioning and **additional unbudgeted** mitigation equipment. Engineers now have to work around an already **sunk cost of ~$1 million AUD** in the generator alone.

The Challenge: Generator Capacity vs Capability

With increasing construction of dedicated EV charging infrastructure, large datacentres for AI and industrial sites with high penetration of electronic loads, backup generators are a must to maintain 100% site reliability. However, GreenVolt Power Quality Solutions has noted increasing equipment failures on backup generator supplies in the recent decade.

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Why? Here's what real world analysis reveals:

1. **Proliferation of Electronic Loads:** Electronic loads such as VSDs, datacentres, inverters and even Active Harmonic Filters themselves, are non-linear loads.
2. **Generator System Impedance:** Typically, generator system impedance (at 50Hz and at the harmonic frequencies) is higher than grid system impedance.
3. **Generator Design:** Historically, backup diesel generators were designed with critical loads in mind (lighting, heating/cooling, critical facilities), which are characteristically linear loads.

The Impact: Equipment Failure

Almost all industrial, commercial and increasingly, residential sites are incorporating a backup diesel generator.

Electronic Loads (Non-linear):

- Electronic loads draw current in rectangular pulses; these contain both the fundamental frequency and higher frequencies which are multiples of the fundamental (harmonics).
- This gives rise to current harmonics. It is inherent to almost all electronic equipment.
- Electronic loads also utilise Pulse-Width-Modulation and phase cutting techniques, which changes the distribution of the harmonics.

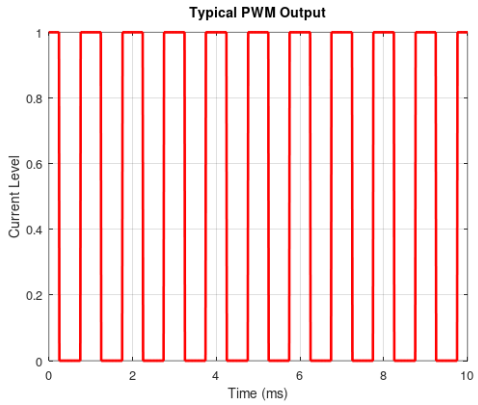

Figure 3: PWM Waveform

Impact of Generator System Impedance:

- A grid supply exhibits a stiffer system impedance than a backup generator, resulting in lower voltage harmonic distortion.
- A diesel generator is more sensitive to current harmonic distortion due to the relatively higher system impedance at the harmonic frequencies.
- The resulting voltage harmonic distortion can yield THD_v values greater than AS/NZS 61000.2.2 standard (compliance limit), which can lead to equipment failures and malfunctioning of the diesel generator.

Generator Intended Design:

- It is common practice in industry to size a generator based solely on the rated current and the apparent power and intended for 50Hz operation.
- When supplying non-linear loads, factors such as THD_v, THD_i and the harmonic spectrum on the grid are critical performance metrics which can be utilised to size a backup generator.

Key Takeaways:

- Electronic loads almost always generate current harmonics. This leads to a non-zero THD_i measurement.
- Generators exhibit a higher system impedance compared to the grid.
- Current harmonics are the dominant cause of voltage harmonics, which can impact the equipment operation.

How can we help?

We can monitor your equipment operation on grid supply and assess the data to size your generator.

Experiencing problems on backup supply? Call us: +61 0402 414 145

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