Hidden Downsides of Impedance Based Grounding & what you can do about it.

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What is High Resistance Grounding (HRG)?

IEEE 142 Grounding Standard with Voltage Stabilizing Ground Reference

System Characteristics	Grounded				Ungrounded	
	Solid	Low Resistance	High Resistanc	Reactance	Ungrounded	W/Voltage Stabilization
Continuity of service on ground fault	No	No	Yes	No	Yes	Yes
Capability to propagage multiphse fault	High	Medium	Low	High	Low	Lowest
Equipment damage potential	High	Low	Very Low	High	Very Low	Lowest
Ground fault current	High			High	Low	Lowest
Transient over-voltage level	2.5X	2.5X	2.5X	2.5X	≥6X	1X
Cable insulation level	1.0X	1.0	1.7	1.0	1.73	1.0
Arc Flash Risk Level	High	Medium	Very Low	High	Very Low	Lowest

Table-1: Methods of different Grounding Systems and Characteristics (Grounding options as applicable for specific installaton requirements)

HRG is traditionally considered a "superior" choice due to its ability to limit transient overvoltage, its resilience against fault conditions, as well as providing a means of locating ground faults. The **IEEE 242-1986 Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems** states that ungrounded power systems offer no advantage over HRG, and are being phased out or in many cases, converted to HRG. (source http://www.i-gard.com/Downloads/techlib/IgardEditorials/EB%20Grounding%20Overview.pdf pg. 2)

Downsides of Industrial HRG

Upon the start of a ground fault:

- The two non-faulting phases rise to the line-to-line voltage, resulting in a significant (over 70 percent) increase in voltage stress on system insulation
- The neutral point rises to line-to-neutral voltage above ground. While this is occurring, the neutral cannot be used for load connections such as single-phase lighting
- If a second ground fault occurs before the first is removed, a line-to-line fault occurs

Additionally, due to the continuous power draw of the HRG, significant electrical energy is wasted. In some cases, this figure can be between $25,000 and $50,000 per year.

Indeed, it seems that ungrounded systems and HRGs have their share of downsides. Surely there exists a way for your system to reap the benefits of both technologies: a protection scheme that is not only solid, safe, and reliable, but also **promises** to eliminate the causes of arc flash, instead of simply softening its effects?

HRG systems are typically installed in the switchgear or MCC, which requires the neutral to be run from the transformer to the Switchgear Building. Typically the HRG limits fault current to 10A or 5A and will drain 2 or 3 AMPs continuously to ground.

The Unconventional Solution: Protected, Ungrounded Transformer

As previously stated in the **IEEE 242-1986,** an ungrounded system "offers no advantage over high resistance grounding". **Advantage of ungrounded systems include: 1.** They do not continuously expend large amounts of energy to maintain their function, **2.** No neutral cable & return path which limits available fault current, & reduces cost. **3.** Provides stable line voltage.

Unfortunately, an ungrounded system cannot inherently control transient over-voltages, and line-to-ground faults, in this type of system, can be difficult to locate. What if there was an "add-on" product that compensates for the weaknesses found in your ungrounded system?

Phaseback: The Elusive "Missing Piece of the Power Quality Puzzle"

The Phaseback Voltage Stabilizing Ground Reference (VSGR) by Applied Energy is the only patented product that has been designed, proven, and tested for the purpose of preventing transient overvoltage, continuously balancing phase to ground Voltages, maintaining the phase angle differential. Rather than attacking voltage instability with the traditional "current-based" approach, the ***Phaseback VSGR*** automatically and continuously interacts with the voltage waveform of your facility's power system.

You will be surprised by the results, as there are so many benefits. One is balanced phase voltage waveform. It uses **0.2AMPS** typically (for 3000kVA Transformer) while limiting the fault current to **2.0 to 3.0AMPS**. This example would apply to a Wye or Delta System, when using The ***Phaseback VSGR*** in the Switchgear, MCC, or installed at the transformer.

When combined with an ungrounded Delta-Delta transformer, ***Phaseback VSGR*** proves that your power system can truly benefit from the best of both worlds. We call this ***AFP*T** Arc Flash Preventing Transformer, which has some features to provide superior isolation and temperature characteristics. The Transformer will filter the harmonics on the system, making it unnecessary to have harmonic filters, reactors, or other very expensive equipment just to reduce the harmonics. Secondly ***Phaseback VSGR*** can be installed at the Transformer, which will save cost of cable and space in the switchgear or MCC, reduce Fault current available to the switchgear, and provide so many more benefits:

- ***Phaseback VSGR*** reduces the fault current in a Delta, Grounded Wye, Ungrounded Wye, Impedance Grounded Wye, Open Delta – Open Delta (grounded or ungrounded), Open Wye – Open Delta (ungrounded).
- HRG will bleed the capacitive charge energy to ground continuously, about 2.0 to 3.0AMPS, typically. ***Phaseback VSGR*** will be using the charge current to help keep the secondary voltages balanced, which is why it drains only 0.2AMPS typically.
- **Isolation** – Any Voltage Class – ***AFP*T** Provides isolation- Harmonics, Transients and Noise.
- **Prevent Arc Flash** on Delta, Wye, Impedance Grounded Wye, and other systems.
- **Reduce Harmonics** to IEE519 levels - ***AFP*T** without additional filtering.
- **Balance Phase Voltages** – continuously fix voltage to ground and phase angle
- **Provide system grnd reference** and limit fault current – ***VSGR***
- **Eliminate Transients** – System wide elimination. Superior to SPDs.
- **Payback** – Phaseback VSGR will pay for itself and reduce energy used.

Prevention is the ultimate form of suppression!

Phaseback VSGR Saves Lives and Saves Money! Take our Challenge!

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