



# “It’s challenging to maximize production and minimize emissions in our power plant.”

*1% increase in maintained H<sub>2</sub> purity translates into up to 250 kW reduction in windage loss (+250 kW power output).*

**Peter Rice, Seals from Aerospace, Power Engineering (2004)**

## How are you ensuring maximum energy output from your hydrogen-cooled generators?

You are under constant pressure to maximize energy output from your power plant. At the same time, you are facing increasing environmental regulations and pressures to try to reduce SO<sub>x</sub> and NO<sub>x</sub> emissions. There is nothing you would like more than to increase your power output without having to install more generators, all the while ensuring that you aren’t introducing any safety risks.

The very last thing you can tolerate is unexpected downtime due to failed windings or other temperature related failures. You are running close enough to your capacity that unexpected maintenance can wreak havoc on your plans.

### What if...

- You could extend your generator life and minimize downtime?
- You could maximize generating capability?
- You could reduce safety hazards associated with hydrogen generator cooling?

*Power Plant Managers we talk to tell us about challenges like these:*

### “I can’t afford to have my generators break down.”

The generator produces heat. If you can’t control the heat and maintain proper cooling, there will be a significant impact on the life of your generators. Allowing the generator to get too hot will increase maintenance and downtime. Unplanned downtime means less power production and potential outages.

### “Energy efficiency is always top of mind, especially now with the pressure for ‘green’ operations.”

Maximizing energy output from existing generators is better for the environment, and your bottom line. Reducing windage losses would increase your power output meaning more energy per generator.

### “I’m concerned about the safety of my employees.”

On top of all the other concerns, the last thing you want is to have unsafe work conditions. It is important to have a good idea of your hydrogen purity to make sure the concentration of hydrogen doesn’t fall enough to become flammable.

## HYDROGEN PURITY

## Improve Power Generation

Hydrogen purity is a critical process variable in your power plant. Hydrogen provides much more cooling capacity than air with its extremely high thermal conductivity, low density, and high specific heat. This means a hydrogen-cooled generator can be smaller than an air-cooled generator. In addition, due to its low viscosity, drag loss in the rotor can be reduced. However, as the hydrogen purity drops (due to leaks in bearings and air entry), the windage losses increase. In fact, an improvement from 95% to 99% purity, on a generator of 175 MW capacity with a 60% capacity factor, is worth between \$48,000 and \$77,000 annually in additional sales dollars.<sup>1</sup>



Many methods are used for determining the hydrogen purity, but a Micro Motion Specific Gravity Meter has several advantages. The meter uses a sample stream of the gas and gives almost continuous updates with response times in only seconds. The meter is virtually maintenance free and can provide specific gravity or molecular weight with an accuracy of +/-0.1% making it ideal for hydrogen purity measurement.

### EXTEND GENERATOR LIFE

With faster visibility to changes in molecular weight, scavenger rates can be increased immediately if the hydrogen purity drops. This will improve cooling of the turbine and ultimately extend the life of the generator.

### MAXIMIZE POWER PRODUCTION

With real-time indication of hydrogen purity, you can control your process to keep the purity high and reduce windage losses. This will mean more power production with the same equipment.

### IMPROVE SAFETY

By constantly monitoring hydrogen purity, you can avoid operating the generator when the hydrogen concentration drops below around 80%, preventing the possibility of explosions. In addition, if you are purging the generator with air prior to generator maintenance, you will have an accurate indication of when the generator is free of hydrogen and safe to work on.

*If the hydrogen purity drops below a certain level (around 80% or so, depending on manufacturers' recommendations), then usually the generator and prime mover are stopped and then the generator is purged of hydrogen. Carbon dioxide is usually used as the medium for purging air from the generator when filling with hydrogen, and also when purging the hydrogen from the generator.*

*Role of hydrogen in generator [PowerPoint slides], Retrieved from Study Galaxy website: <http://studygalaxy.com/ordinaryview.php?id=669>*

<sup>1</sup>Wolff, David E. (May 2009). Hydrogen for Generator Cooling – The Pressure, Purity and Dewpoint Difference [PowerPoint slides]. Retrieved from Proton Energy Systems website: <http://www.protononsite.com/common/pdf/archivo117.pdf>

©2012 Emerson Process Management. All rights reserved.

The Emerson logo is a trademark and service mark of Emerson Electric Co. DeltaV is a mark of one of the Emerson Process Management family of companies. All other marks are the property of their respective owners.

The contents of this publication are presented for information purposes only, and while effort has been made to ensure their accuracy, they are not to be construed as warranties or guarantees, express or implied, regarding the products or services described herein or their use or applicability. All sales are governed by our terms and conditions, which are available on request. We reserve the right to modify or improve the designs or specifications of our products at any time without notice. Content of legal disclaimers is dependent on each business unit's legal requirements.

[www.MicroMotion.com/Gas](http://www.MicroMotion.com/Gas)

