PID: a problem in the global solar industry

The performance degradation of solar modules

Renewable energies are among the most important sources of electricity in Germany. Their expansion is a central pillar of the energy transition. Solar energy is one of the most significant renewable energy sources. Photovoltaic systems and solar parks represent an ever-increasing share of global energy production, because photovoltaics offer many advantages: extremely low operating costs and reliable yield forecasts; they do not require extensive construction measures and do not produce either pollutants or noise.

Photovoltaic systems are also becoming particularly attractive in terms of their service life, which is now specified at 20 to 40 years. This depends primarily on the quality of the individual components. The quality of the solar modules, inverter and mounting frame is therefore crucial. The service life of the PV system is also determined by factors such as professional planning and design, the execution of the installation, and regular maintenance and servicing.

A problem that now occurs in many PV systems and considerably impairs their service life is Potential Induced Degradation (PID) – the performance degradation of solar modules. As a result of negative voltage between the solar modules and the ground potential, there is a successive reduction in performance, meaning photovoltaic systems lose efficiency and yield on a daily basis. According to representative measurements and scientific studies, even the newest high-quality solar modules lose at least 0.25% of their Wp output per year.

Since the losses accumulate over the years, the initial, apparently very small 0.25% turns into a loss of at least 5% after a period of 20 years. This means an average annual loss of revenue of 2.5% over the 20-year period. If you view this 2.5% loss in relation to an average return from a PV system of 6-7%, the negative influence of PID on the yields and returns of PV systems can be clearly seen. With environmental conditions such as high ambient temperatures, solar irradiance, air humidity and salt content, more

Constantin Wenzlik

Float Controller SI, designed for string inverters or small central inverters with system voltages up to 1000 V

significant degradation is to be expected, resulting in considerable losses in yield within a very short time.

PID is quite difficult to identify in most cases, especially in its early stages, due to its uniform development. The solar system may already show significant, permanent loss of yield before PID can be detected with the help of monitoring data or before there are significant changes in the performance ratio of a PV system. Thermographic images or electroluminescence measurements (EL measurements) can contribute significantly to the early detection of PID.

The good news is that, in principle, the PID effect can be prevented from the outset and crystalline modules that have degraded can be restored to their original rated output.

PES asked Constantin Wenzlik, developer of the Float Controller technology and managing director of PADCON GmbH, how and why PV systems should be protected in order to keep the yields and returns of the systems consistently high and thus contribute decisively to the energy revolution.

PES: Solar modules are constantly being developed and improved. For some years now, module manufacturers have been advertising PID-free modules. Is PID even a real issue anymore?

Constantin Wenzlik: Solar modules are certainly getting better and we actually see extremely degraded modules less often. And that's a really good thing. In order to advance renewable energy, we need reliable energy producers that are stable in the long term. But the fact that we see extremely degraded modules less often doesn't mean PID generally occurs less frequently.

By improving the quality of the modules, the level of degradation can be reduced, but not the frequency. Just 5 years ago, we often saw degradations of >30% of the rated output. In plants with newer modules, it's less common to see such high levels of degradation. Their loss is more likely to be in the range of 5 to 10% of the rated output. However, this value shouldn't be underestimated. A loss of 5% can have a significant impact on the profitability of a plant.

Another point regarding the so-called PID-free modules. PID is a physical effect that always occurs and therefore can't be completely prevented. However, the effect can be reduced by improving the quality of the modules and using optimized insulation materials. In the best case, however, we're still talking about an annual degradation of >0.25% per year. Over a period of 20 years, this still represents an average loss of 2.5%. For this reason, we recommend that PV systems are always equipped with anti-PID protection.

PES: You're talking about basic anti-PID protection. What does this protection look like and what solutions does PADCON offer?

CW: In general, the aim is to prevent a negative voltage potential in the solar modules compared to the ground potential. This negative voltage is the main cause of PID. You can prevent a negative potential in two different ways. Some PV systems offer the possibility of grounding the negative pole of the solar generator, i.e., connecting it directly to the ground potential.

Or you can use anti-PID boxes, such as the PADCON Float Controller, to actively raise the potential of the PV generator so there's no negative voltage on the modules compared to the ground potential. We have solutions for plants with string inverters and plants equipped with central inverters.

PES: Grounding the negative pole sounds easier and cheaper. Does it make any sense to use anti-PID boxes?

CW: Grounding the negative pole has two decisive disadvantages. Firstly, grounding isn't always possible. Especially if string inverters are installed on the system,

Float Controller CI, designed for larger photovoltaic power plants with system voltages from 1000 V to 1500 V

grounding the negative pole in this way is possible only in rare cases.

Secondly, grounding the negative pole of a solar generator considerably increases the risk of personal injury and the system may be entered only by personnel trained and instructed in electrical engineering.

This isn't the case when using anti-PID boxes. So, you see, other solutions are needed.

PES: You mentioned that new modules are expected to degrade by >0.25% per year. Does an investment in anti-PID protection actually pay off?

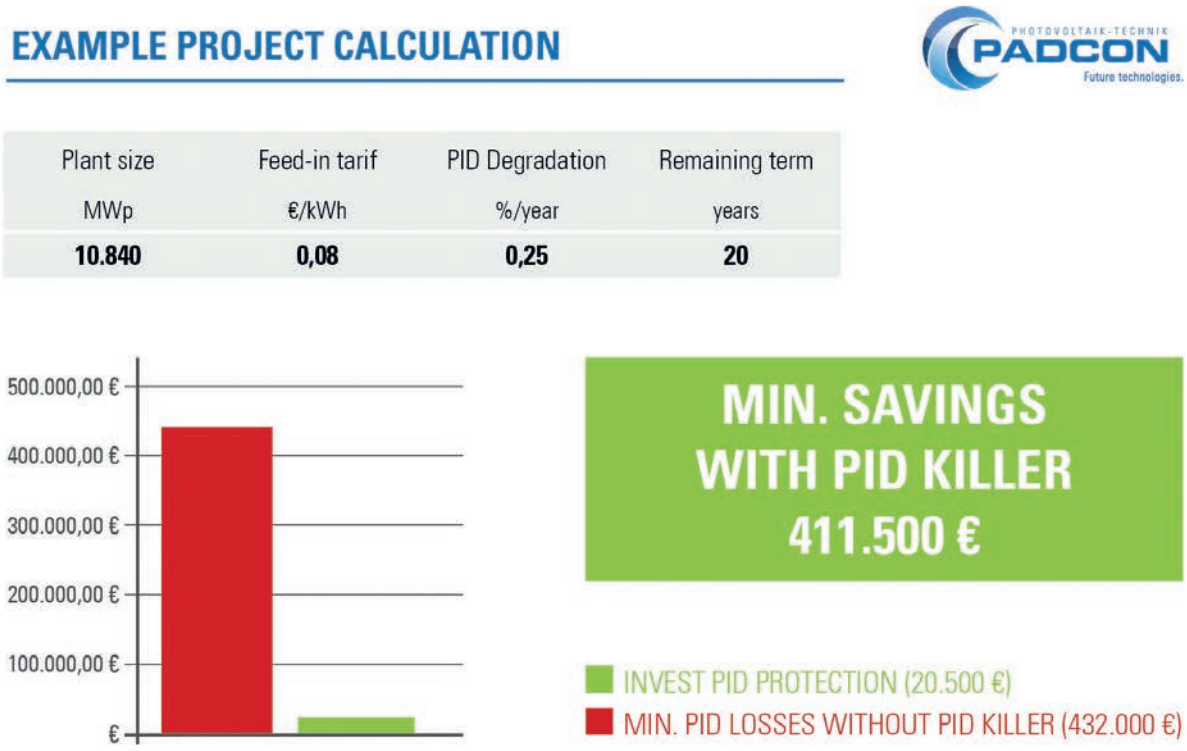
CW: 0.25% is a very optimistic average. Depending on environmental conditions such as temperature, humidity, etc., the value can be well over 0.25% per year. It's also important to note here that the losses add up. This means that within 10 years a degradation of >2.5% occurs.

The profitability of the investment depends largely on the basic parameters of the respective investment. Depending on the predicted annual yield and the corresponding feed-in compensation, our products have an amortization period of between half a year and around 2 years.

Installation example: In PV plants with multi-MPPT inverters the additional installation of a Multi Connector enables the Float Controller to deal with up to 20 MPPTs.

PES: PV plant construction is characterized by high pricing pressure and small margins. Is there currently any willingness in the market to take PID protection into account right from the beginning?

CW: We are still at the very beginning of preventive use. If PID protection isn't required from the outset by the investor or the module manufacturer, there's little interest on the part of the EPCs to bear the



PV plants are losing yield and efficiency every day due to PID – according to studies, at least 0,25 % per year. Depending on environmental conditions, a greater degradation of PV modules is to be expected. The result is a dramatic loss of earnings within a very short time.
By using an anti PID Solution on new photovoltaic plants from the beginning you can keep the efficiency of the plants at the highest level and save at least 2,5 % of your returns every year.

costs of PID protection themselves.

However, investors and asset owners are demanding PID protection increasingly often. Some module manufacturers now also demand measures to prevent PID from the outset. This is mainly due to an increase in the installation of PV systems with a DC voltage of up to 1500V. And the higher the DC voltage of a PV system, the higher the risk that the modules will have increased PID. We've already had customers for several years who preventively equip all their PV systems with our Float Controller.

There's a clear upward trend here. If we do our homework and offer efficient solutions, it'll become standard practice in the coming years for PV systems to be preventively protected against PID.

Installation example: Installed Float Controller CI for the regeneration of degraded PV modules.

About PADCON

PADCON GmbH (a member of the HOCH.REIN Group) specializes in the development and implementation of PID solutions. The Float Controller technology makes it possible to stop PID on PV systems simply and effectively and to successfully restore the performance of affected modules. This makes it possible to raise the yields of already degraded PV systems back up to their rated output.

Float Controller technology has been continuously developed since 2011. In December 2019, the PID Solutions/Float Controller division, including the right to use the name PADCON, was transferred to the HOCH.REIN Group, an international medium-sized investment holding company that invests continuously in the further development of technologies in the global PV market.

With experience of installing more than 3,000 anti-PID products, PADCON GmbH is one of the market leaders in this segment.

Further information is available at www.padcon.com.

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