Active power control of electrolysis by cell temperature control

The increasing deployment of large-scale power consumption units like electrolysis systems, coupled with a rising share of renewable energy systems, prompts a need for a reliable and efficient connection to transmission grids.

As part of the operational requirements, these units should withstand rapid frequency changes and led to new requirements for the connection of these units to transmission grids. Among these requirements is the need for fault-ride-through (FRT) and ideally, actively contribute to frequency stabilization.

The active power input of electrolysis systems is dependent on the direct current applied to individual other key operation requirements such as the rate-of-change-of-frequency (RoCoF) withstand capability.

The power consumption units are stacks and the sum of the stack voltages. These units can manipulate grid frequency by adjusting their power intake. To boost the grid frequency, power consumption required to remain connected to the grid even during rapid frequency changes, and ideally, these units should also be actively controlled to stabilize the frequency.

However, while it is relatively easy to reduce the power consumption to increase the grid frequency, increasing the power intake for power consumption units without can be reduced. In contrast, an increase in the power intake can lower the frequency value. Moreover, the challenge arises when the power consumption units are operating at 100% and an increase in power intake is required.

Previously, the solution to this problem was to operate the plant in partial load overload capacity can be a challenge if they are already operating at 100% capacity. Historically, to overcome this challenge, the power plant could or add an additional parallel load to increase the power intake. However, these solutions can be inefficient and may not be feasible in either be constantly operated in partial load or an additional parallel load could be utilized to take up the power. Nevertheless, these solutions all situations.

The proposed solution takes an innovatively approach, it capitalizes on the fact that the electrolysis polarization curve advantage of the fact that the polarization curve of the electrolysis is dependent not just on the cell age, but also on the cell temperature. Therefore, if

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a higher active power intake is required, and not only depends on the cell age but also on the cell temperature.

When a higher active power intake is needed, and the electrolysis is at maximum operation, the active power the electrolysis is already running at its maximum operating current, the active power intake could be increased by adjusting the cooling water control intake can be increased by lowering the operating temperature setpoint of the electrolysis. This is achieved by adjusting the cooling water control valves and lowering the operating temperature setpoint of the electrolysis.

This action would lead to a decrease in cell temperature, thereby valves which leads to a lower cell temperature. Consequently, the cell voltage rises for a constant current, leading to a higher active power consumption without altering the gas production rate.

This method is efficient and does not require the over-dimensioning of any components. The main differences increasing the active power consumption without altering the gas production rate. The advantages of this method are numerous.

Firstly, it provides between this invention and known solutions are significant. Unlike the state of the art, which only allows electrolysis to be regulated within an additional functionality for grid services from electrolysis by using already existing components, without the need for over-dimensioning.

Secondly, the newer the cells its allowed gas production regime and is externally controlled, and prior inventions which achieve overload capability only through external equipment, this invention allows for the regulation of active power beyond the rating of the electrolysis. This is achieved with a minor time limitation if the plant is at its end-of-life rating.

This innovation offers a more flexible and efficient solution to the challenge of connecting large-scale power consumption units to the transmission grids, contributing to the ongoing efforts to increase the share of renewable energy systems.

In conclusion, the invention provides a novel and efficient solution to a significant challenge in the renewable energy sector. By making use of the temperature setpoint of the electrolysis, albeit over a longer time period since the heat exchangers are running at the design point. In contrast the inherent properties of electrolysis systems, it provides a practical and cost-effective way to enhance the connection of large-scale power consumption units to transmission

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grids. This contributes to the broader goal of increasing the share of renewable energy systems and maintaining grid stability.