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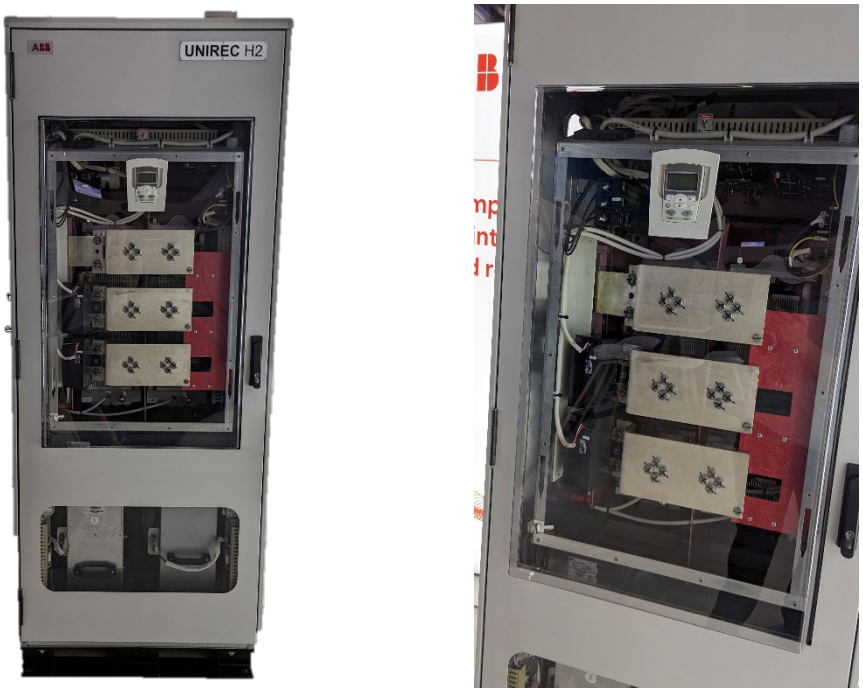
Application Fact Sheet

SIL 2 Rectifier Monitoring for Hydrogen production

Application report
Monitoring the rectifier current

1. What is the initial situation?

- Electrolysers are used to produce hydrogen, chlorine or ammonia. Various processes are used for this: AEL/AEM, PEM or SOEC.
- Depending on the electrolysis process, water (PEM) or salt solution (AEL), for example, is split using **electrical energy** (voltage at two electrodes) via several ion exchange membranes and the splitting products (hydrogen, oxygen, chlorine, caustic soda) are captured.
- The electrical energy is provided as DC current from a **rectifier**
- Before the electrolyser goes under load, a smaller DC current from a **polarization rectifier** is connected to ensure the correct polarization of the individual membranes
- For the safe operation of the electrolyser, it is crucial that a minimum current always flows. Otherwise, hydrogen ions in the electrolyser may recombine to form H2 atoms, creating a **risk of explosion**. This is particularly relevant in the PEM process.
- In order to eliminate this explosion risk, the operator may have to take considerable protective measures, restrict access to the electrolyzer bay, invest in ventilation, train personnel, etc.
- Some of these costs can be reduced if the current at the rectifier is monitored with a certain SIL level instead and a safety rated alarm signal is triggered if it falls below the critical level
- This is not possible without MÜTEC products, as there is no other signal converter with SIL2 certification that can measure currents via shunt resistors of any size



Typical rectifier for the electrolysis process

2. Solution:

- An HVT 300-DV is installed on the secondary side of the **main rectifier**, which reliably measures the current via a shunt resistor. (2x HVT 300-DV for redundancy and voting reasons*)
- An HVT 300-DV is installed on the secondary side of the **polarization rectifier**, which reliably measures the current via a shunt resistor. (2x HVT 300-DV for redundancy and voting reasons*)
- In addition, an HVT 300/400 DX is often installed on the primary side of the rectifier to safely measure the **AC voltage** between the transformer and rectifier (e.g. 1500V AC)
- If the current falls below a certain value (process-dependent), the HVT 300-DV usually sends **an alarm signal to the PLC via the relay outputs**. Two limit values (e.g. pre-alarm and main alarm) are available on the device.
- The analogue 4-20mA output of the HVT 300-DV rectifier is used to transmit the measured current to the PLC.
- The monitoring system is designed to be safe and redundant. It is **maintenance-free** due to low failure probabilities PFDavg (average Probability of Failure on Demand)

* 1oo2 voting, for example, can prevent the system from being switched off by mistake

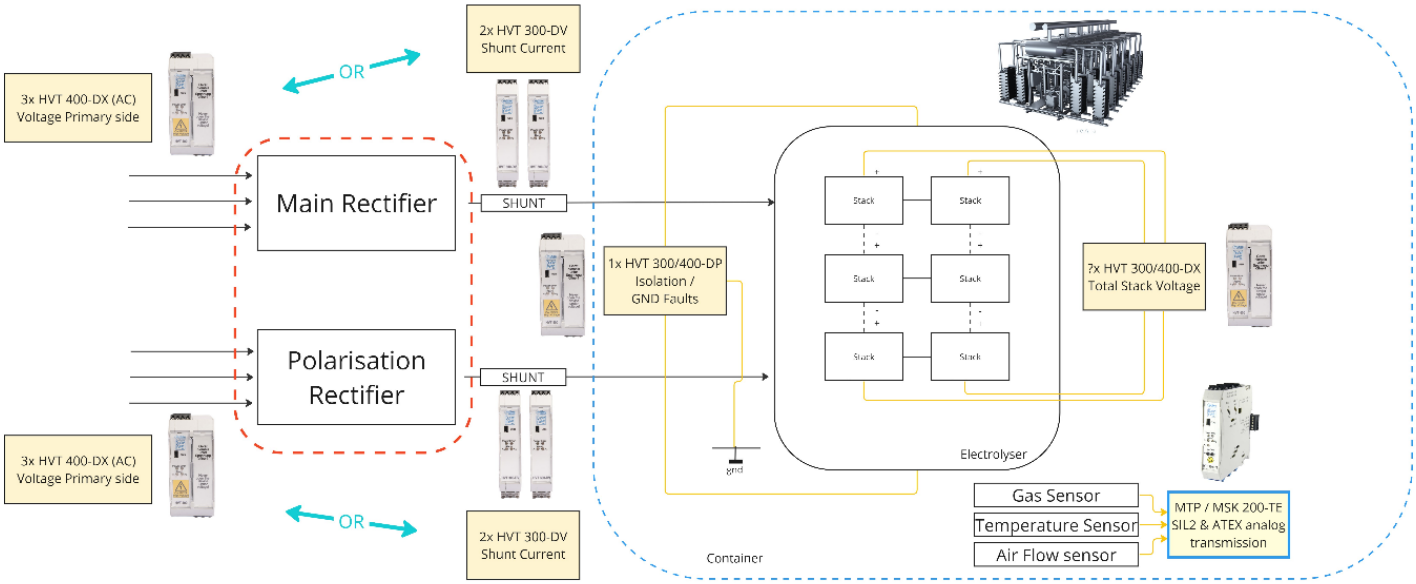


Illustration 1 Overall PEM Monitoring, Left side shows rectifier monitoring

3. What needs to be considered during planning and implementation:

- Works with all electrolysis processes with DC rectifiers
- Plan the following:
  - Design the shunt resistor so that it maps the current to 0-70mV to match the measuring range of the HVT 300-DV
  - Integration of the SIL relays (REL3 & REL4) of the HVT 300/400 by series connection or in PLC (required for SIL rating)
- Note the following during implementation: EMC influence of rectifiers is not negligible (installation with distance or special room / cabinet)

4. Customer benefits:

- No health hazards for employees, a critical explosion risk can be ruled out
- No risk to the equipment
- Possibly reduced expenditure for other explosion protection measures, e.g. ventilation, employee training, etc.
- Measurement and SIL2 alarming in one device
- Maintenance-free SIL2 (in accordance with IEC/EN 61508) and high FIT. As a rule, the systems are only checked every 10 years (proof test interval)
- Easily configurable HVT: alarm values individually configurable via Windows software (2 SIL relays, 2 freely configurable relays)
- High dielectric strength of the device, can be installed at high potential

5. Restrictions

- No contactless measurement (2 cable pairs per device)

6. Why our solution is the best

- The only SIL2-certified signal converter with which voltages up to 1500V and any currents can be safely measured and alarm values safely switched
- Low probability of failure and long product service life
- Secure *and* flexible risk management

7. References

- Siemens, PEM electrolysis, e.g. in the NormandHy project, Trailblazer, Hy4Chem
- ABB, AEL electrolysis, e.g. in the NEOM project

If you have any questions or concerns, please do not hesitate to contact us!

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