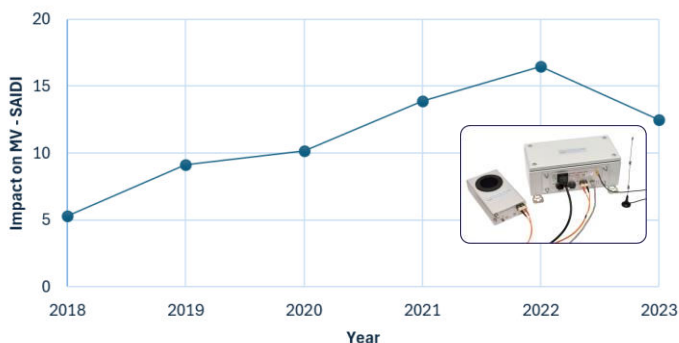


SUCCESS CASE 23.2024

Smart Cable Guard

IMPROVING GRID RELIABILITY BY PREVENTING POWER OUTAGES IN MEDIUM VOLTAGE GRIDS

MV - SAIDI reduction [%]



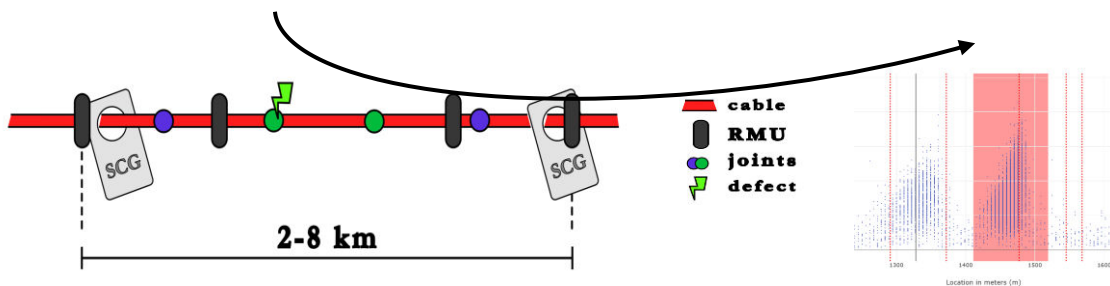
THE CHALLENGE

Grid reliability is crucial for grid operators, especially in the context of the energy transition. The main cause of outages in medium voltage (MV) grids is cable damage (e.g., due to excavation work) and joint failures.

In the future, the grid is expected to face more failures due to potential overloading from increased demand and the integration of renewable energy sources. Outages not only disrupt customer service but also divert skilled technicians from building new infrastructure to repairing existing systems, hindering the overall grid development. In the Netherlands, the MV grid is fully cabled, making cable failures one of the dominant outage causes.

THE SOLUTION

Smart Cable Guard (SCG) is an online sensor system designed to prevent power failures by precisely localising partial discharges in joints and cables that precede a failure.



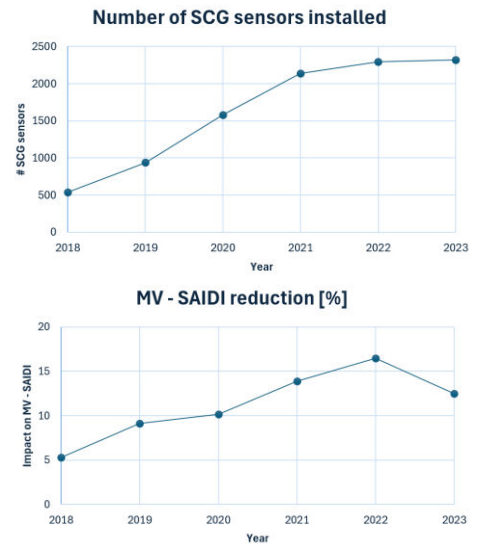
Schematic of SCG sensors in the MV-grid localising faults (left) and detecting localised Partial Discharge activity (right).

The SGC not only helps prevent failures: when a fault (short circuit) occurs, the system can pinpoint its exact location. This reduces recovery time significantly. The system can even detect faults that occur outside of the monitored section.

To detect partial discharges in the data gathered by SCG, Alliander has developed its own artificial intelligence (AI)-powered detection platform Guardian. Using this platform, skilled operators can judge early, AI-generated warning signals and take appropriate action. In the process, valuable insights are gathered on the failure behaviour of monitored grid components.

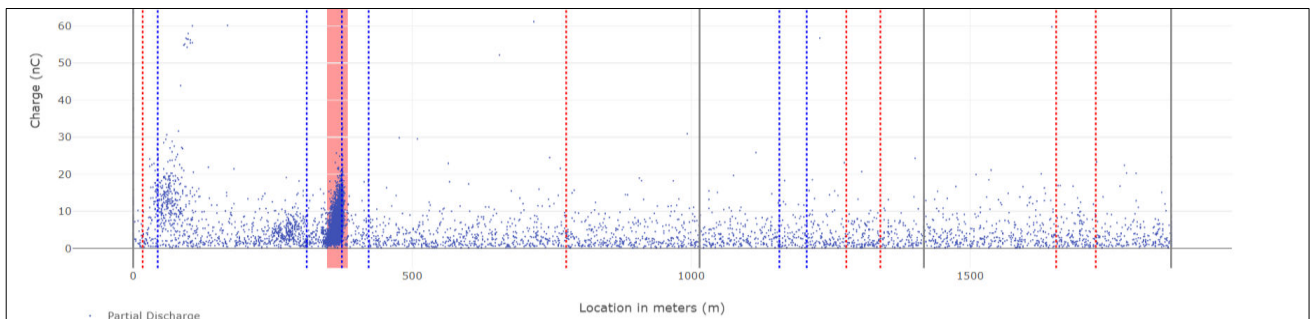
MAIN ACHIEVEMENTS

- Alliander has already rolled out **2'300 sensor systems** monitoring **15%** of its **most critical MV grid connections**.
- The System Average Interruption Duration Index (**SAIDI**) of the total MV grid has been **reduced by about 2 minutes per customer** (~15% of the previous average value of SAIDI).
- More than **250 outages** have been **prevented** using the SCG in the last five years.
- The SCG is integrated into Alliander's outage management system and allows immediate fault localisation, **reducing recovery time by 20%** in grids monitored by it.



KEY SUCCESS FACTORS

- Convincing the control room operating experts and technicians of the **trustworthiness of the system**.
- **Standardising the sensor placement** for regional teams and different types of installations.
- Defining a **risk-based rollout** taking into account asset types and impact upon outage.
- Implementing **standardised and scalable data analysis and decision processes**.



Partial discharges (blue dots) and warning (red bar) as shown in the Guardian platform to operators. The x-axis represents the location on the cable in meters, while the dotted lines represent cable joints. The joint highlighted by the red bar was preventively removed.

WAY FORWARD

Planned future uses of the SCG system include:

- **Temperature monitoring:** data from the SCG system can be used to estimate real-time cable temperature and allow Alliander to increase grid capacity by using real-time cable rating.
- **Asset-specific failure characteristics:** the SCG gives new insight into the failure mechanisms and degradation of cables and joints. This allows Alliander to replace them at the optimal time.
- **Meshed grid operation:** the SCG can be used to operate meshed grids, thus increasing transport capacity by up to 20-30% and improving voltage quality.