Highly sensitive sensors for GIS health checks

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Highly sensitive sensors for GIS health checks

Extending the life of ageing gas-insulated substations (GIS) requires precise data on their dielectric health from partial discharge monitoring. But the physical and electromagnetic environment is challenging for sensor design.

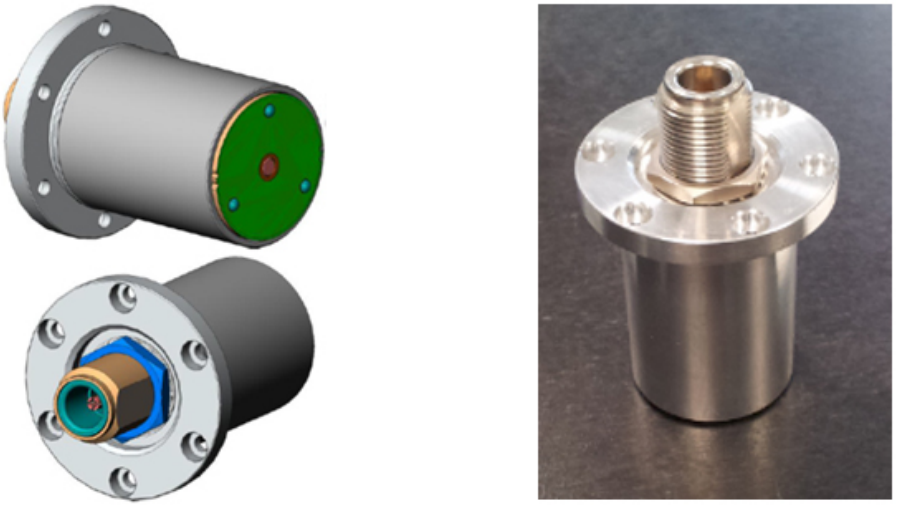
GIS have been around since the 1960s, and as the equipment ages, reliability can deteriorate. Moreover, the dielectric failure rate of GIS is higher for voltages above 170 kV. GIS could attain even greater availability rates by improving health monitoring through more effective in-service diagnostics. The IEC 62271-203 standard addresses this through stricter on-site testing, and recommends using partial discharge (PD) monitoring diagnostics.

For the user hoping to extend the lifetime of a GIS by retrofitting dielectric monitoring equipment, sensitivity is an issue. Thibaut Mauffrey, Alstom Grid GIS Digital Solutions Support Engineer, highlights a dilemma facing sensor designers: “Signal detection is crucial to diagnosis and the measuring equipment has to find the right compromise between the high sensitivity required to detect mobile particles, the most common defects, and a PD sensitivity value that can be obtained in the field. If the sensor is not shielded in an efficient manner, one can experience electromagnetic interference, even from mobile phones in the 300 MHz to 2 GHz range.” Radio transmitters and electrical corona can also cause problems.

A reputation to maintain

A number of devices are available on the market, but as Charlie Girard, Alstom Grid GIS Service Product Line Manager explains, “Due to the inadequate quality of existing sensors in terms of sensitivity, we decided not to offer a retrofit solution for PD monitoring with third-party devices as it wouldn’t be compatible with our quality and accuracy criteria. Alstom has built a worldwide reputation in GIS, and our customers have the right to expect more from us than from non-specialists in this field.”

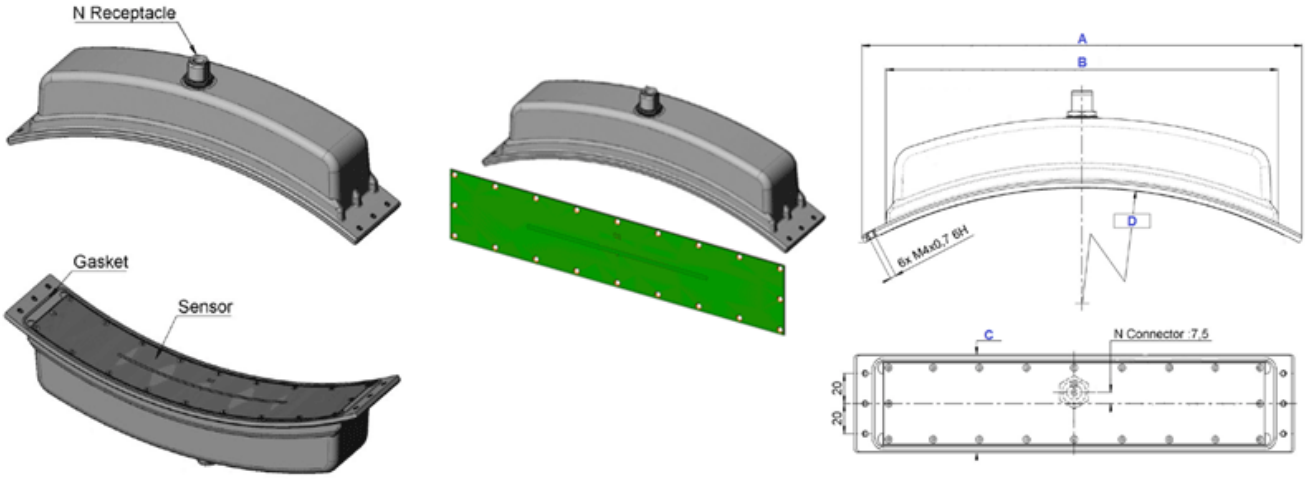
Lab tests carried out by Mauffrey and his colleagues show that the sensors being developed have far better sensitivity and accuracy than the devices with which they were compared – up to three times better in some bandwidths. Another limiting factor with sensors available on the market was the minimum size of coupler to fit with any type of GIS. Girard is pleased with the results: “We achieved satisfactory sensitivity for a 30 mm diameter device, compared to around double that size for those on the market. That was probably the greatest technical challenge we had to overcome.”



Viewport sensor - 32 mm

Specialist knowledge for general purpose

Two types of antenna were designed with the support of a specialist in aerospace and military applications. One is a viewport antenna that can be fitted to inspection viewports, the other is a barrier sensor to put on insulator flanges, where the flange design permits this. The antennas are the most sensitive available today, and each has been optimised using finite element electromagnetic modelling.



Barrier sensor on insulator flanges

This specialist expertise is combined with general applicability. Thanks to their standard Type N socket connector, these new sensors can be connected to any PD monitoring equipment of any gas-insulated substation, whoever the manufacturer. And because it is an external sensor, the mounting components and procedures have been designed so that legacy equipment can be upgraded without having to shut down the installation or to dismantle any of the components under SF6 gas pressure.

Girard insists that developing an in-house product is also part of a philosophy: “We can now propose a fully integrated and cost-effective solution for the retrofit of the whole range of GIS and the whole chain of technology, from detection to diagnosis.” Mauffrey adds that the human factor is vital all along the chain. “The technology and software can only do so much. In the end, the GIS and monitoring device expert is the one who is providing the right diagnosis to the customer to undertake the preventive maintenance action.”

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