

Improved internal arc protection with new techniques

October 26 2016

A new study from the University of Vaasa, Finland, investigates development directions of internal arc protection. Arc faults in switchgear can be characterized as electrical explosions which are very hazardous to personnel and devastating to equipment.

Lauri Kumpulainen's doctoral dissertation investigates development directions of internal arc protection. Arc faults in switchgear can be characterized as electrical explosions which are very hazardous to personnel and devastating to equipment.

"The safety of passenger cars improved significantly when safety belts were widely implemented. Analogously, the safety and reliability of electricity distribution systems can be enhanced by applying arc protection based on detection of light. This proven technology should be internationally standardized," says Kumpulainen, who defends his dissertation at the University of Vaasa.

Improvements in arc protection technology

Kumpulainen created a big picture of arc protection in his research work. He identified especially three potential areas for development: preemptive protection, communication within the protection system, and speeding up of the protection.

Again Kumpulainen compares the development of arc protection

technology with the technology introduced in cars. He reminds that recently the number of sensors, enabling self-diagnostics and safety, has significantly increased.

"Correspondingly, medium and low voltage switchgear can be equipped with sensors which constantly monitor the possible phenomena indicating slowly developing faults. Part of the potential faults can thus be identified well before they escalate into high energy arc faults."

One of the key areas of the work has been has been the investigation of sensors that could be utilized in preventive maintenance. Sensors for on-line monitoring of partial discharges in MV switchgear and a sensor for monitoring the temperature of connections in LV switchgear have been evaluated.

Communication in arc protection systems is another area developed in the research work. The laboratory experiments with the developed prototype system indicate that IEC 61850 standard based communication provide adequate speed and reliability also in arc protection systems. The developed system provides a number of benefits compared with systems with proprietary communication.

Since arc faults are explosive by nature, they set exceptional speed requirements to the protection. The bottleneck in the reduction of the arcing time is normally the operation time of the circuit breaker. Improvements in circuit breaker technology will directly lead to improvement of arc protection. However, there already exists extremely fast technology to extinguish the arc. Short-circuit devices can be applied in sensitive applications where the pressure impact should be mitigated along with the minimization of the thermal impact of the arc.

Publications have already disseminated the results

The article-based doctoral dissertation is mainly composed of journal articles. In addition to that, Kumpulainen has published and presented a number of conference articles, disseminating the results worldwide.

"From the scientific point of view, I have suggested development directions for arc protection. From the practical point of view, I humbly hope that the publications will contribute to the safety and reliability of switchgear by promoting the proven technology of optical arc detection. We in Finland have achieved very good results by applying this technology, so I think it should be standardized and become as common as seat belts and airbags in [passenger cars](#)," says Kumpulainen.

Provided by University of Vaasa

Citation: Improved internal arc protection with new techniques (2016, October 26) retrieved 19 April 2024 from <https://phys.org/news/2016-10-internal-arc-techniques.html>

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