HiMON®

Modular measuring and condition assessment system for HVAC and HVDC cables

HIGHVOLT Prüftechnik Dresden GmbH

Test, measurement and condition assessment equipment

HIGHVOLT Prüftechnik Dresden GmbH

HIGHVOLT – Test technology from the heart of Europe

Located in Dresden, Germany

Large HV test hall (60 m x 47 m x 33 m)

HIGHVOLT in facts

40 %
world market share

100 %
skilled staff

85 %
turnover by export

Representations worldwide

Service worldwide

Active participation in committees

View into the office building

Leading edge technology for energy transition

Research & development

Factory testing

On-site testing

Measuring

A success story of more than 115 years and continuing …

1904 — Foundation of Koch & Sterzel

1948 — Integration into TuR (Transformatoren- und Röntgenwerk)

1991 — Takeover of TuR by Siemens

1996 — Management buyout and foundation of HIGHVOLT

2002 — Member of Reinhausen Group

2022 — Acquisition of ATS

Lighthouse projects around the world

Most powerful resonant test system for cables

Nexans, USA

First mobile transformer test system in Africa

Reinhausen ZA, South Africa

Transformer impulse test system

Mayo Transformadores, Argentina

Automated distribution transformer test system

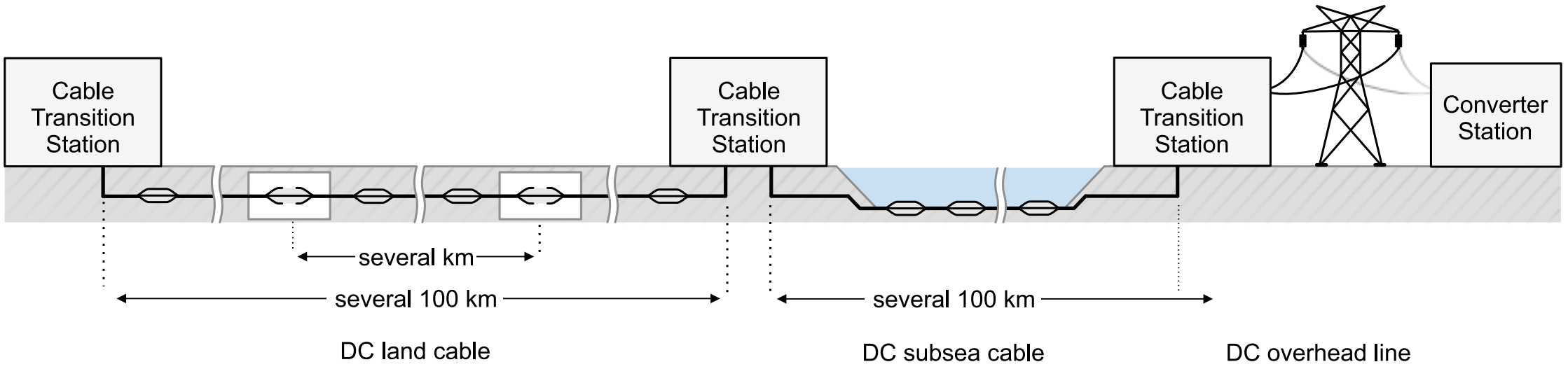
ABB, Poland

National research test fields

Korea Electrotechnology Research Institute (KERI), RO Korea

Availability of cable systems

Principal of transmission lines and their availability



Availability [1)]	**approx. 95 % [2)]**	**approx. 92 % … 97 %**	**> 99 %**

1) depending on lengths
2) annual failure rate per km (per pole) = 0,001

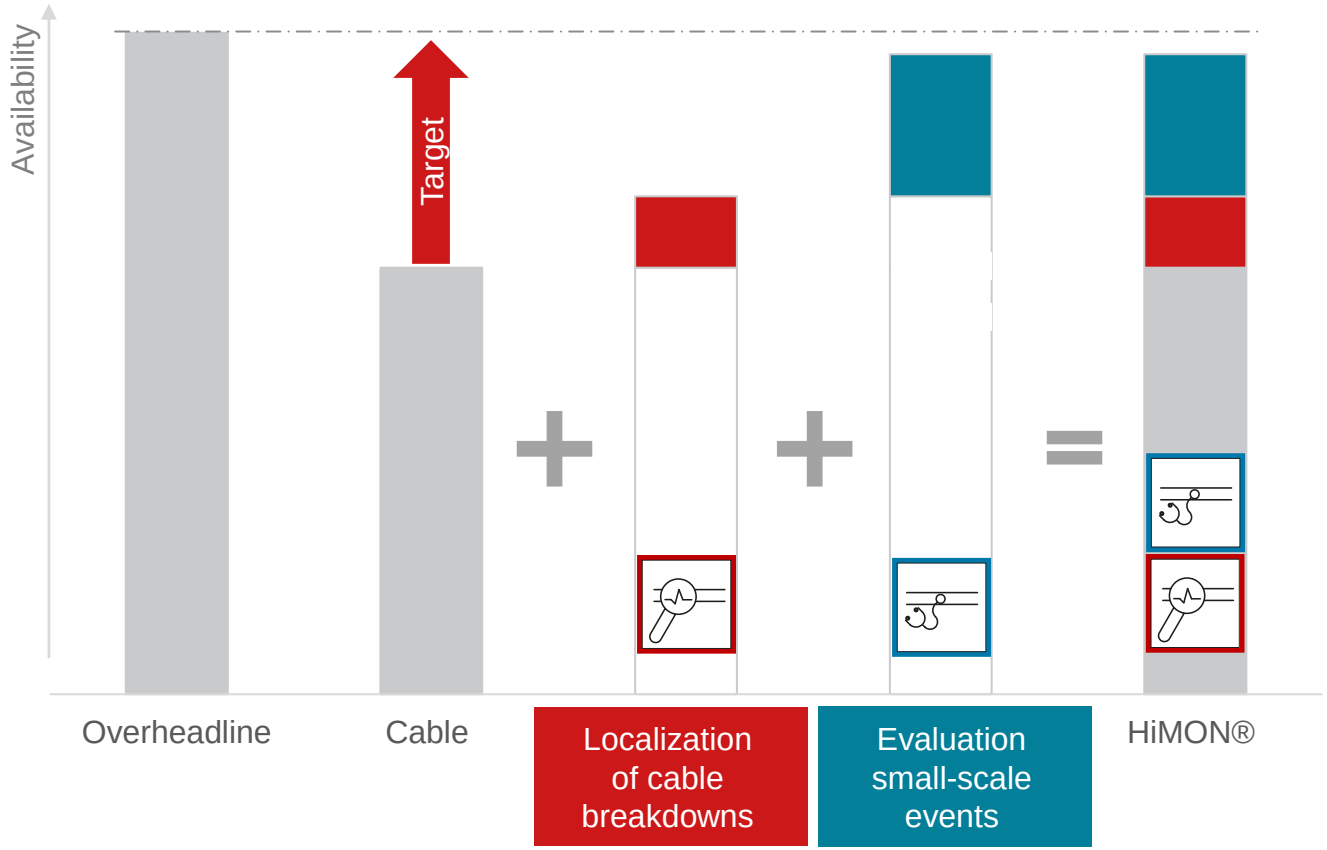
Motivation for condition assessment on cables

Goal - Increase in availability of cable transmission lines

- Condition assessment during factory testing, commissioning and operation
  - Fast localization of cable breakdowns
  - Detection of oncoming faults
  - Evaluation of aging

Result - Recommendations for action

Increase in availability for cable systems

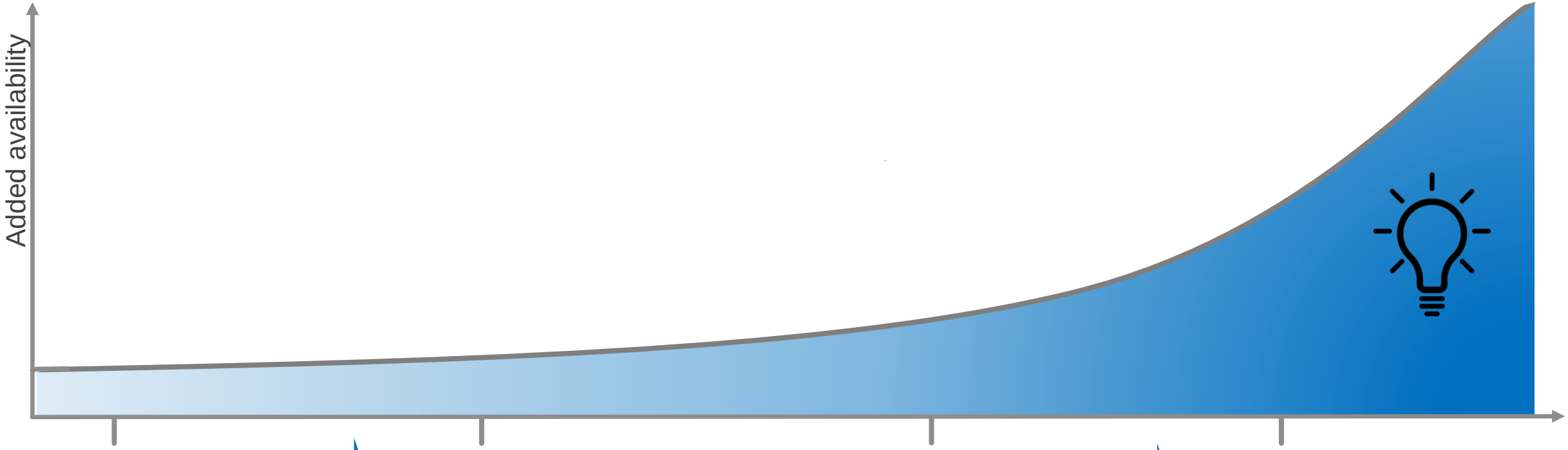


Target: Reduce 30% of repair time

Target: 70% of faults are found in advance, so they can be repaired during planned shutdowns.

HiMON® makes the availability of cable systems comparable to that of overhead lines.

Added availability of transmission systems (functions)



Manufacturing
AC/DC factory test

- Fast localization of cable breakdowns
- Quality assurance (PD) for joints / cables

Installation

- Theft monitoring for the cable system
- Quality assurance (TF) during on-site joint installation

Commissioning
AC/DC after-installation test

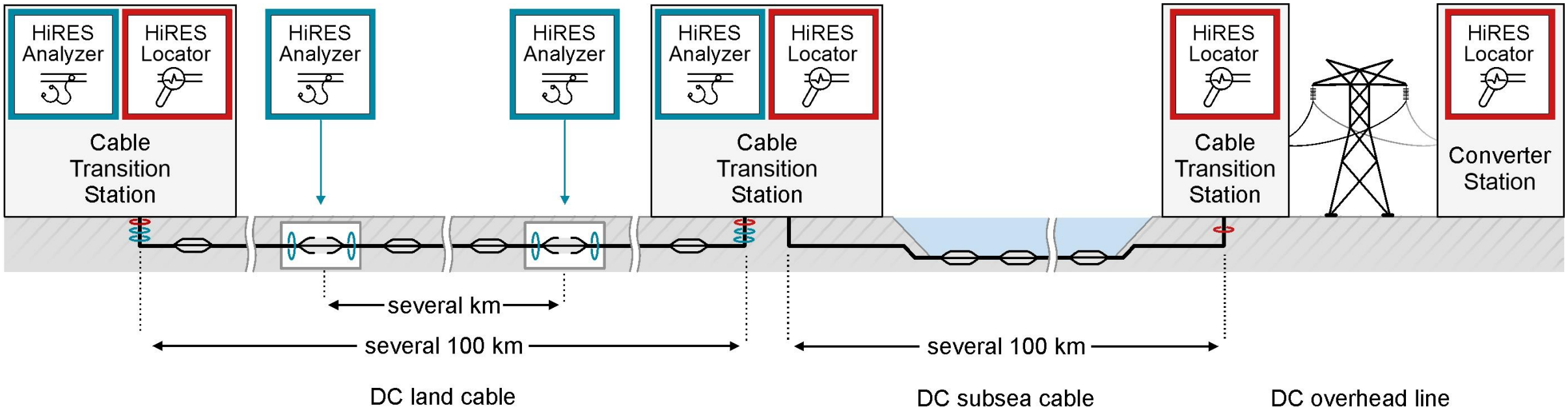
- Fast localization of cable breakdowns
- Quality assurance (PD) for joints / cables

Operation

- Fast localization of cable breakdowns
- Small-scale event evaluation
- Risk-analysis

Overview about HiMON®

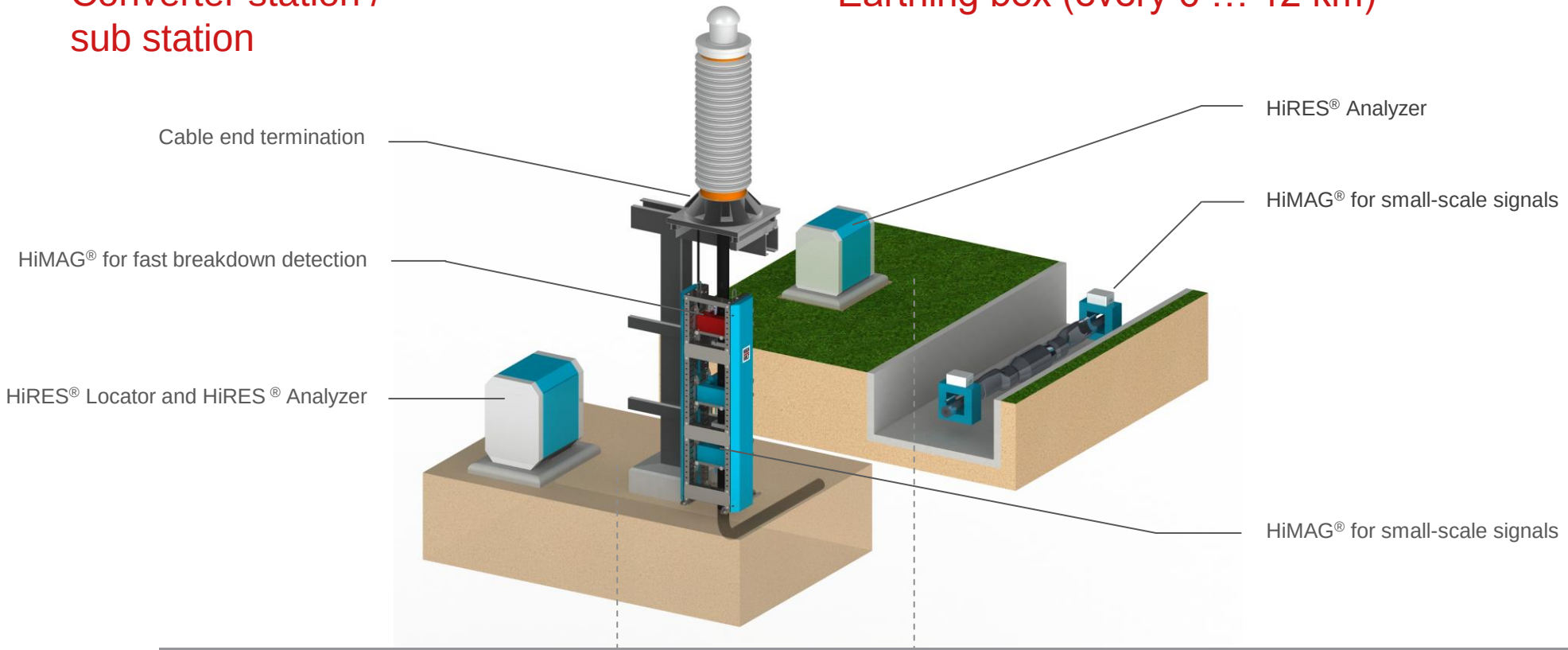
System integration



System integration (one pole / one phase)

Converter station / sub station

Earthing box (every 6 … 12 km)



HiMON® Intelligence Cluster

Product and service overview

HiMON®
Intelligence Cluster

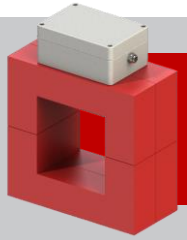
HiMAG® family
HFCT sensors

HiRES® family
Event recorder

HiMON®
Service

Service-level-agreement

Fast localization of cable breakdowns



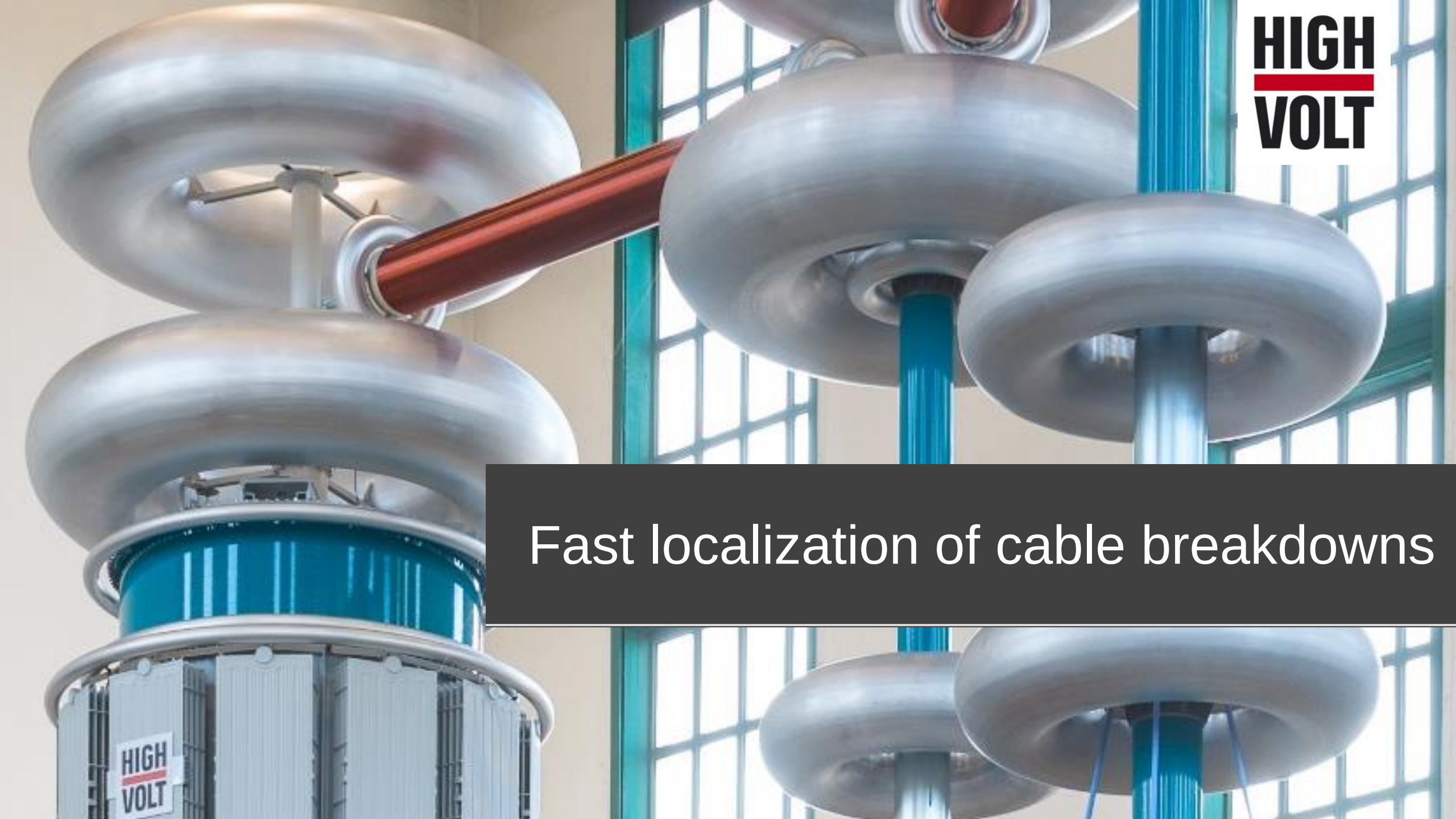
HiMAG®
Red

HiRES®
Locator

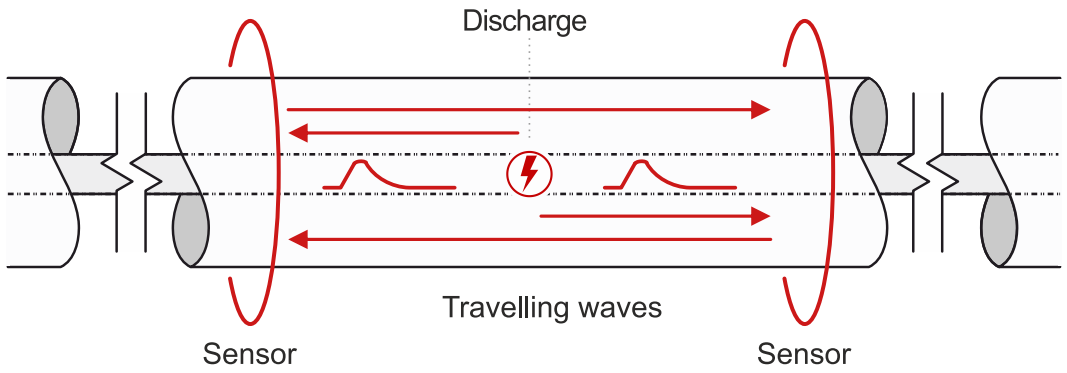
Evaluation of small-scale events

HiMAG®
Blue

HiRES®
Analyzer


HIGH
VOLT
Fast localization of cable breakdowns
HIGH
VOLT

Method for fast localization of cable breakdowns (RT-TDR)



Real Time - Time Domain Reflectometry (RT-TDR)

- **Cable breakdown**
  A break down within the cable insulation causes a high-power transient impulse that leads to travelling waves moving in both directions of the fault location.

- **Fault localization**
  Determining the location of the fault under consideration of the measured transit time of the travelling waves.

Cable data
length, v = f(C‘, L‘, R‘),
of each cable segment

Fingerprint measurement
Determination of propagation speed
for each cable segment

Components for fast localization of cable breakdowns

Event Recorder
HiRES® Locator

HFCT Sensor
HiMAG®

Overview about main components

Sensor

- HFCT sensor HiMAG® or wide band divider

Event recorder HiRES® Locator, incl.

- Digitalization unit (125 MS/s, 14 Bit)
- Industrial server
- 19-inch plug-in design

IT infrastructure

- Data collector on premise
- HiMON® Intelligence Cluster
- Flexible concept for cyber security
- Data is not system relevant (integration in IT-infrastructure)

HFCT Sensor HiMAG® for fast detection of cable breakdowns

Benefits of HiMAG® in comparison to wide band divider

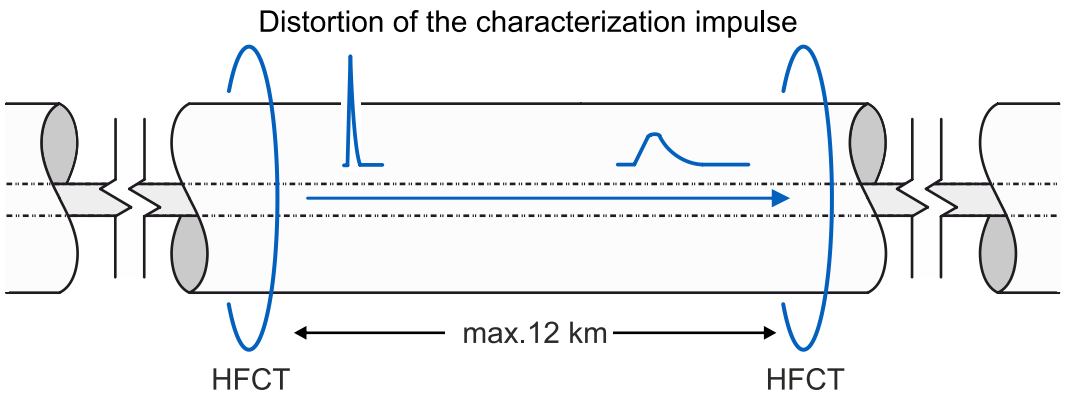
- Easy integration, no intervention in transmission system
- Lower investment costs
- Smaller footprint
- Lower maintenance cost

Evaluation of small-scale events

Methods for small-scale signal evaluation (RT-TF and TruePD)

RT-TF

Analysis and synthesis of all cable sections

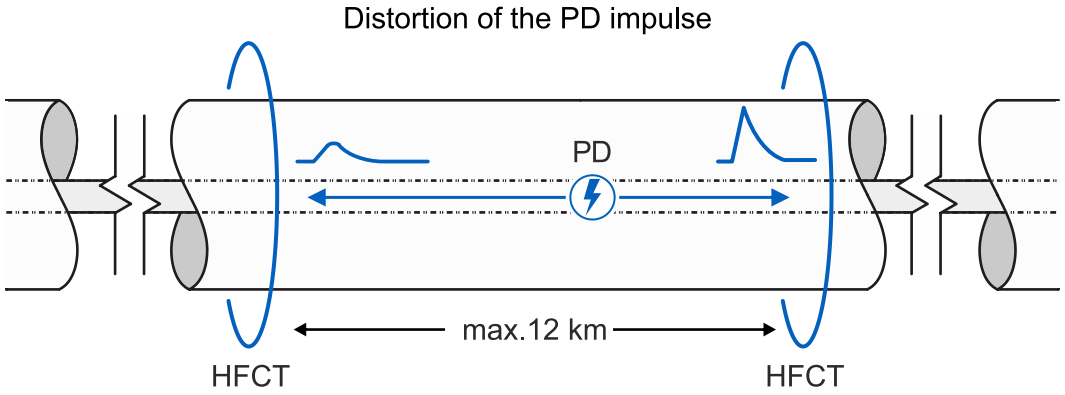


Periodic modelling of a cable section between two sensor units.

Injection of small impulses into the cable in order to determine the transfer function of the cable section.

TruePD

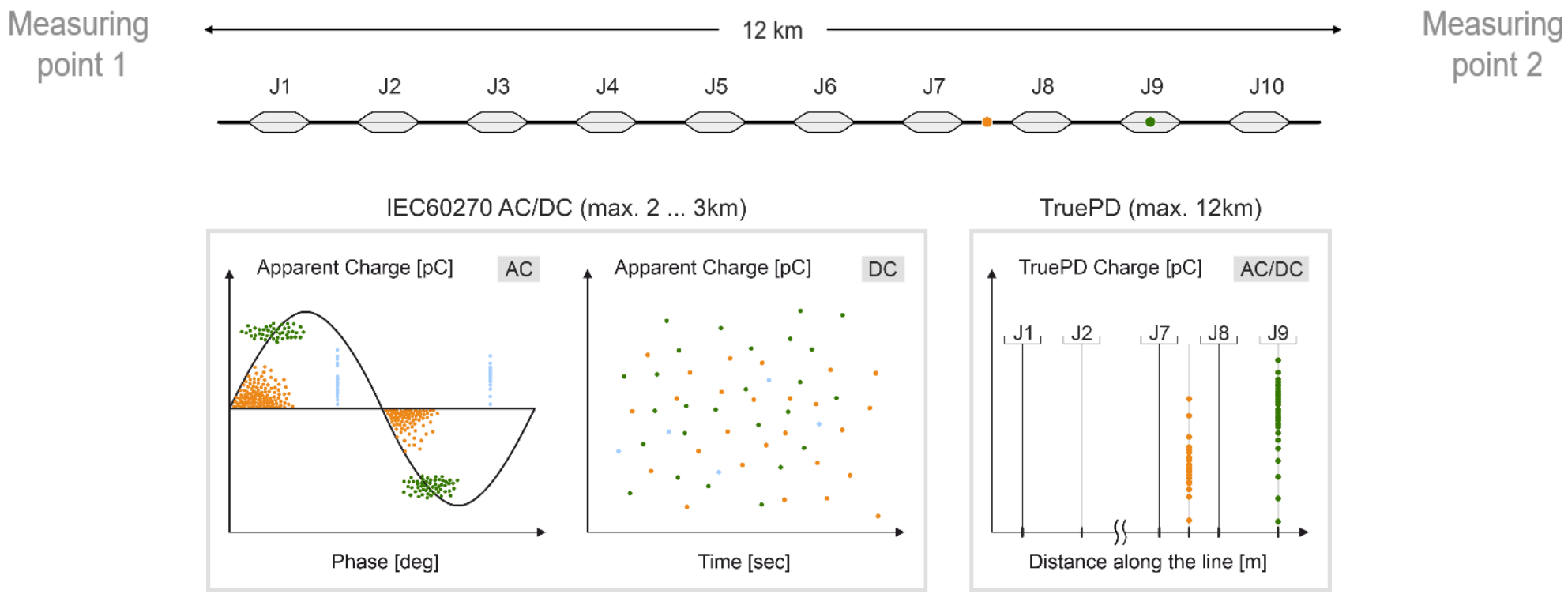
Measurement and filtering of real signals



Localization and determination of detected partial discharges at the location of the fault under consideration of the actual cable transfer function.

Classification and characterization of the events with AI algorithms.

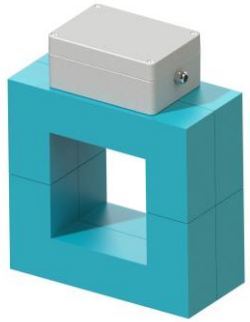
Comparison of results: methods acc. to IEC 60270 and TruePD



TruePD is a fast and robust method for the evaluation of the condition of AC and DC cable systems.

Components for evaluation of small-scale signal

Event Recorder
HiRES® Analyzer



HFCT Sensor
HiMAG®

Overview about main components

Sensor

- HFCT sensor HiMAG®

Event recorder HiRES® Analyzer, incl.

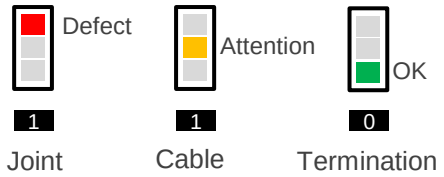
- Digitalization unit (250 MS/s, 16 Bit)
- Impulse generator
- FO LAN repeater
- Industrial server
- 19-inch plug-in design

IT infrastructure

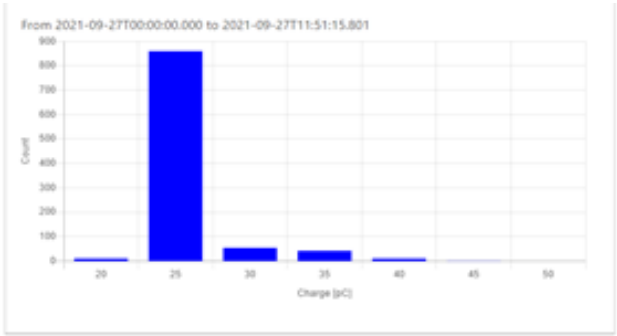
- Data collector on premise
- HiMON® Intelligence Cluster
- Flexible concept for cyber security
- Data is not system relevant (integration in IT-infrastructure)

HiMON® Intelligence Cluster

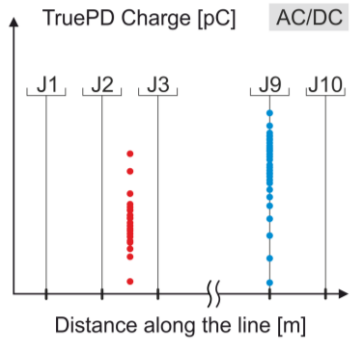
Reports



Traffic lights

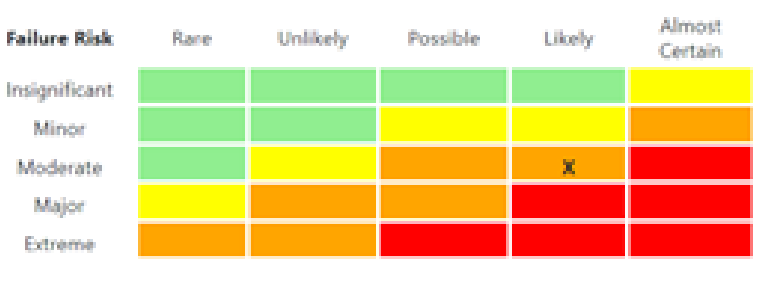


Frequency of the charges

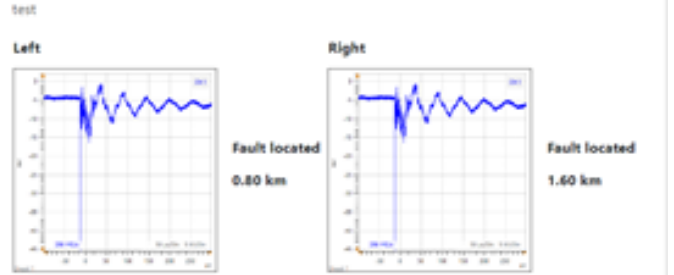


Spatially resolved PD

PD Trend [1)]



Risk-analysis

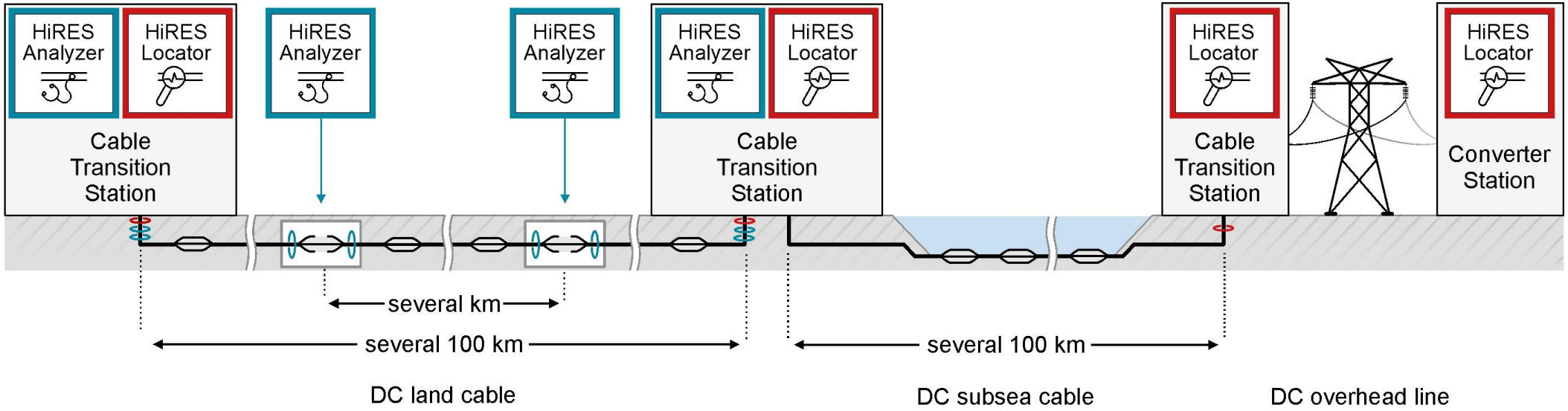


Pulse shapes

1) threshold values are generated from real operating experience

Conclusion

Conclusion – Increase of availability [1)]



	DC land cable	DC subsea cable	DC overhead line
	approx. 95 %	approx. 92 % … 97 %	> 99 %
RT-TDR	+ 1 %	+ 1 %	
RT-TF + TruePD	+ 1.5 %		
HiMON®	approx. 97.5 %	approx. 93 % … 98 %	

1) Based on example calculations

Conclusion – Benefits of HiMON®

- HIGHVOLT is neutral
- Reduction of downtime costs
- Reduction of failure probability
- Economical integration in new and existing cable systems
- HIGHVOLT is an experienced partner for the realization of demanding projects

HIGH VOLT
Test with the best.

Highest availability for your cables due to our successful cooperation.