

HiMON[®]

Modular measuring and condition
assessment system for HVAC and HVDC cables

HIGHVOLT Prüftechnik Dresden GmbH

The image shows a large industrial high-voltage testing facility. In the foreground, there are several large, silver, toroidal (donut-shaped) components, likely part of a transformer or reactor, mounted on a blue metal structure. A thick, copper-colored rod is visible, extending from the left towards the center. In the background, there are more similar components and a large window with a grid pattern. The overall scene is brightly lit, suggesting an indoor industrial environment.

**HIGH
VOLT**

Test, measurement and condition assessment equipment

HIGHVOLT Prüftechnik Dresden GmbH

**HIGH
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HIGHVOLT – Test technology from the heart of Europe



Located in Dresden, Germany

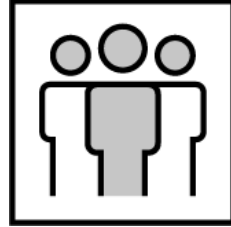
**HIGH
VOLT**

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

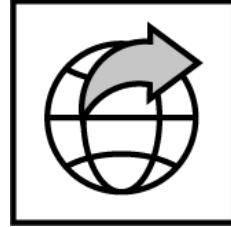
HIGHVOLT in facts



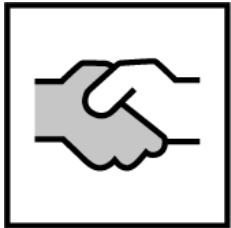
40 %
world market share



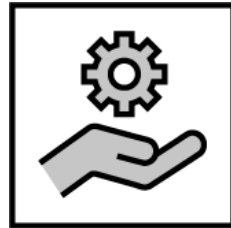
100 %
skilled staff



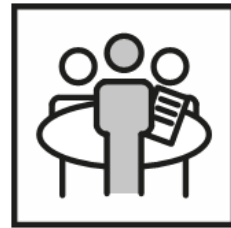
85 %
turnover by export



Representations
worldwide



Service
worldwide



Active participation
in committees



View into the office building

Leading edge technology for energy transition



Research & development



Factory testing

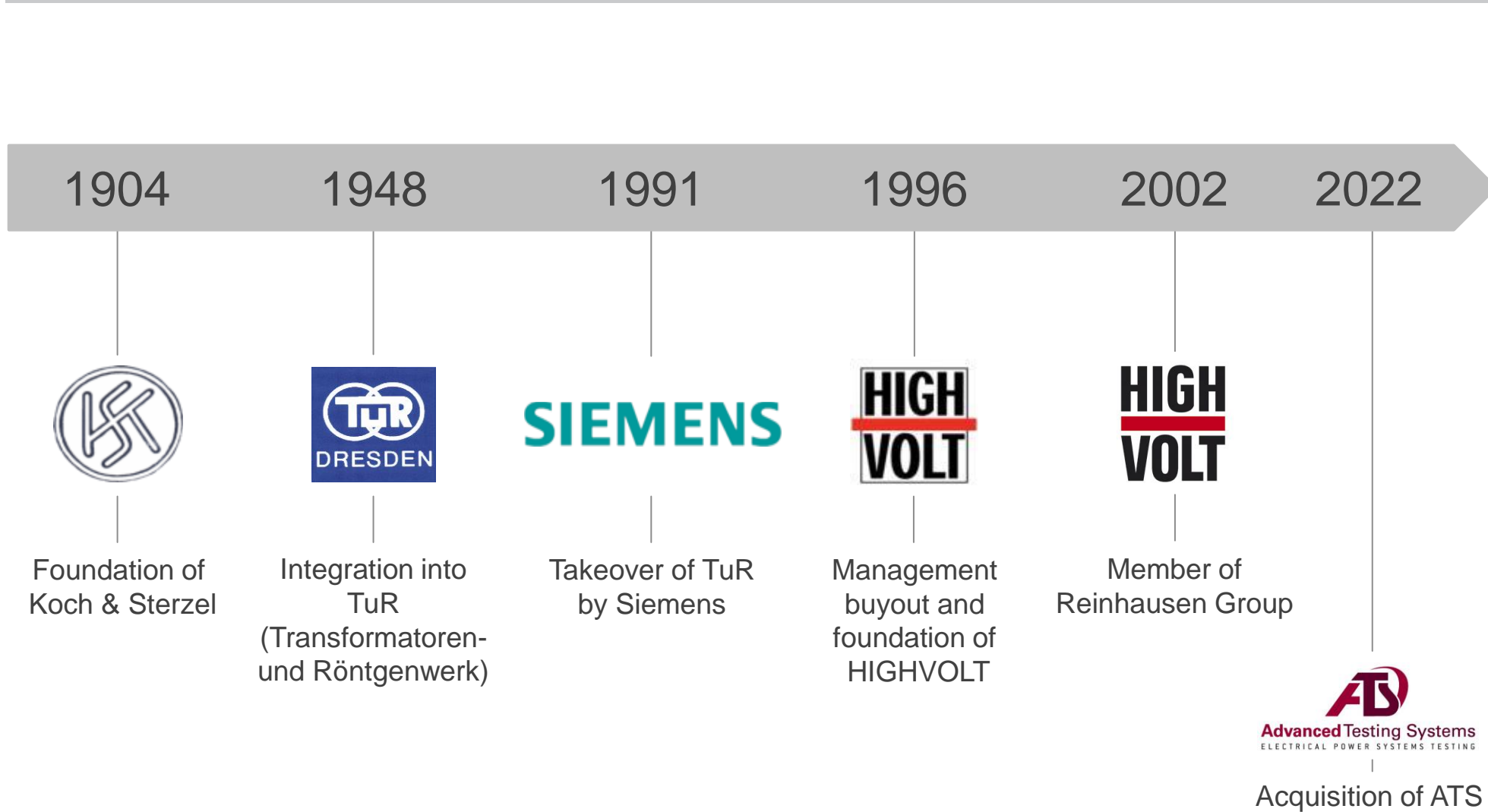


On-site testing



Measuring

A success story of more than 115 years and continuing ...



Lighthouse projects around the world



Most powerful resonant test system for cables

Nexans, USA



Transformer impulse test system

Mayo Transformadores, Argentina



Automated distribution transformer test system

ABB, Poland



First mobile transformer test system in Africa

Reinhausen ZA, South Africa



National research test fields

Korea Electrotechnology Research Institute (KERI), RO Korea

The logo consists of the words "HIGH" and "VOLT" stacked vertically in a bold, black, sans-serif font. A thick red horizontal bar is positioned between the two words.

**HIGH
VOLT**

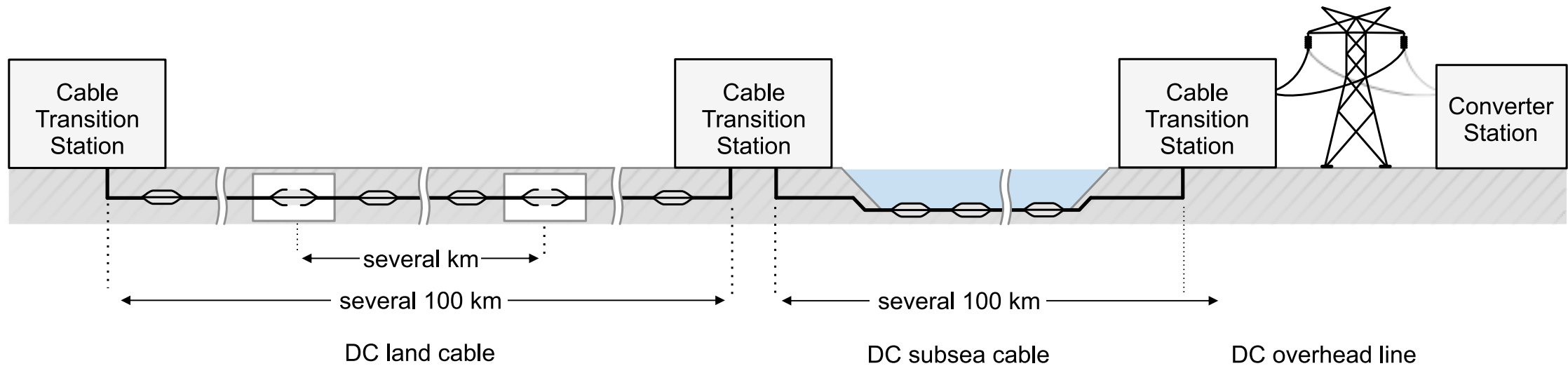
The image shows a high-voltage cable system with multiple grey, disc-shaped insulators mounted on blue vertical support poles. A red cable is visible in the upper left, and a blue cable is visible in the lower right. The background features a window with a grid pattern.

Availability of cable systems

A small version of the "HIGH VOLT" logo is located on a white label attached to the bottom left of the equipment. The label has a red horizontal bar between the words.

**HIGH
VOLT**

Principal of transmission lines and their availability



Availability ¹⁾	approx. 95 % ²⁾	approx. 92 % ... 97 %	> 99 %
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- 1) depending on lengths
- 2) annual failure rate per km (per pole) = 0,001

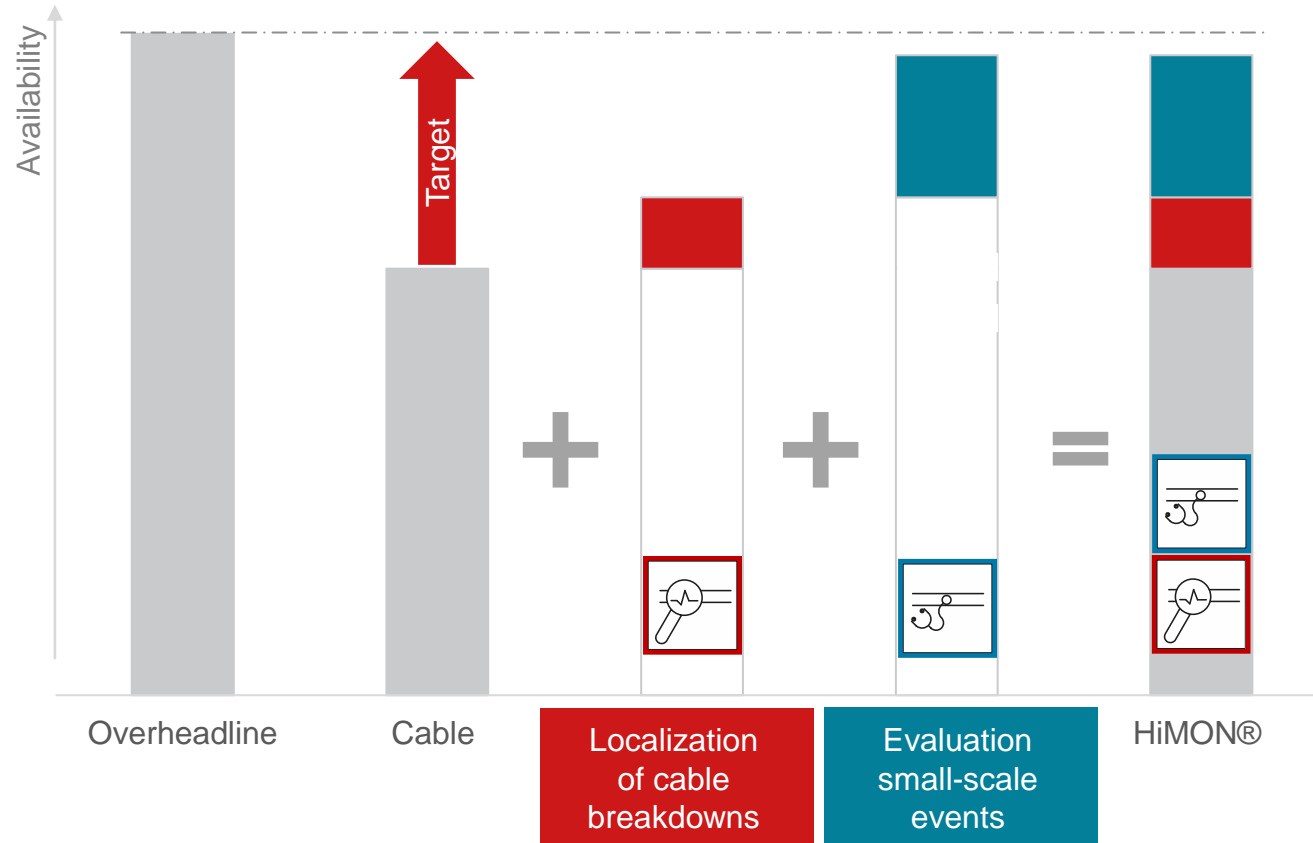
Motivation for condition assessment on cables

▶ **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

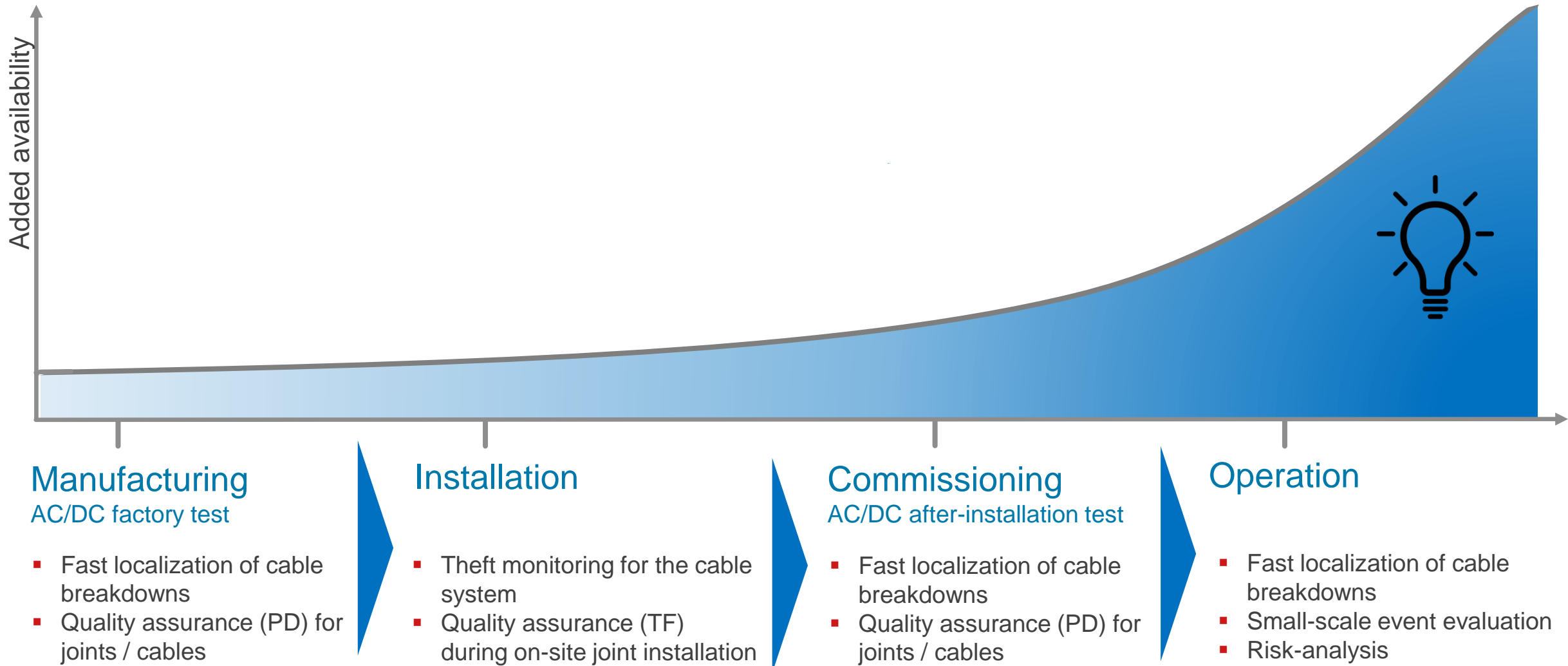


Target: Reduce 30% of repair time

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)



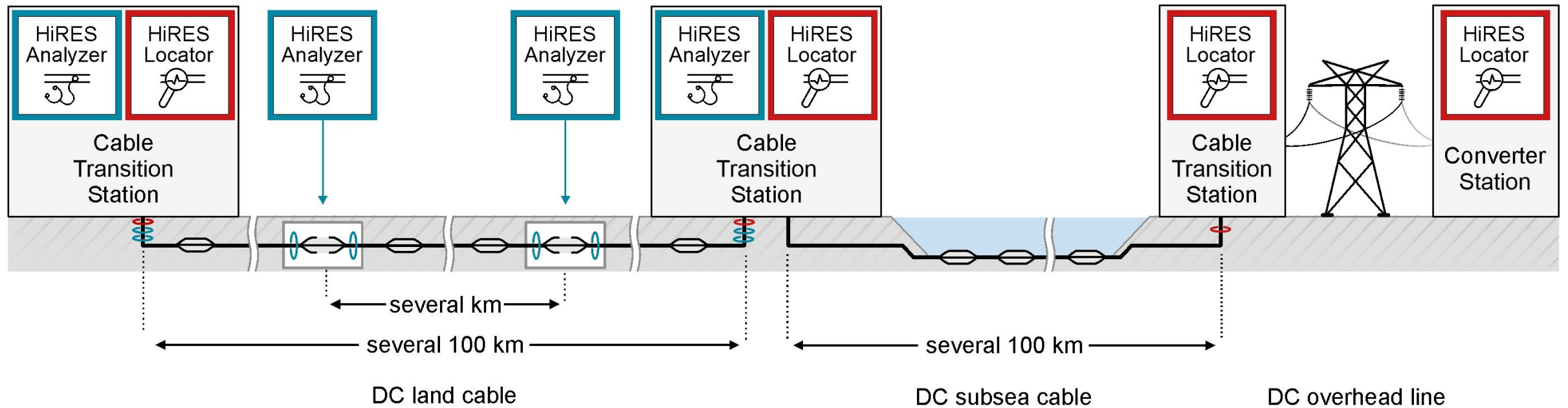


**HIGH
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Overview about HiMON[®]

**HIGH
VOLT**

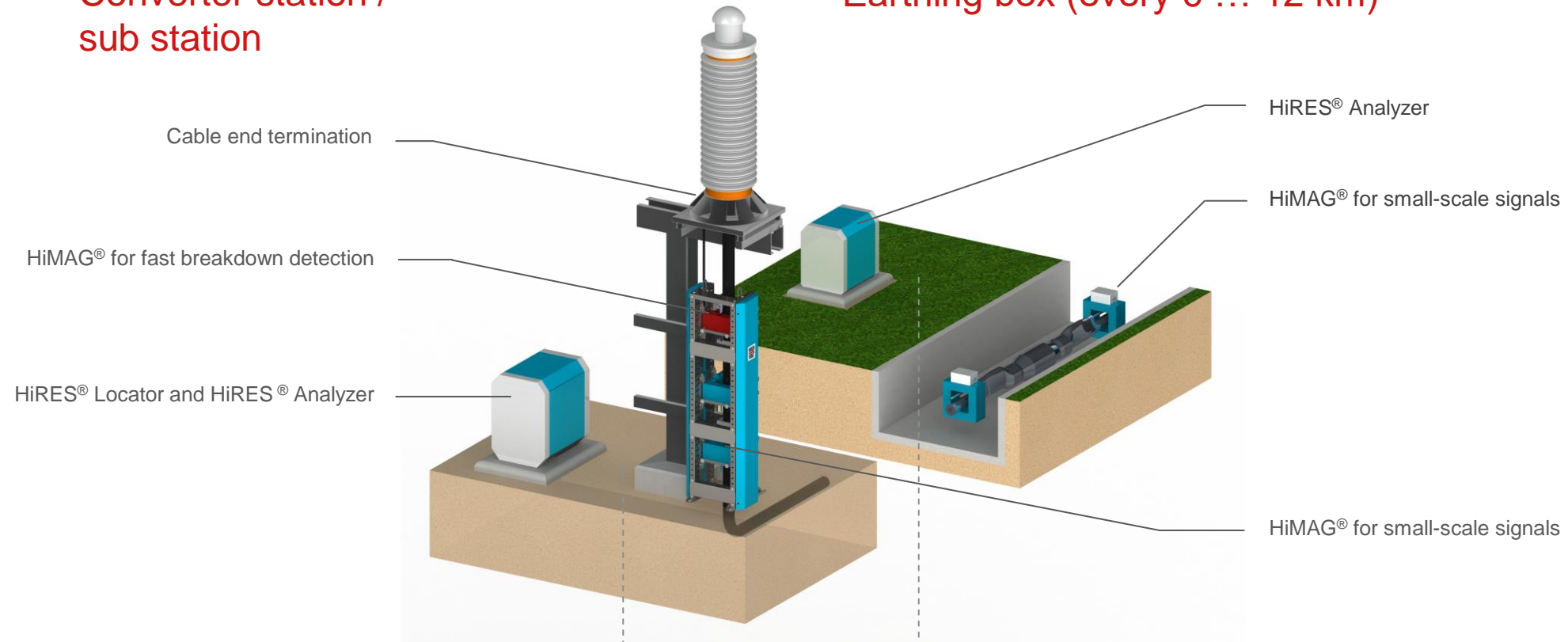
System integration



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

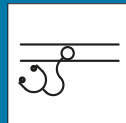
**Fast localization of
cable breakdowns**



HiMAG[®]
Red

HiRES[®]
Locator

**Evaluation of
small-scale events**



HiMAG[®]
Blue

HiRES[®]
Analyzer



The image shows a high-voltage testing facility with several large, silver, toroidal components mounted on blue vertical supports. A red cable is visible in the upper left. The background features a window with a grid pattern. The text 'HIGH VOLT' is displayed in the top right corner, and a dark banner with white text is centered across the middle of the image. A small 'HIGH VOLT' logo is also visible on the bottom left of the equipment.

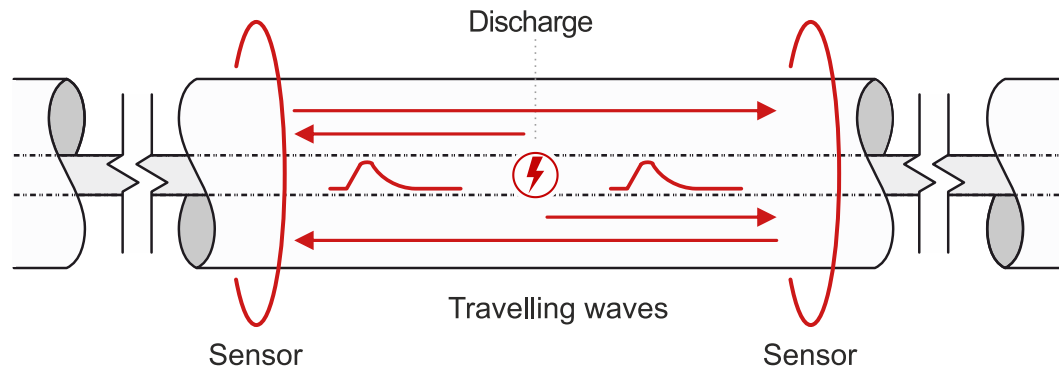
**HIGH
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Fast localization of cable breakdowns

**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

The background of the slide is a photograph of a high-voltage laboratory. It features several large, silver, disc-shaped insulators mounted on vertical blue support poles. A prominent red horizontal rod is visible in the upper left. The scene is lit by natural light from a window with a grid pattern on the right.

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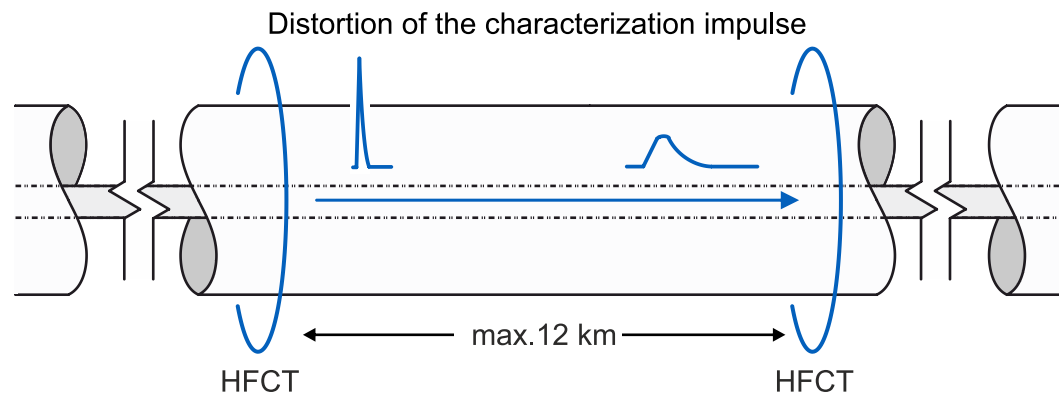
Evaluation of small-scale events

**HIGH
VOLT**

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

RT-TF

Analysis and synthesis of all cable sections

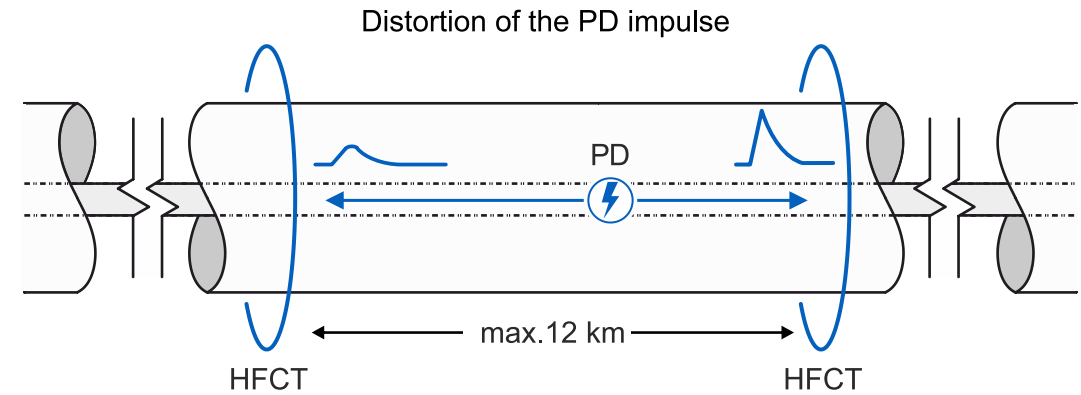


Periodic modelling of a cable section between two sensor units.

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

TruePD

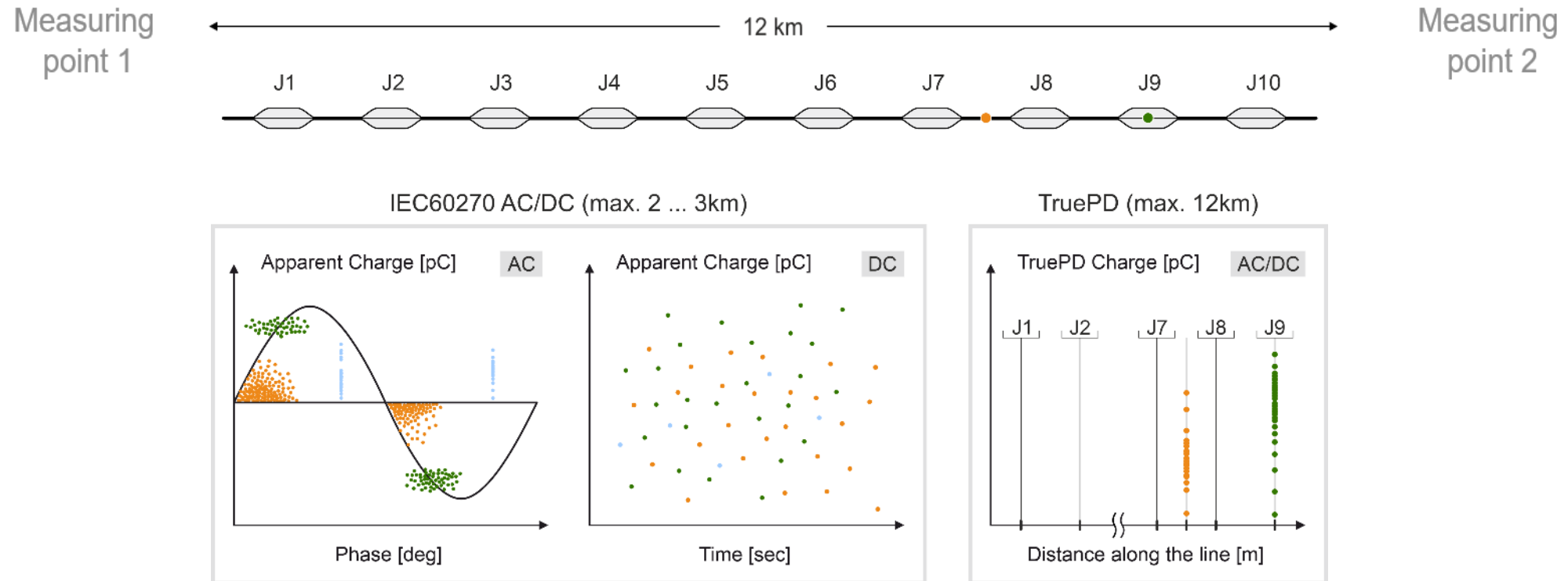
Measurement and filtering of real signals



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

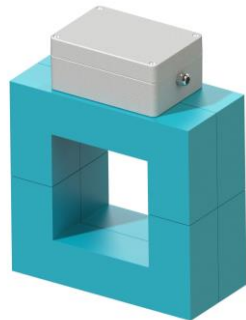


TruePD is a fast and robust method for the evaluation of the condition of AC and DC cable systems.

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)

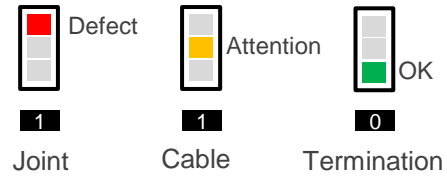


**HIGH
VOLT**

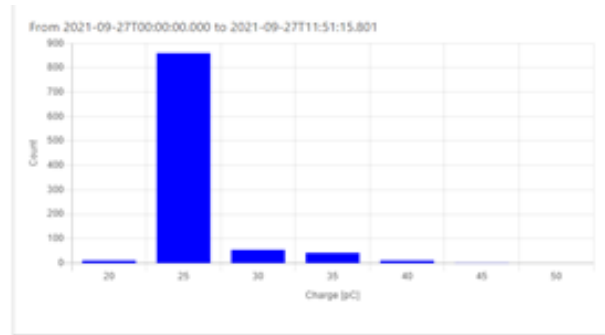
HiMON[®] Intelligence Cluster

**HIGH
VOLT**

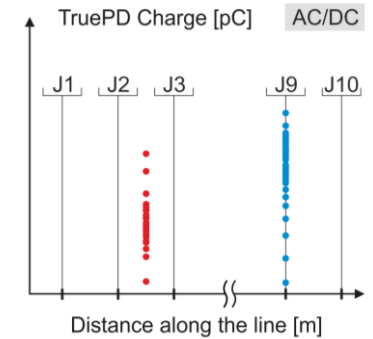
Reports



Traffic lights



Frequency of the charges



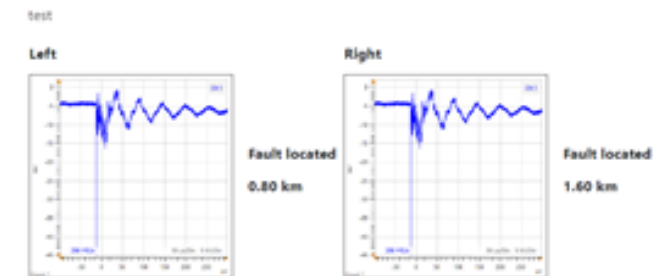
Spatially resolved PD



PD Trend ¹⁾

Failure Risk	Rare	Unlikely	Possible	Likely	Almost Certain
Insignificant	Green	Green	Green	Green	Yellow
Minor	Green	Green	Yellow	Yellow	Orange
Moderate	Green	Yellow	Orange	Orange X	Red
Major	Yellow	Orange	Orange	Red	Red
Extreme	Orange	Orange	Red	Red	Red

Risk-analysis



Pulse shapes

1) threshold values are generated from real operating experience

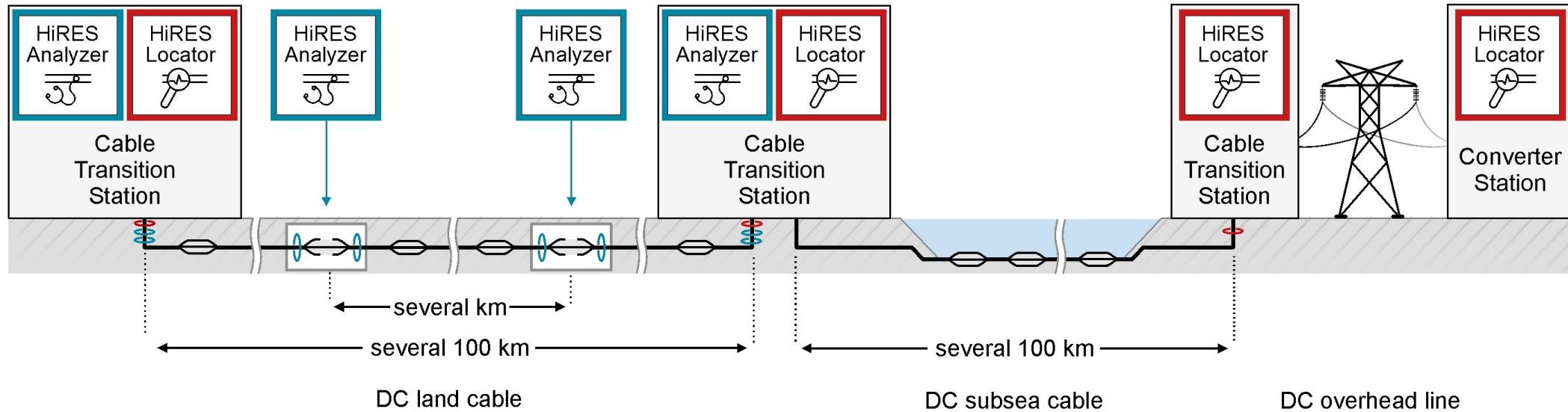
The background of the slide is a photograph of a high-voltage laboratory. It features several large, silver, disc-shaped insulators mounted on blue vertical support poles. A prominent red horizontal rod is visible in the upper left. The scene is lit from the side, creating strong highlights and shadows. A window with a grid pattern is visible in the background on the right.

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Conclusion

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Conclusion – Increase of availability ¹⁾



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.**