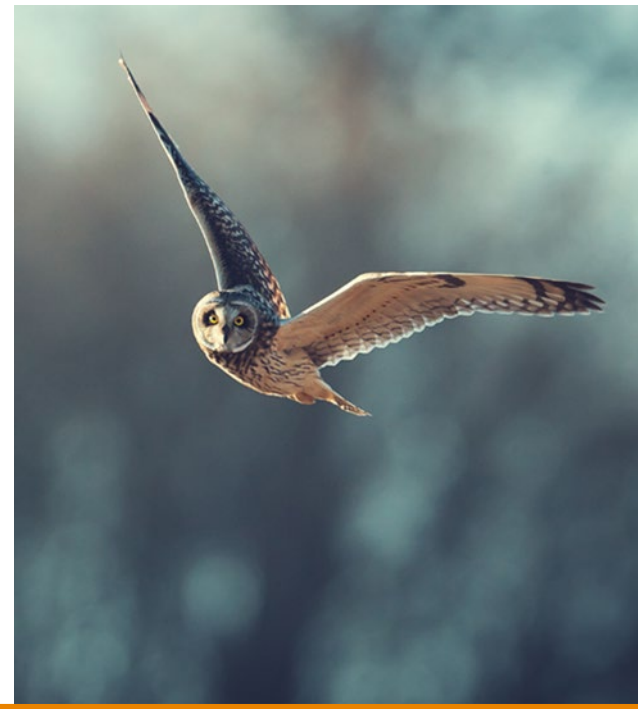
Smart Monitoring Solutions to Improve Reliability in Distribution Power Grids

EVERY CONNECTION COUNTS



Agenda

- TE Connectivity Overview
- Customer Challenges
- Smart Monitoring Portfolio
- Q&A

$2.1B

COMMUNICATIONS

Appliances, Data & Devices

$9.0B

TRANSPORTATION

Automotive, Industrial & Commercial Transportation, Sensors, Application Tooling

$3.8B

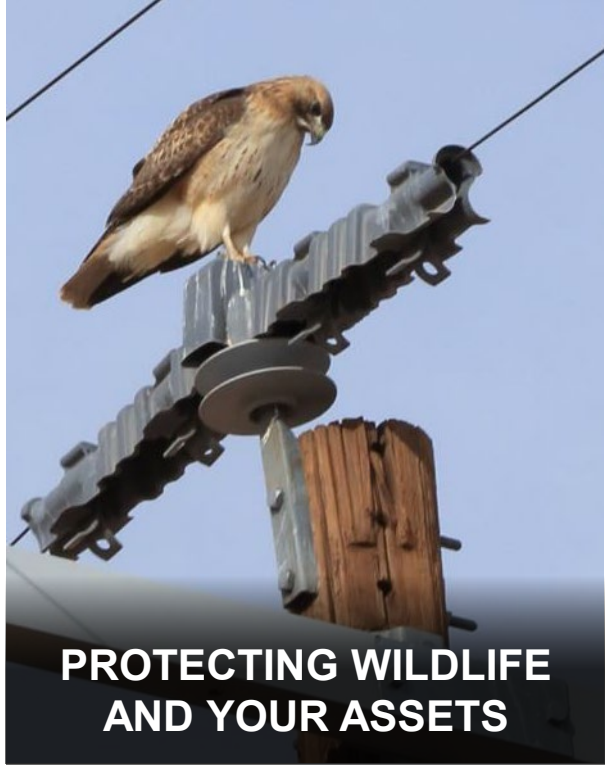
INDUSTRIAL

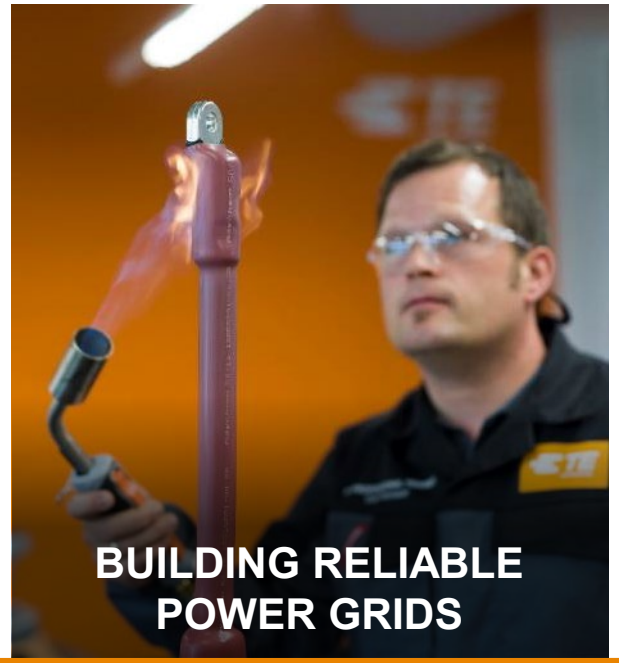
Industrial, Aerospace, Defense & Marine, Medical, Energy

WE CREATE A SAFER, SUSTAINABLE, PRODUCTIVE AND CONNECTED FUTURE.

247B

PRODUCTS MANUFACTURED ANNUALLY





CUSTOMERS RELY ON US TO INNOVATE SUSTAINABLE ENERGY NETWORKS AND KEEP THE POWER ON

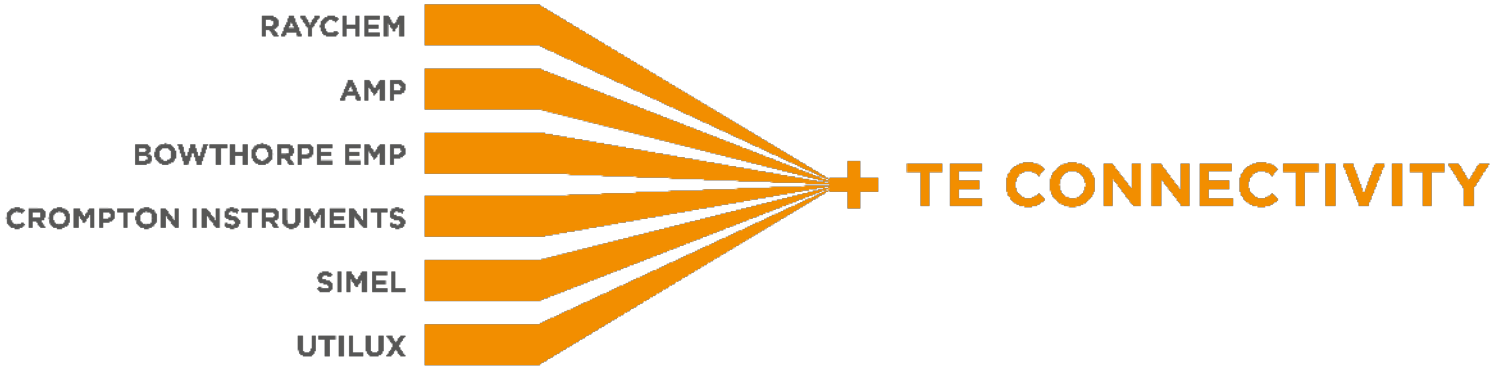
2900
EMPLOYEES DEDICATED TO ENERGY

$738M
ENERGY GLOBAL REVENUE FY21

PARTNERING IN
130+ COUNTRIES

WORLD's top Utilities, EPCs and OEMs

If you know Raychem, you know TE Connectivity.



Emerging Challenges in Distribution Grids

In 2030, 20% of our global energy will rely on wind power, and the demand for solar power continues to grow.

As the emergence of points of power generation multiples, the increased power flow is adding pressure on grids that have already been running for decades.

With the demand for energy growing exponentially, it is essential that grids can manage the increased electrical stress, in order to avoid disruption to your network.

Our smart solutions can help you:

- Improve safety for operators and people
- Improve the reliability of your grid
- Achieve network automation and remote control

Unplanned Outages in Industrial Facilities - Data Centers

With an ever-evolving landscape in computing and the increasing need for cloud storage, there is one thing that must remain constant: your power supply.

To achieve the industry's standard uptime of Five-9s (99.999%), reliable power delivery is essential. As a result, data centers have always had monitoring and control in place, however, it is possible to make improvements in personal safety and facility awareness by increasing power monitoring.

We offer:

- Connections that are reliable and high-performing
- Kries CAP-Line for personal safety through voltage monitoring
- Kries IKI-Line to minimize the time to detect and locate a fault

The average cost of an outage in a data center is estimated to **$9k** in lost revenue per minute*

*Source: https://www.vertiv.com/globalassets/documents/reports/2016-cost-of-data-center-outages-11-11_51190_1.pdf

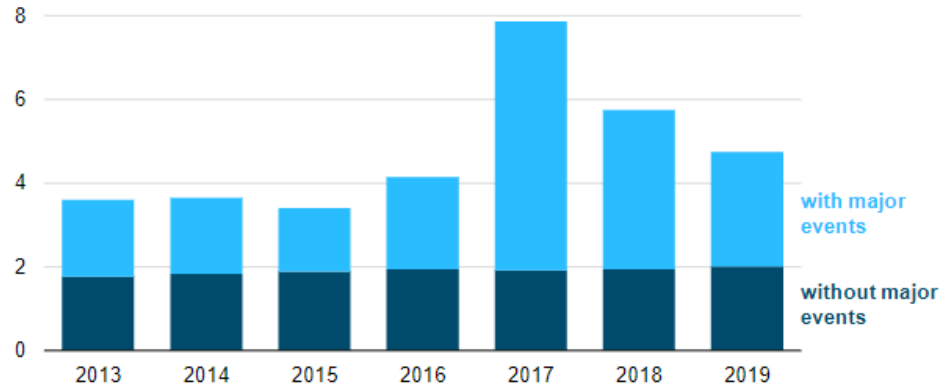
Unplanned Outages in Utilities

With more than 150,000 miles of power lines, the US power grid is one of the largest worldwide. Overhead lines are key to connect the network; from generation, to transmission and distribution. They are also the most vulnerable when it comes to weather and animal-related challenges.

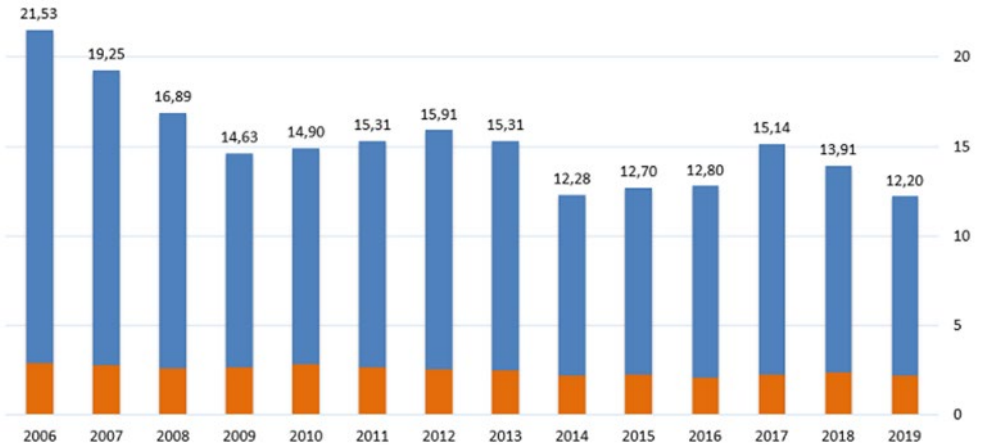
A common way to track down time for utilities is System Average Interruption Duration Index (SAIDI). Being able to efficiently restore power reduces the impact of unplanned faults.

Our smart solutions can help you locate faults on underground and overhead distribution power lines increasing grid reliability and safety.

Average duration of total annual interruptions in electricity service in the United States* (hours per customer)



Average duration of total annual interruptions in electricity service in Germany - with smart grid solutions (minutes per customer)



**Source: US Energy Information Administration, Annual Electric Power Industry Report*

The Real Cost of Power Outages

4.7 hours

The average total annual interruption in electricity service hours per customer in the US

1.5 hours

The average duration of an interruption per customer excluding major events

100,000 USD

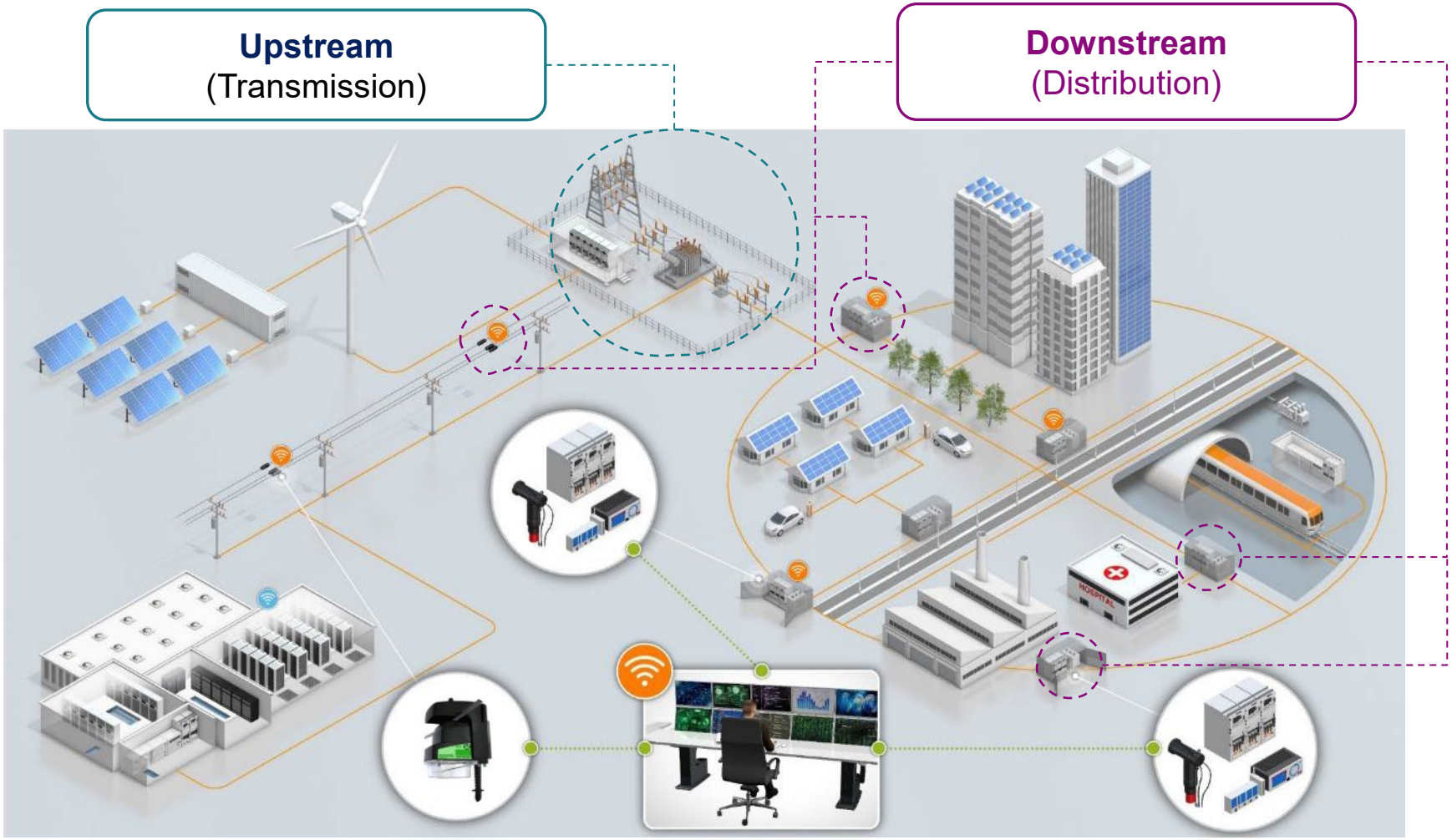
The average cost of an outage for a utility per hour

Solutions + Expertise

Enabling Smart Grids with Sensors & Intelligent Electronic Devices (IED)

Network Management
Grid monitoring
(U, I, f)

Asset Management
Condition monitoring
(PD, Temp.)



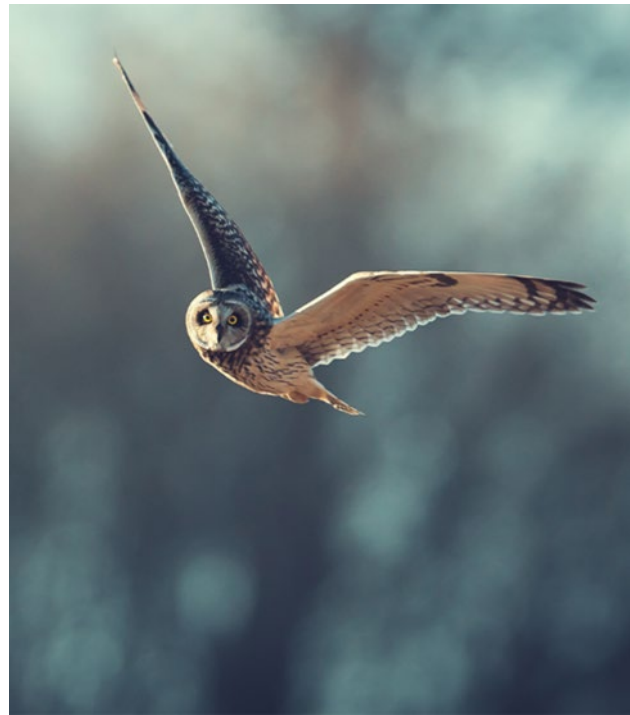
One Connectivity Partner for Safe, Reliable, High-Performing Power Grids

From generation, to transmission, to distribution, to wherever energy is needed – we are one source for multiple connectivity and sensors needs:

CONSULT	DESIGN	TEST	TRAIN
• Our TE experts and network of authorized distributors can support you wherever you are located • Knowledgeable technical support to help you select the right solutions	• Collaborate with our engineering team to create a custom solution • Our research and development teams have years of experience and thousands of patents, which can be leveraged for your ideas	• We test custom solutions in our labs • We test the cable you selected to our solution to ensure highest performance and reliability	• We provide tailored installation training • Competency assessments for installers, trainers and supervisors

Smart Monitoring
Kries Portfolio

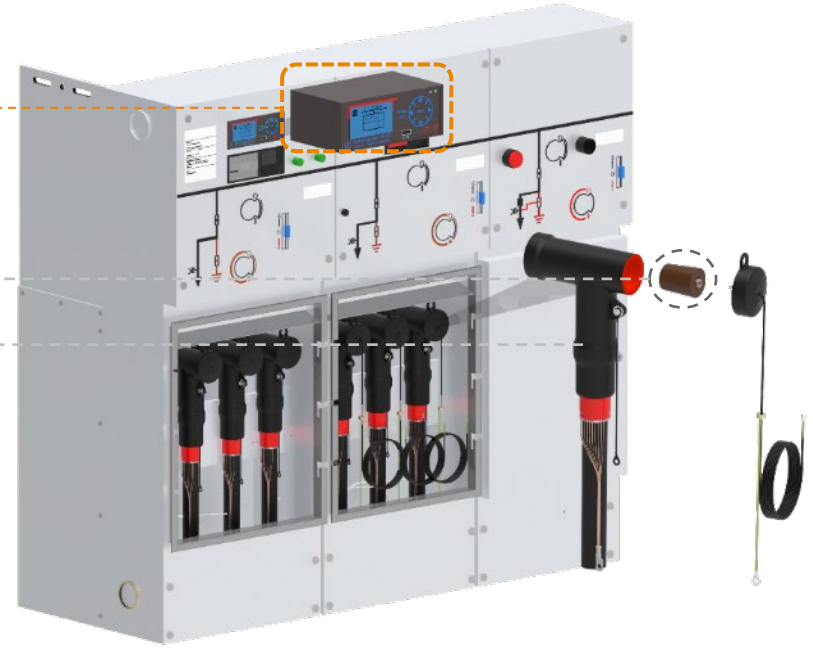
EVERY CONNECTION COUNTS



Grid Monitoring Value Chain

TE 's Focus

1	Sensor
2	Cable Accessories
3	Data treatment (Intelligent Electronic Devices)
4	Telecommunication
5	SCADA



TE Connectivity:

- Supplier of sensored cable accessories & Energy products
- Partnering with Kries to offer a complete solution

Introducing Kries Energietechnik

- Headquarters in Waiblingen-Beinstein, Germany
- Privately owned and managed by founder and CEO, Gunter Kries
- Electrical and electronic manufacturing
- Intelligence for energy distribution grids: Monitoring, Protection, Automation
- Industries: Wind, Solar, Data Centers, Mining, Municipalities, Large Utilities worldwide

TE Connectivity (TE), a world leader in connectivity and sensors, is now the exclusive reseller of Kries grid monitoring products across North, Central and the majority of South America with the aim to enable a smarter, more reliable and sustainable power network.

https://www.te.com/usa-en/about-te/news-center/smart-grid-solutions-americas-kries-partnership.html

25+
years of experience in grid monitoring

1000k
voltage detecting systems installed

26
countries

82
employees

Distribution Grids: What is happening?

CONVENTIONAL GRIDS

- No monitoring or remote control
- Uni-directional power flow from large power plants to end consumer

WHAT IS CHANGING?

- Distributed power generation
- Rising expectations for power quality and power availability
- Increased demand on electricity (eg: charging stations)
- Aging infrastructures

CONSEQUENCES

- Unstable power supply
- More frequent and longer duration of unpredicted faults

Resulting in:

- Economic consequences of power loss
- Occupational risk and safety

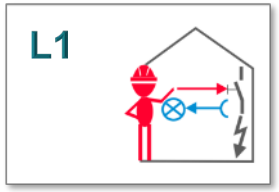
THE SOLUTION - INCREASE NETWORK VISIBILITY AND TRANSPARENCY

- Power presence monitoring
- Fault monitoring
- Power flow monitoring

Levels of Integration

Level 1 : Local Indication

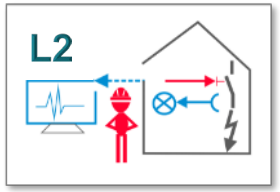
IKI Overhead / IKI-10 / CAPDIS-S1



+ Communication

Level 2 : Remote Indication

IKI Overhead / IKI-23 / CAPDIS-S2



+ Remote Control

Level 3 : Remote Monitoring & Remote Control

IKI-50 paired with: Smart RSTI / CAPDIS-S1 or -S2

Your Benefits

SAFETY

Permanent Voltage Detection (CAP-Line)

- Additional safety features to protect the linemen
- Permanently-installed devices replace temporary measurement
- Remote monitoring (SCADA)

RELIABILITY

Fault Passage Indication (IKI-Line)

- SAIDI reduction
- Preventive diagnostics (fault detection and prediction)
- Efficient localization of outages

AUTOMATION

Remote Control and Network Automation

- Prevent outages
- Reduce penalties
- Cost efficient smart grid implementation

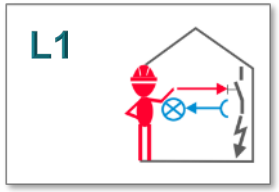
CAPDIS

Voltage Presence Detection for Switchgears and Equipment

EVERY CONNECTION COUNTS

Levels of Integration

Level 1 : Local Indication



IKI Overhead / IKI-10 / CAPDIS-S1

+ Communication

Level 2 : Remote Indication

IKI Overhead / IKI-23 / CAPDIS-S2

+ Remote Control

Level 3 : Remote Monitoring & Remote Control

IKI-50 paired with: Smart RSTI / CAPDIS-S1 or -S2

Improving Safety for Operators

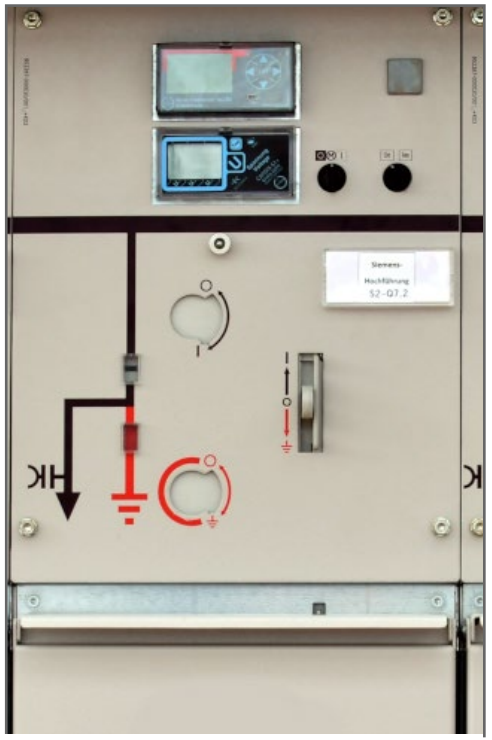
Permanently installed Voltage Detection and Indicating Systems (VDIS) offer improvement over current procedures for confirming proper de-energization.

Today, the operator needs to use a hot stick with a voltage detector. It is the most common method today, and yet, very dangerous as the operator is potentially exposed to an immediate arc flash hazard.

Tomorrow, VDIS can bring you:

- **Improved reliability**
- **Increased accuracy of the measure**
- **Improved safety : eliminating the operator's exposure to potential hazards**
- **Ability to check for voltage presence and phasing at included test points**

Operator using a hot stick with a voltage detector



Permanent Voltage Detection and Indicating System

Voltage Detection & Indication System // CAP-Line

CAPDIS-S1

The Kries CAP-Line is a monitoring solution, engineered for permanent voltage monitoring and voltage detection. It includes an integrated screen to display partial discharge, preventing impending failures.

The personal safety of grid operators is improved as it is not necessary to open the switchgear to measure the voltage, protecting the operator against incidental contact with energized equipment.

FEATURES & BENEFITS

- Compact design
- Interface for additional measurement (e.g., phase comparison)
- Remote control (in combination with IKI-Line)
- LRM-System
- Voltage Detection and Indication Systems (VDIS) replace temporary methods such as hot-sticks, increasing personal safety

MAINTENANCE-FREE DEVICE.

SELF-TEST.

CAP-Line : Voltage Measuring & Monitoring

Presence of Voltage

- Safety of user and system
- SCADA integration through output relays

- *CAPDIS S1-R4.5*
- *CAPDIS S2-R4.5*

Operational State

- Predictive fault detection (PD)

- *CAPDIS S1-R5*
- *CAPDIS S2-R5*

Monitoring of Voltage

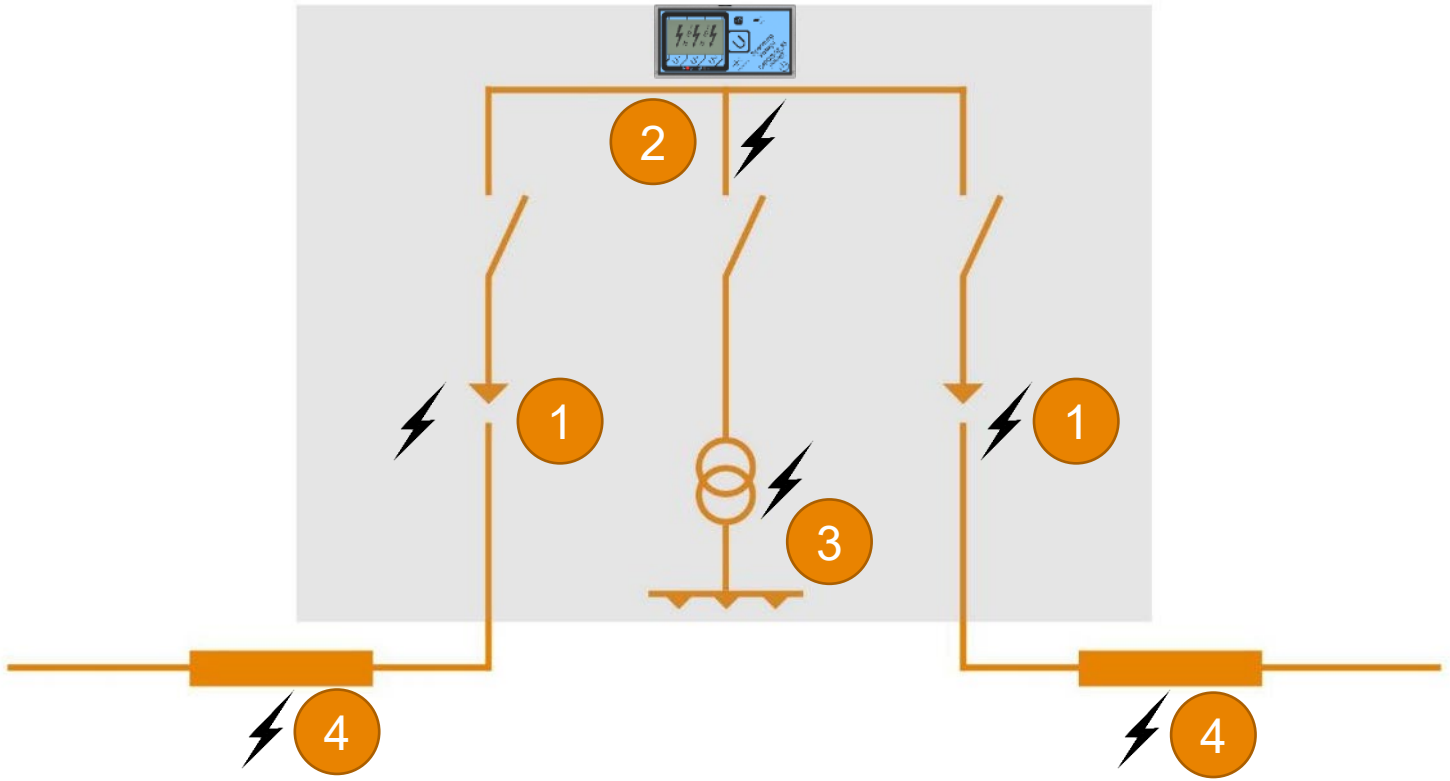
- Economical solutions
- Potential Transformer (PT) replacement
- Space saving

- *CAPDIS-M*
- *CAPDIS-4o*

Voltage Detection and Partial Discharge Indication

CAPDIS R5 can detect partial discharges within switchgears in:

1. Cable termination
2. Busbars
3. Transformer
4. Adjacent splices



Case Study: Increasing Safety for Operators

REGION Frankfurt (Germany)

TYPE Fraport (Frankfurt Airport)

PRODUCTS CAPDIS-S1

CUSTOMER CHALLENGE

Frankfurt Airport is the largest air traffic hub in Germany. Its distribution grid comprises a vast network of 297 switchgears cells that are frequently checked by plant operators. The voltage test operation is conducted using hand-hand voltage testers which can endanger the safety of operators, should a voltage flashover occur.

SOLUTION

Kries and Fraport agreed to install CAPDIS devices on the switchgears cells to allow plant operators to perform voltage test operations, without having to open the switchgear or cable compartment, thereby avoiding a potential flashover.

OUTCOME

In the period from 2018 to 2020, Fraport retrofitted around 250 medium voltage switchgear cells with integrated CAPDIS® voltage test systems, eliminating the risk of arc faults for operators and increasing the reliability of the power supply.

Fault Indication in Distribution Networks

IKI-OH

IKI-10

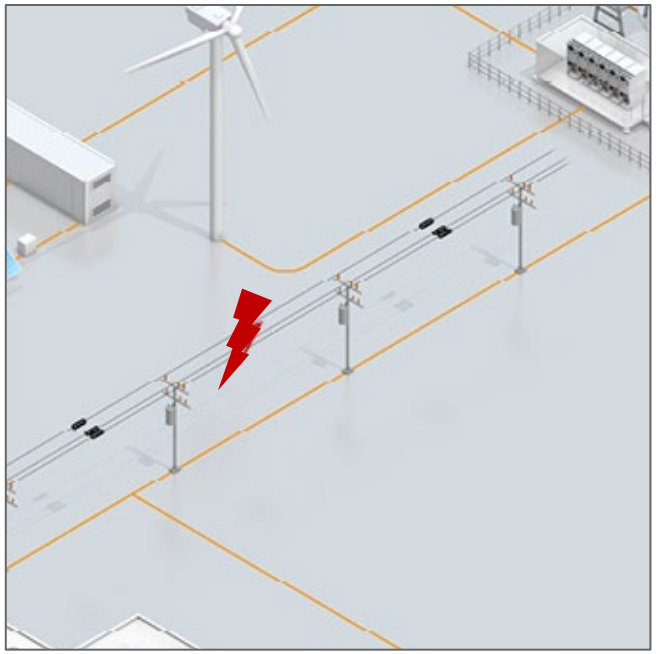
IKI-23

EVERY CONNECTION COUNTS

Fault Passage Indication

A fault indicator is a device which provides visual or remote indication of a fault on the electric power system.

It will notify the operator if the current spike from the fault has passed the monitoring equipment for both underground and overhead networks.



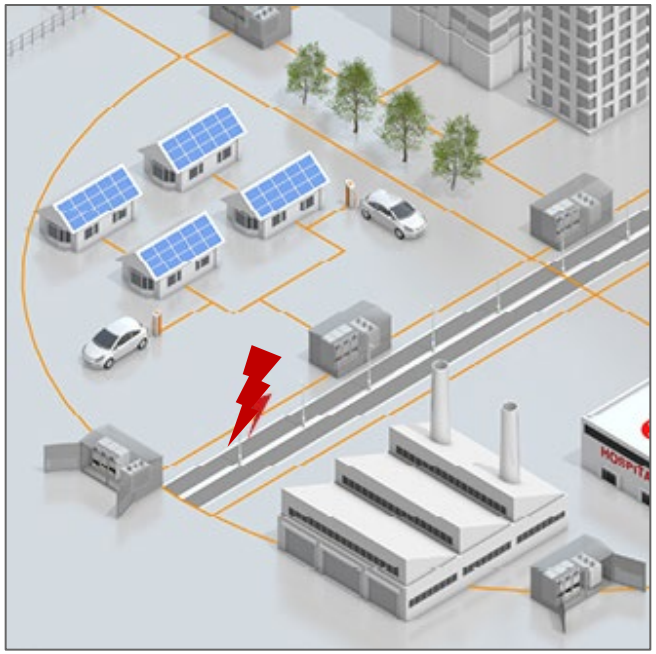
Overhead Fault Detection

IKI-OH

IKI-Overhead *Radio*

IKI-Overhead *Radio*

IKI-Overhead *Without communication*



Underground Fault Detection

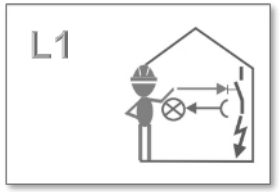
IKI-10

IKI-23

Levels of Integration

Level 1 : Local Indication

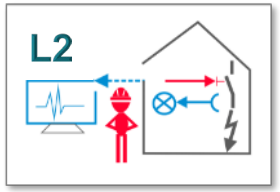
IKI Overhead / IKI-10 / CAPDIS-S1



+ Communication

Level 2 : Remote Indication

IKI Overhead / IKI-23 / CAPDIS-S2



+ Remote Control

Level 3 : Remote Monitoring & Remote Control

IKI-50 paired with: Smart RSTI / CAPDIS-S1 or -S2

IKI-Overhead for Distribution Lines

IKI-OH

When a fault occurs on overhead lines, it can take several hours for utilities to locate the issue and send a maintenance team. By relying on sensors to detect faults, we are helping our customers reducing the time needed to locate the issue, thereby significantly reducing the duration of the outage.

The Kries IKI-OH portfolio consists of:

- **A strobe-only version for local visual indication**
- **A communicating version integration with SCADA systems**

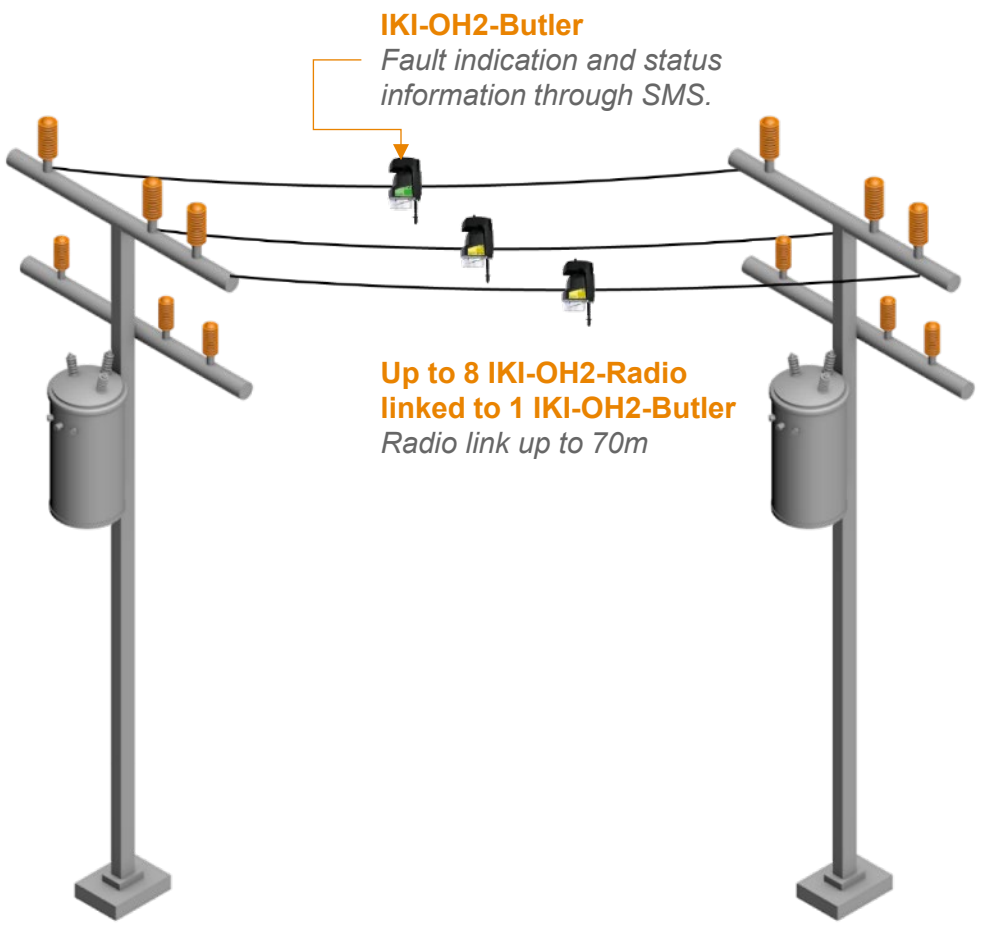
FEATURES & BENEFITS

- Ultra-bright LEDs with 360° visibility
- Long life battery (10-15+ years)
- Sealed from water and dust - IP67 rated for dust/moisture intrusion
- Tested to IEEE-495 standards
- Reduction in fault detection time (line monitoring and fault detection)
- Ability to detect high impedance faults
- Easy installation with hot stick, no extra tool required

CAN BE INSTALLED IN ENERGIZED DISTRIBUTION POWER LINES.

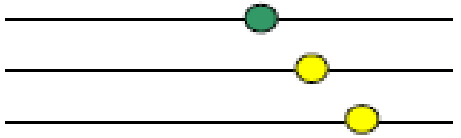
IKI-OH: Communication Between Sensors

Up to 9 pieces of IKI-Overhead can work together in a set.

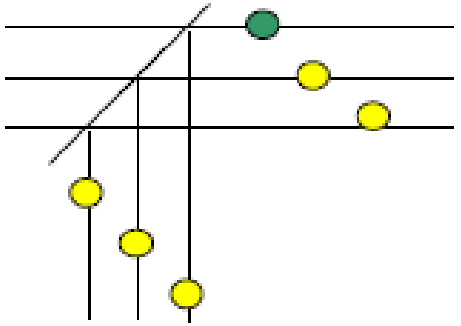


IKI-OH2-Butler
IKI-OH2-Radio

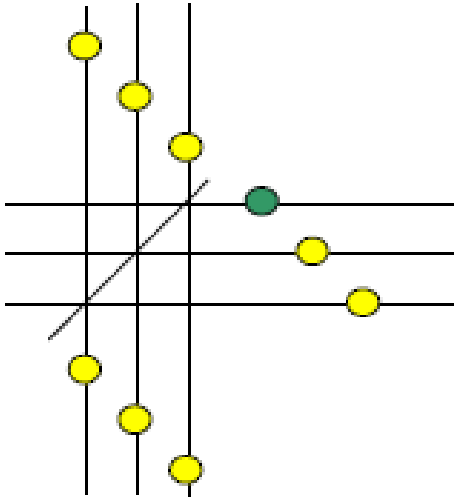
Overhead line



2-way junction



3-way junction



IKI-Underground for Distribution Lines

IKI-10 Light // IKI-23

The Kries IKI-Line monitors over-current and fault conditions enabling faster fault location and reducing outage duration. IKI-23 combined with CAPDIS devices improves SAIDI indicators by enabling directional fault indication, reducing the Mean Time to Repair (MTTR) for operators.

IKI-10 Light

IKI-23

FEATURES & BENEFITS // IKI-10 Light

- Detection, display and remote signaling of earth short-circuits (earth faults)
- Signalization via integrated bright LED, external LED blinker or mechanical flag (optional)
- Reset by time or via supply voltage

IKI-23 combined with CAPDIS

FEATURES & BENEFITS // IKI-23

- Directional short-circuit fault indication
- Earth fault with direction
- Static earth fault with direction
- Transient earth fault with direction
- Transient disturbance for insulation problems in cables

INTEGRATED BATTERY BUFFER. MAINTENANCE-FREE.

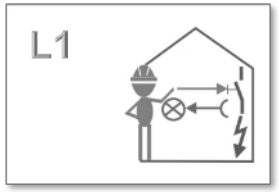
IKI-50

Grid-Inspector IKI-50
Fault Detection – Grid-Automation

EVERY CONNECTION COUNTS

Levels of Integration

Level 1 : Local Indication



IKI Overhead / IKI-10 / CAPDIS-S1

+ Communication

Level 2 : Remote Indication

IKI Overhead / IKI-23 / CAPDIS-S2

+ Remote Control

Level 3 : Remote Monitoring & Remote Control

IKI-50 paired with: Smart RSTI / CAPDIS-S1 or -S2

Grid Inspector & Remote Control for Switchgears

IKI-50

Kries IKI-50 is a compact and easy-to-install field monitoring and control device, enabling grid visibility and transparency. It can be integrated in switchgears to provide load and fault information, preventing overloads or grid saturation. Combined with our Smart RSTI, IKI-50 is able to monitor both voltage and current with one device, turning the switchgear into a digital substation.

FEATURES & BENEFITS

- Early fault detection
- Load flow monitoring
- Remote control
- Grid automation
- Compact
- Increase in efficiency
- Power load monitoring increasing grid visibility
- Fault detection reducing downtime (SAIDI)
- Remote control and network automation, improving the flexibility of the grid and increasing reliability

TE's Smart RSTI (Voltage Measurement)

Split Core Current Transformer

Grid Inspector IKI-50 (Fault Detection & Remote Control)

IKI-50 + CAPDIS (Directional Fault Detection)

REMOTE MONITORING.
REMOTE CONTROL.

IKI-50 – Application Example: Automatic Transfer Switch

Value Proposition

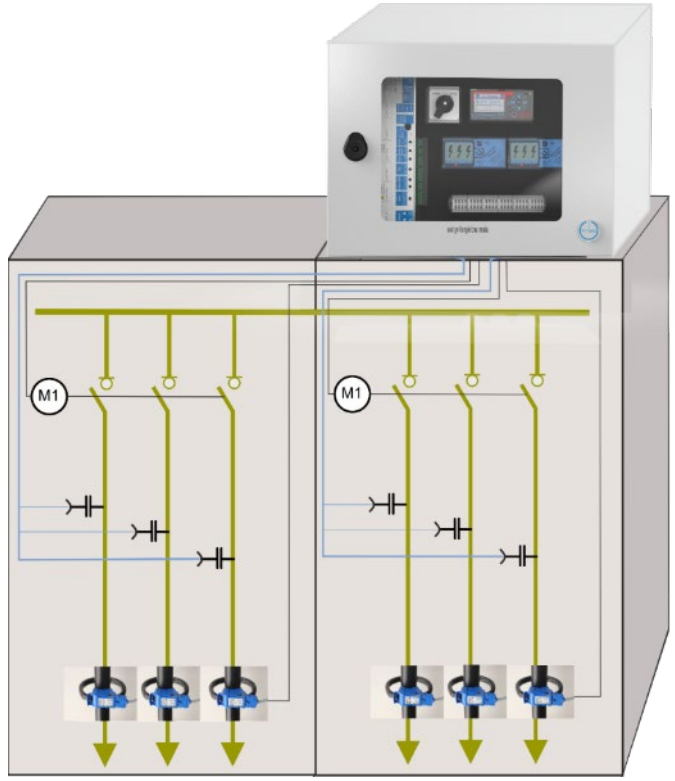
Automatic transfer switch in case of outage or failure
In less than 3 sec. with plug and play ATS solution.

Typical applications

Replacement of emergency generator

Main MV-incoming feeders of:

- Hospitals
- Data centers
- Railway / street tunnels
- VIP customers



Ready to Make Every Connection Count?

Visit TE.com/energy to get updates on our product innovations

CONNECT WITH US

energy.marketing@te.com
TE.com/energy-contact