

# Industry

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## NAVIGATOR

SUSTAINABLE DEVELOPMENT  
STRATEGIES FOR T&D

CONFERENCE 2025

# The role of monitoring systems in sustainable development

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9 April 2025

# KONČAR

ELECTRICAL ENGINEERING  
INSTITUTE

## Agenda

- The Importance of Monitoring Systems in Digitalization
- Utilizing Big Data for Equipment Performance Insights
- Intelligent Condition Monitoring Framework for Sustainable Development
- Advanced Monitoring Techniques
- Standardizing Monitoring Practices Across the Grid



# The Importance of Monitoring Systems in Digitalization



- Role of Monitoring Systems in Power Grids:
  - Performance Assessment
    - Enables real-time assessment of component performance and condition
  - Ensuring Reliability
    - Essential for maintaining the reliability of power grids, preventing outages and failures
  - Data Analytics
    - Supports informed decision-making for efficient grid management



# The Importance of Monitoring Systems in Digitalization

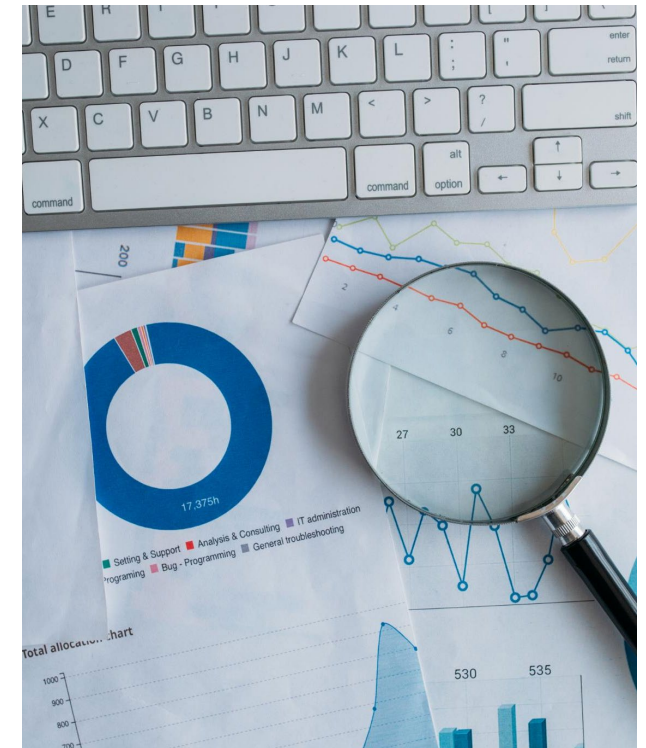
- Strategic Investments for Sustainable Development
  - Importance of Monitoring Systems
    - Crucial for tracking progress towards sustainable development goals
  - Operational Efficiency
    - Enhances the operational efficiency of power infrastructure, leading to cost savings and reduced downtime
  - Durability of Infrastructure
    - Extends the life span of power infrastructure, ensuring its reliability and effectiveness



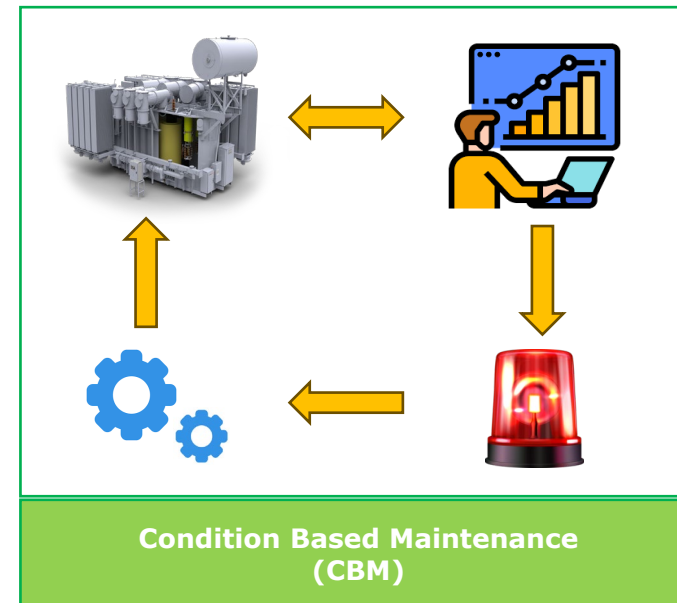
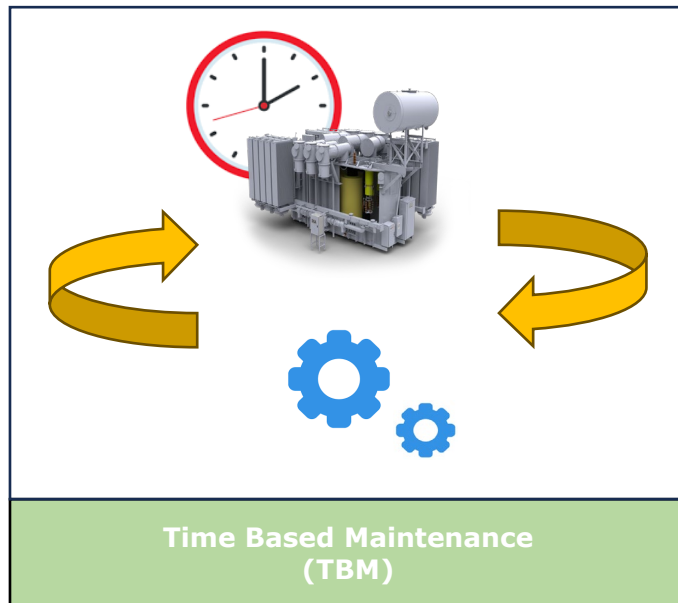


# Utilizing Big Data for Equipment Performance Insights

- Enhancing Performance Through Data Insights
  - Big Data Analysis
    - Collecting and analyzing data to identify trends and develop data-driven digital twin models
  - Data-Driven Maintenance Strategies
    - Analyzing operational data supports informed maintenance strategies that reduce downtime




# Intelligent Condition Monitoring Framework: Driving Sustainable Development in Power Grid Infrastructure




# Intelligent Condition Monitoring (ICM) Framework





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LABORATORIJSKI  
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### ISPITNI IZVJEŠTAJ

Broj izvještaja: 101723  
 Ukupan broj stranica: 9  
**Predmet ispitivanja:** Dijagnostička ispitivanja energetskog transformatora

**Sadržaj:** Otpor izolacije namota  
 Kapacitet i faktor dielektričnih gubitaka izolacije namota  
 Kapacitet i faktor dielektričnih gubitaka izolacije provodnika  
 Struje magnetiziranja  
 Rasipni induktivitet namota  
 Djelatni otpor namota  
 Ovlaženost izolacijskog sustava (PDC/FDS metoda)


Ispitni objekt: Energetski transformator – ATR1

- Integrating Offline and Online Measurement Techniques
  - Comprehensive Equipment Health View
    - Holistic understanding of equipment health, enabling better decision-making.
  - Prevent delays in intervention
    - Alarms before escalation into major failure

Gas in oil		Rate of gas change alarms		Gas sensor status	
Hydrogen H2	0 ppm	Hydrogen ROC Alarm	●	Gas sensor Watchdog	●
Carbon monoxide CO	0 ppm	Carbon Monoxide ROC Alarm	●	Gas sensor Caution Indicator	●
Carbon dioxide CO2	0 ppm	Carbon Dioxide ROC Alarm	●	Gas sensor Alarm Indicator	●
Acetylene C2H2	0 ppm	Acetylene ROC Alarm	●	Gas sensor Service Indicator	●
Ethylene C2H4	0 ppm	Ethylene ROC Alarm	●		
Ethane C2H6	0 ppm	Ethane ROC Alarm	●		
Methane CH4	0 ppm	Methane ROC Alarm	●		
Oxygen O2	0 ppm	Oxygen ROC Alarm	●		
Moisture in oil	0 ppm				

Gas sensor record info	
Number of gas sensor measurements	0
Gas sensor measurement time	01.01.1970.01:00:00
Measurement record number	0





# Improving Reliability of Critical Equipment

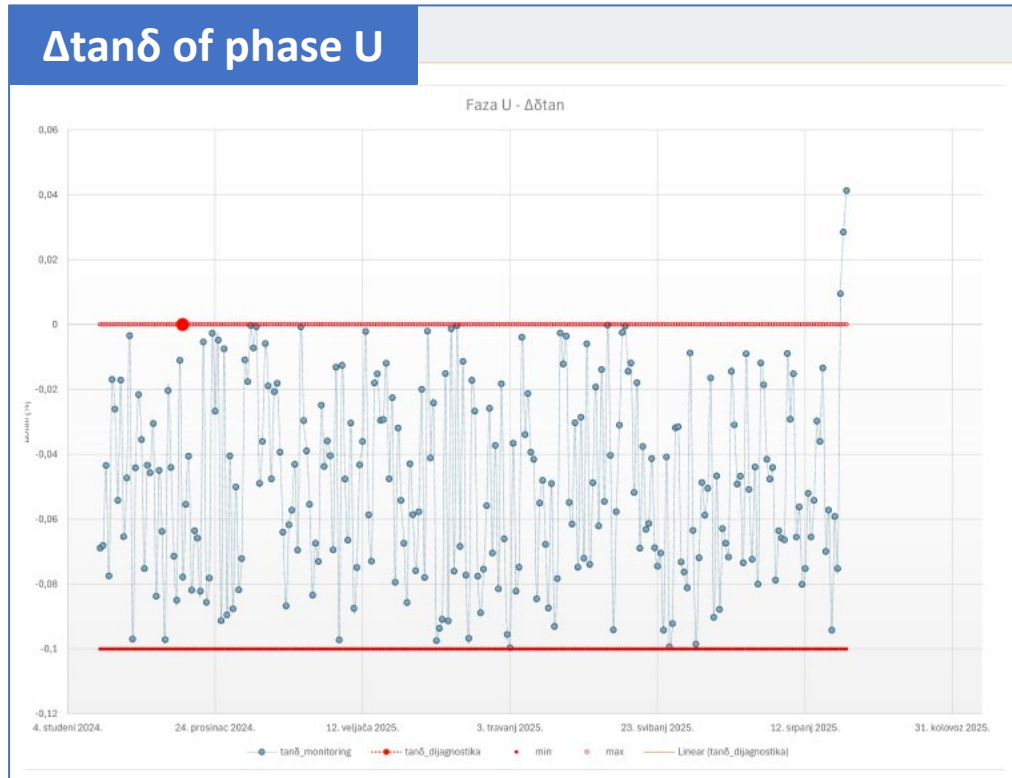


- Power Transformers and GIS as critical equipment
- Integrated Monitoring Approach
  - Managing large volumes of data
  - Ensuring a comprehensive approach to assessing equipment condition
- ICM Implementation Framework
  - Guidelines for transformer ICM development issued by CIGRE





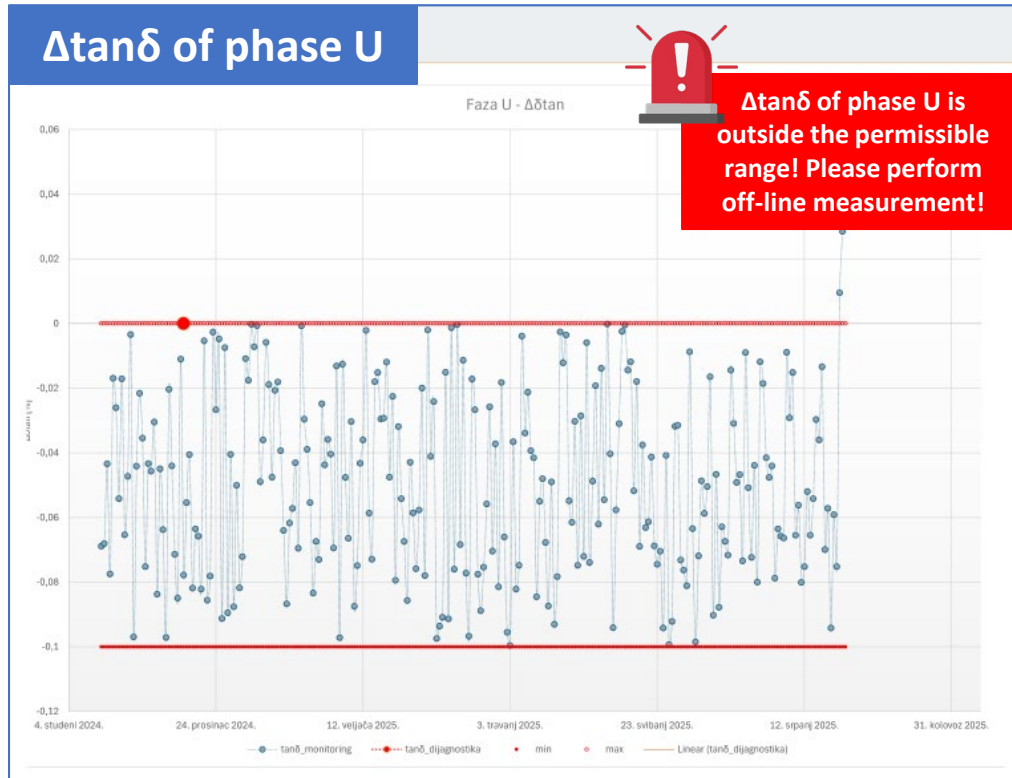
# Example of Integrating Offline and Online Techniques



1. The monitored parameter exceeds the permissible range.



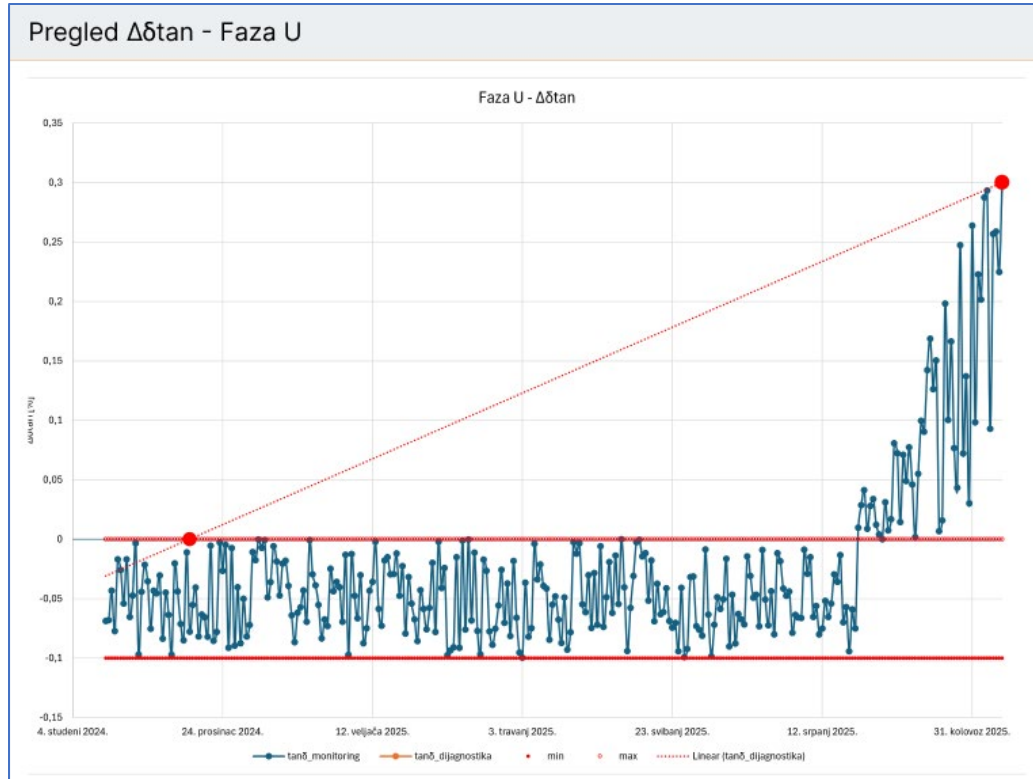
# Example of Integrating Offline and Online Techniques



1. The monitored parameter exceeds the permissible range.
2. An alarm notifies staff about the recorded issue and suggests possible actions.



# Example of Integrating Offline and Online Techniques

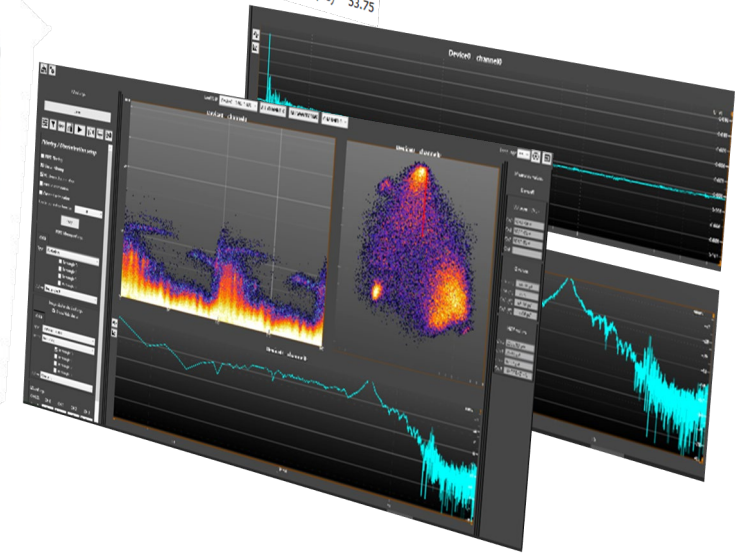
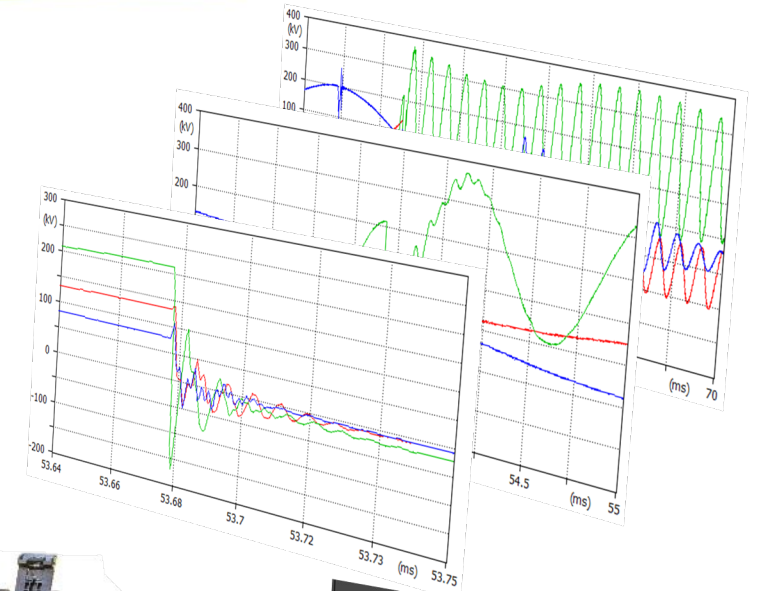


1. The monitored parameter exceeds the permissible range.
2. An alarm notifies the staff about the recorded issue and suggests possible actions.
3. The staff identifies the issue and performs off-site testing to confirm the problem.



## Advanced Monitoring Techniques

- Transient recorder
  - Fast overvoltages caused by atmospheric discharges and switching operations
  - Helps detect potentially dangerous states in the network
- Partial discharges
  - Automatic PD event classification
  - Advanced denoising tools
- Failure analysis
  - Root-cause analysis
  - Expert services





# Standardizing Monitoring Practices Across the Grid

- Efficient Asset Management
  - Allowing organizations to optimize resource allocation, reduce operational costs and extend equipment life
- Leveraging big data analytics
  - Supports data-driven decision-making and enhances the overall effectiveness of grid monitoring practices
- Driving Digital Transformation
  - Enhancing resilience and adaptability in a rapidly changing environment



## Conclusions

- **Intelligent Condition Monitoring (ICM) plays a crucial role in sustainable development through key points:**
  - Proactive Maintenance using big data,
  - Integration of Offline and Online Measurements,
  - Standardization of Monitoring Practices across the Fleet
- **ICM enhances the reliability, efficiency, and resilience of power grid infrastructure while reducing operating costs!**



## Contacts



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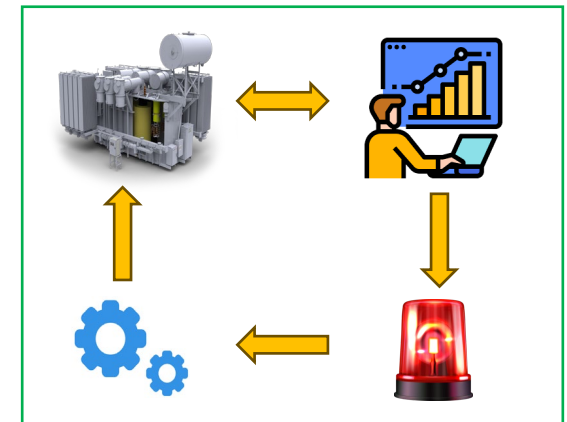
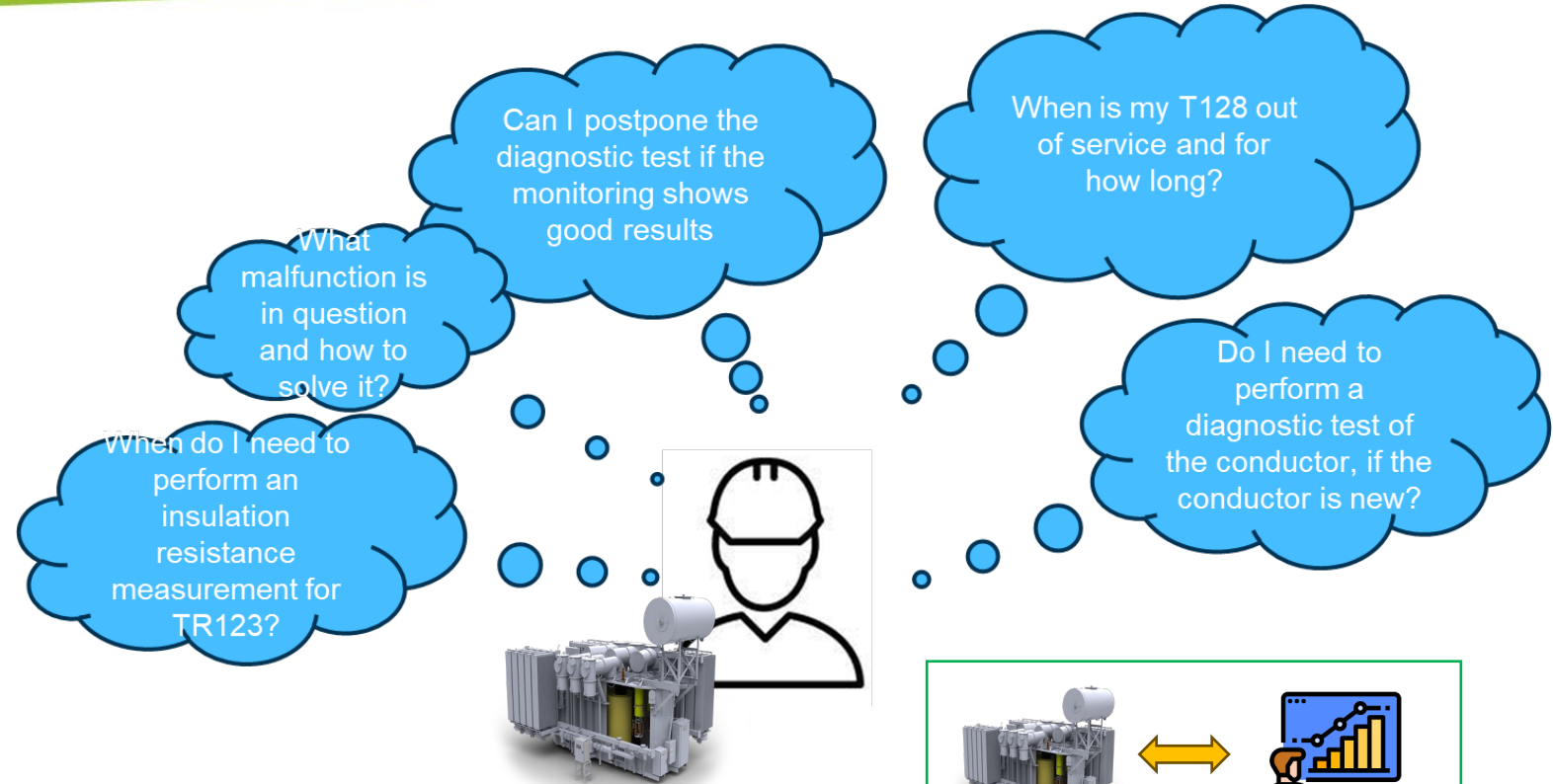
<https://koncar-institut.hr/en>



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Condition Based Maintenance (CBM)



Thank you!

