

Under the patronage of **HRH Prince Khalid Al-Faisal**
Advisor to the Custodian of the Two Holy Mosques & Governor of Makkah Region



المؤتمر الدولي الثاني والعشرون لإدارة الأصول والمرافق والصيانة
The 22nd International Asset, Facility & Maintenance
Management Conference

Digitization - Excellence - Sustainability

Online Insulation Monitoring Technology

A Real-time Insulation Monitoring Solution

26-28 January 2025

The Ritz-Carlton Jeddah, Kingdom of Saudi Arabia

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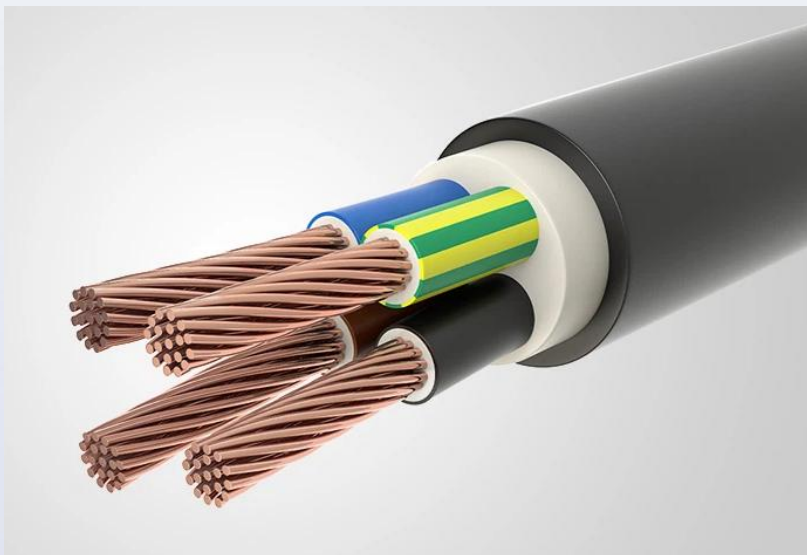
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- 03 | TSNL-2000™
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Technical Background

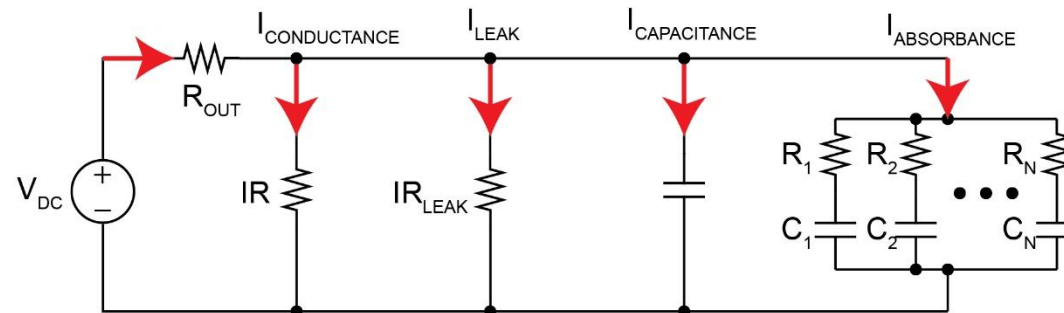
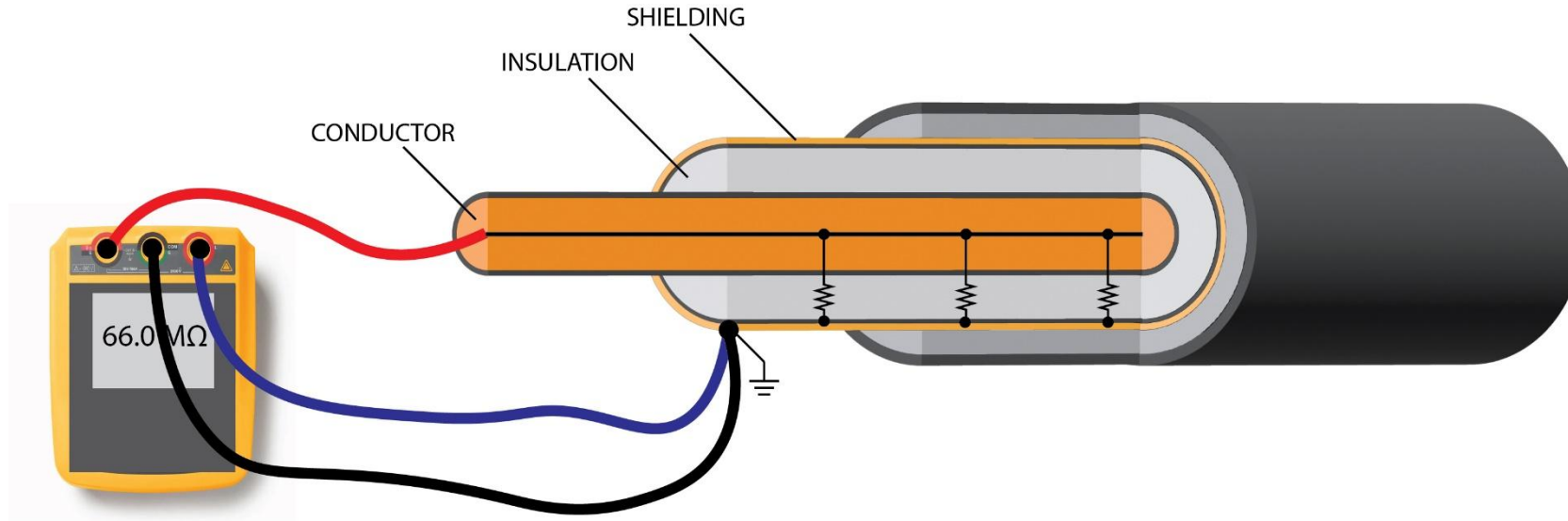
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Insulation faults



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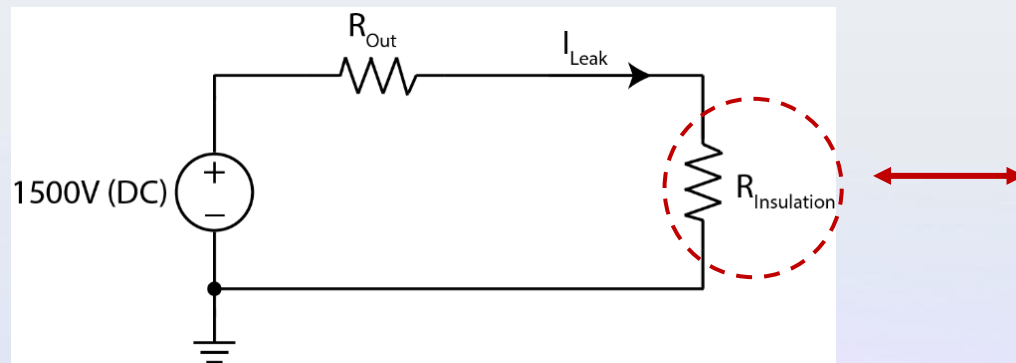
Conventional Insulation Resistance Measurement



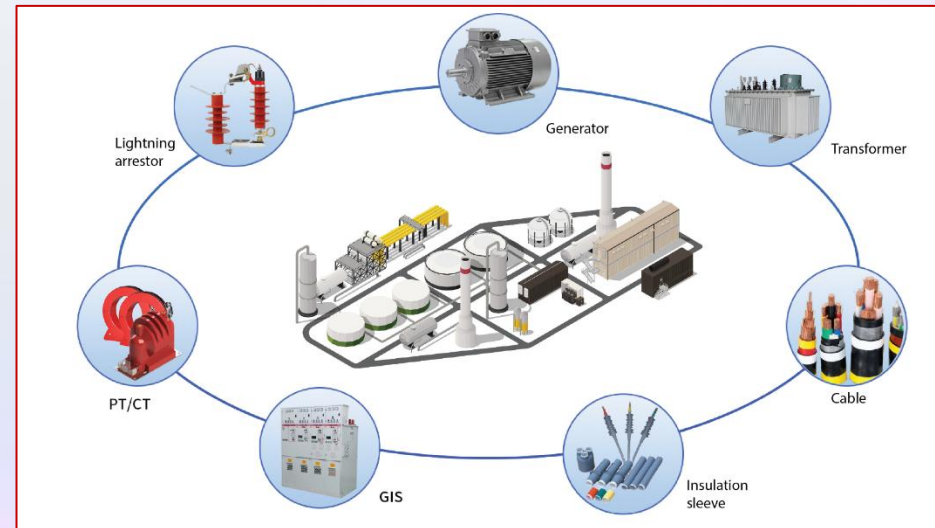
IR measurement per IEEE

TSNL-2000 Insulation Resistance Measurement

Equivalent Circuit

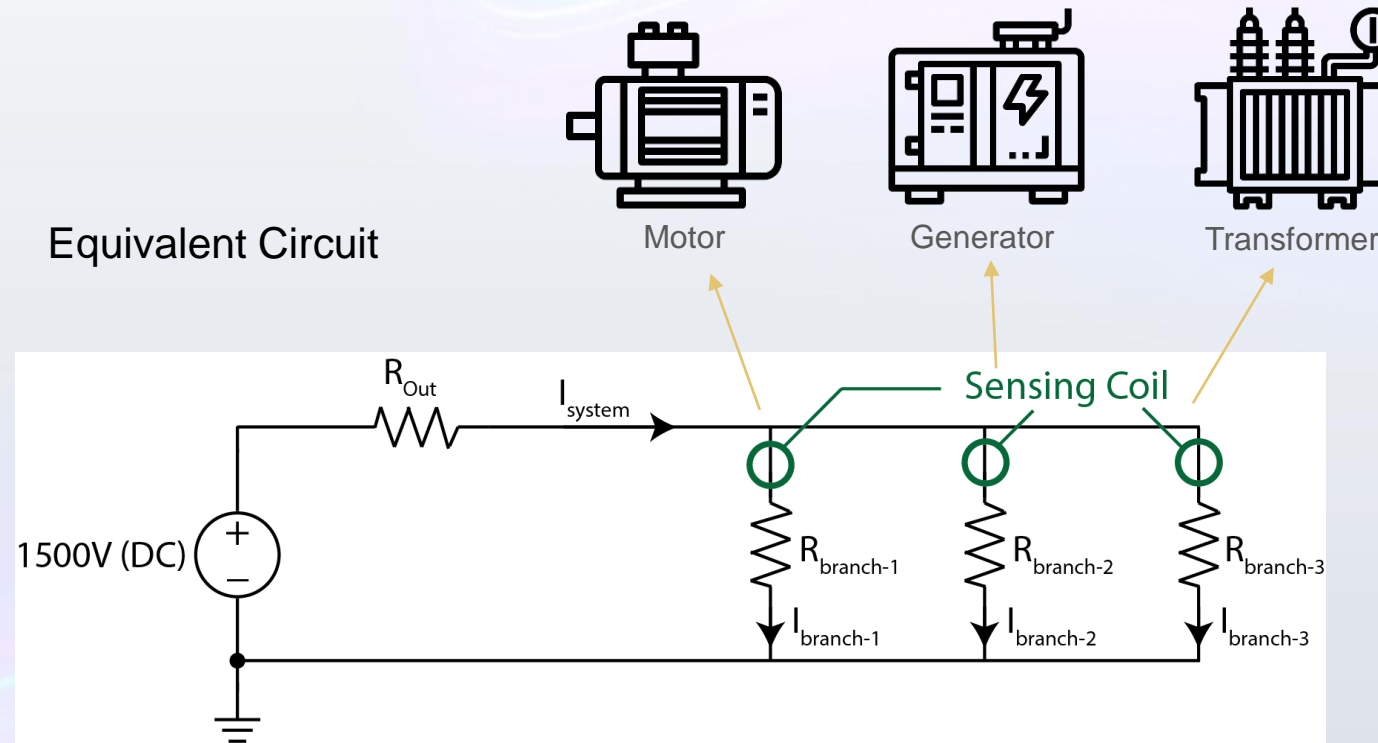


$$R_{Insulation} = \frac{1500V}{I_{Leak}} - R_{out}$$



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TSNL-2000 Insulation Resistance Measurement



$$R_{Insulation} = \frac{1500V}{I_{Leak}} - R_{Out}$$

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Technical Background



Conventional Insulation Test Method

- Test conducted periodically.
- System needs to be de-energized.
- Uncertainty during scheduled maintenance.
- Time consuming and laborious tasks.



Online Insulation Monitoring Technology

- Continuous measurement while the system is running.
- Real-time data monitoring and fault detection.
- Identifies potential rapid degradation of insulation for all the feed lines within the system.
- Accessible on the main control center of the plant.

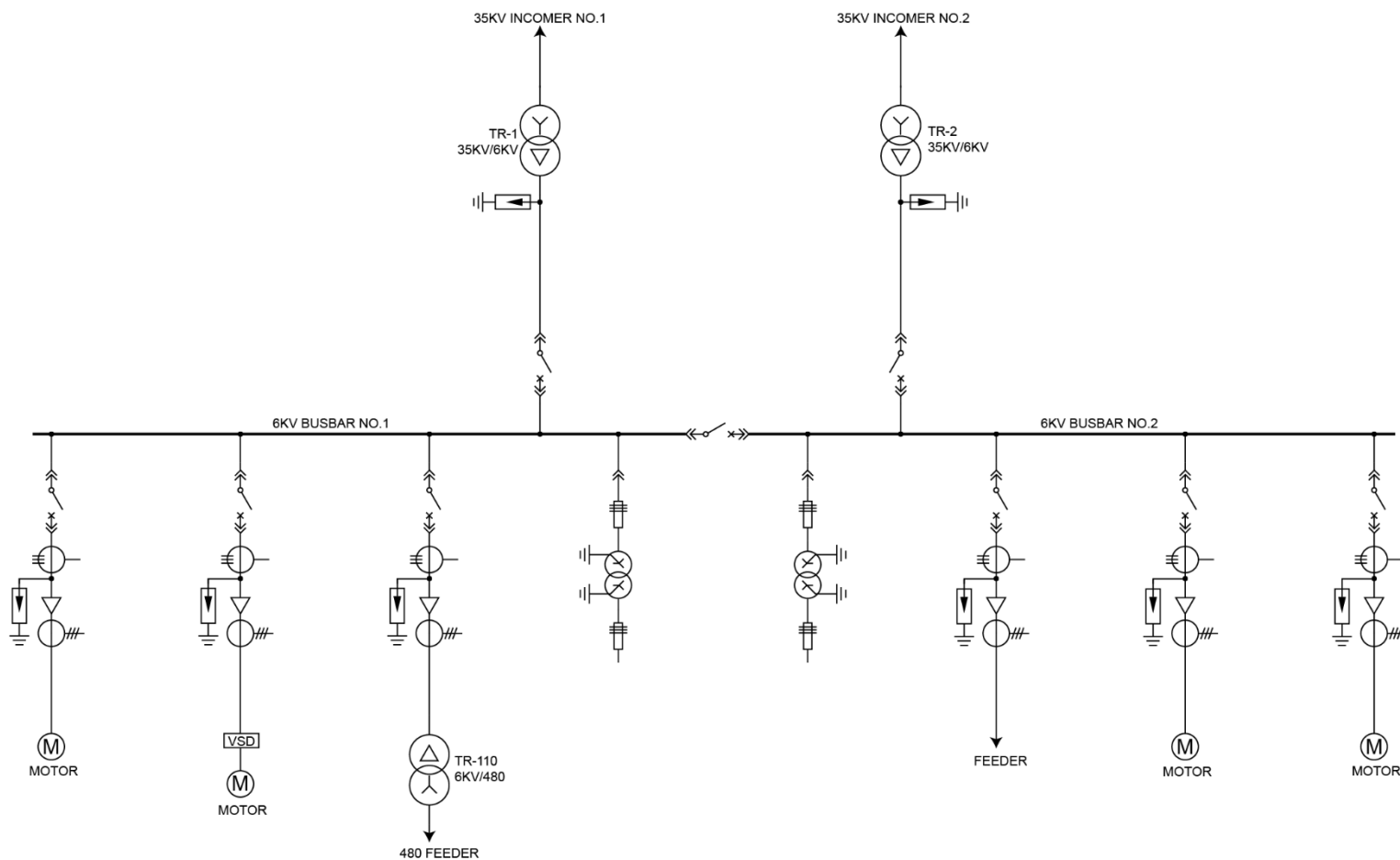
Real-time monitoring of insulation resistance during operation is crucial for electrical systems and equipment. Implementing online insulation monitoring holds great significance.

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Technical Principle

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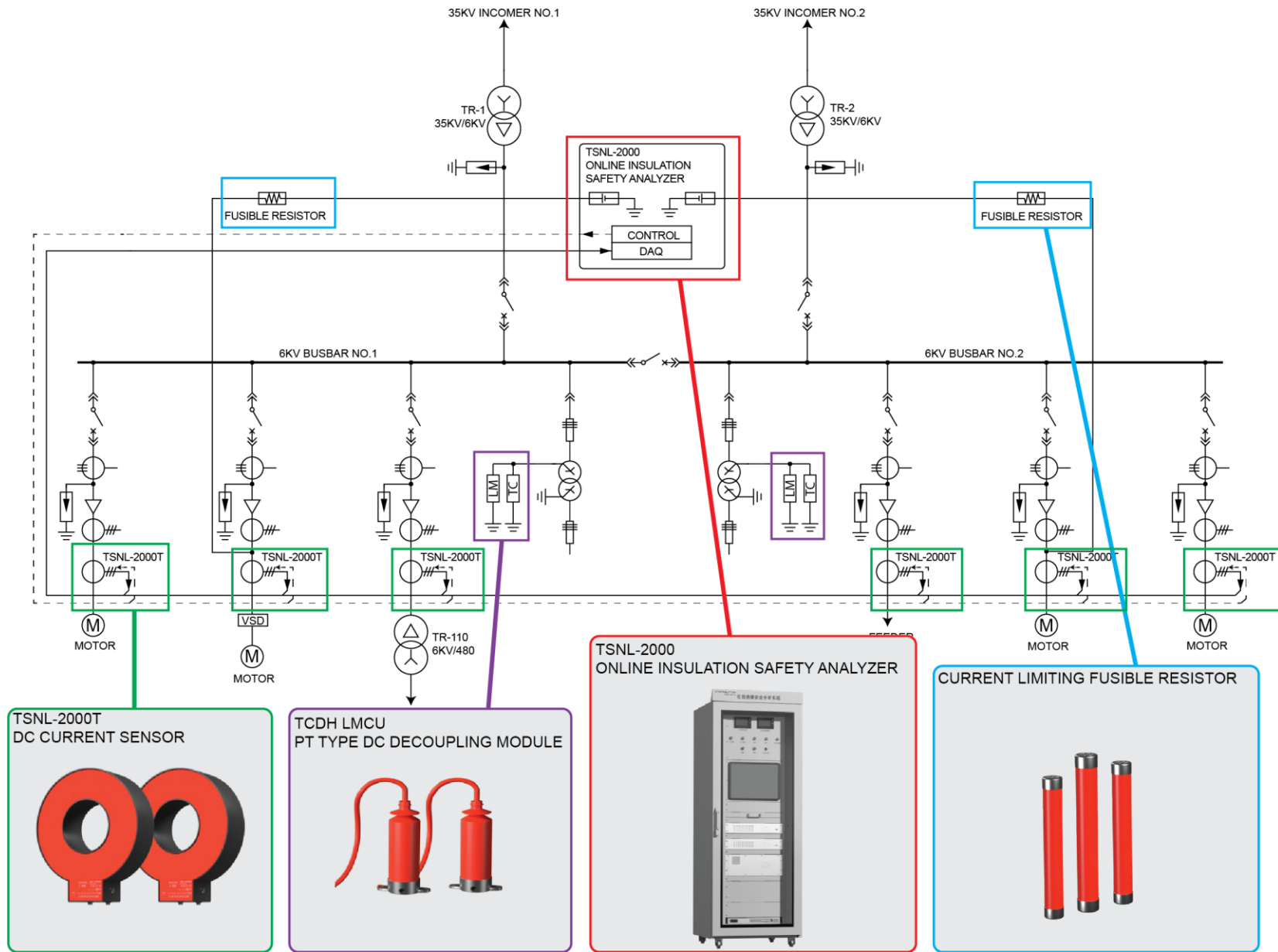
TSNL-2000 IMPLEMENTATION EXAMPLE
35 KV / 6 KV SUBSTATION UNGROUNDED



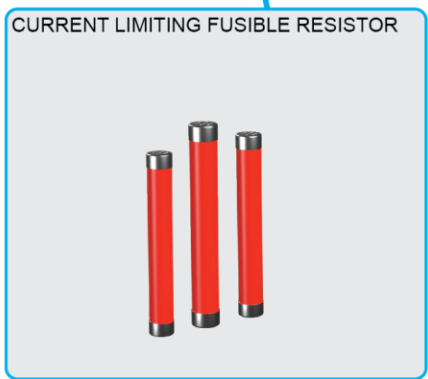
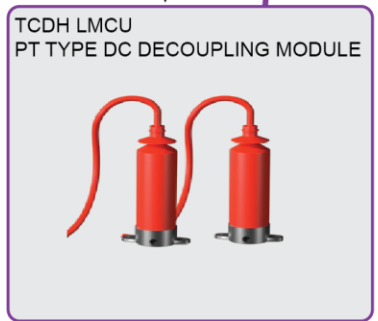
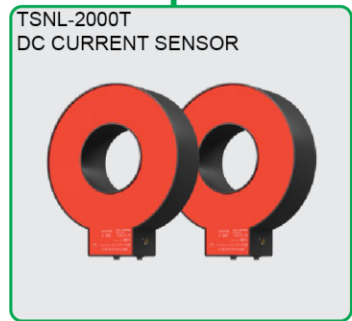
SYMBOL	DESCRIPTION
	TRANSFORMER
	CIRCUIT BREAKER DRAWOUT TYPE
	CIRCUIT BREAKER
	VT: VOLTAGE TRANSFORMER
	CAPACITOR
	CONTACTOR
	CABLE TERMINATION
	CURRENT LIMITING FUSIBLE RESISTOR
	NGR: NEUTRAL GROUNDING RESISTOR
	VSD: VARIABLE SPEED DRIVE
	ZYNC OXIDE VARISTOR
	LIGHTNING ARRESTOR
	ELECTRIC MOTOR
	MEDIUM VOLTAGE BUSBAR
	MEDIUM VOLTAGE CABLE
	CONTROL CABLE
	SIGNAL CABLE
	CT: CURRENT TRANSFORMER
	ZERO PHASE CURRENT TRANSFORMER
	TSNL-2000D CURRENT SENSOR
	INSULATION SENSING SIGNAL INJECTOR
	INDUCTOR
	LMCU:
	TCDU:
	POWER FUSE

Application example—ungrounded system

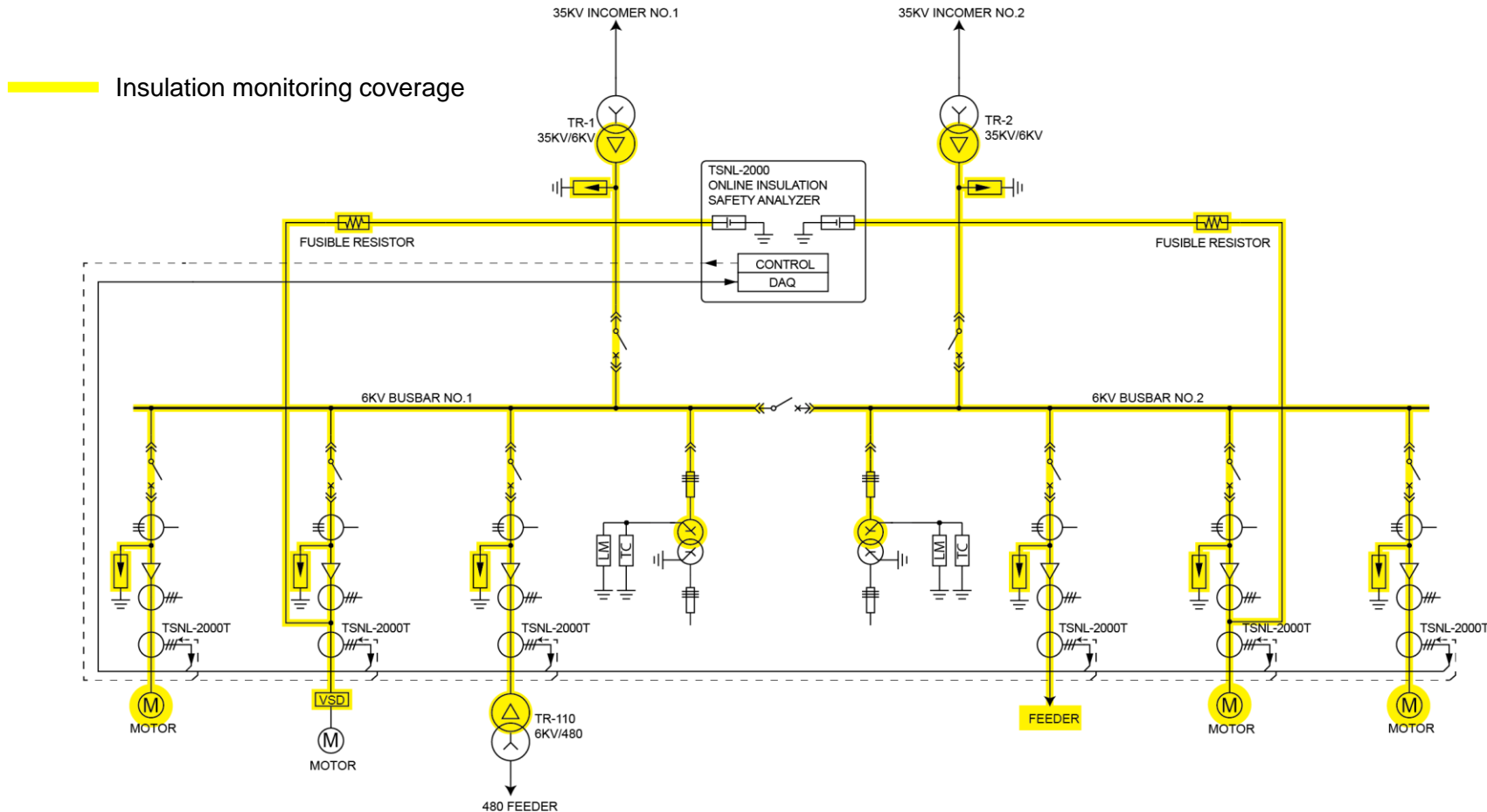
TSNL-2000 IMPLEMENTATION EXAMPLE 35 KV / 6 KV SUBSTATION UNGROUNDED



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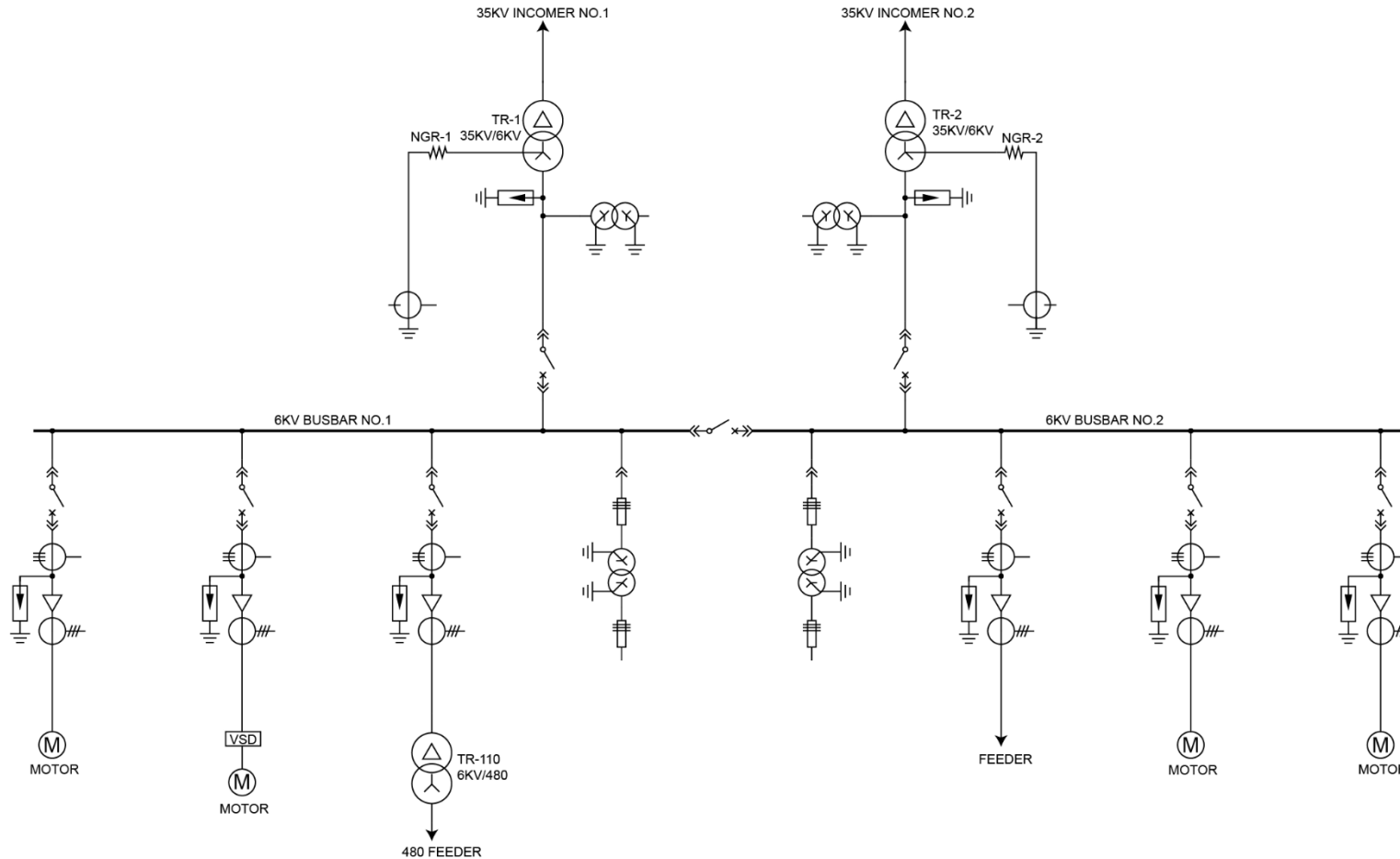
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Application example—grounded through NGR / ASC system

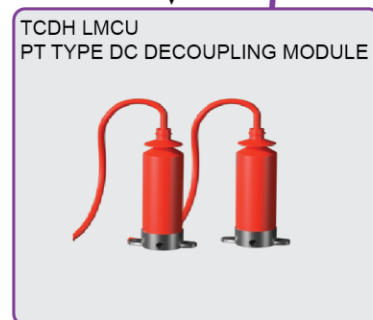
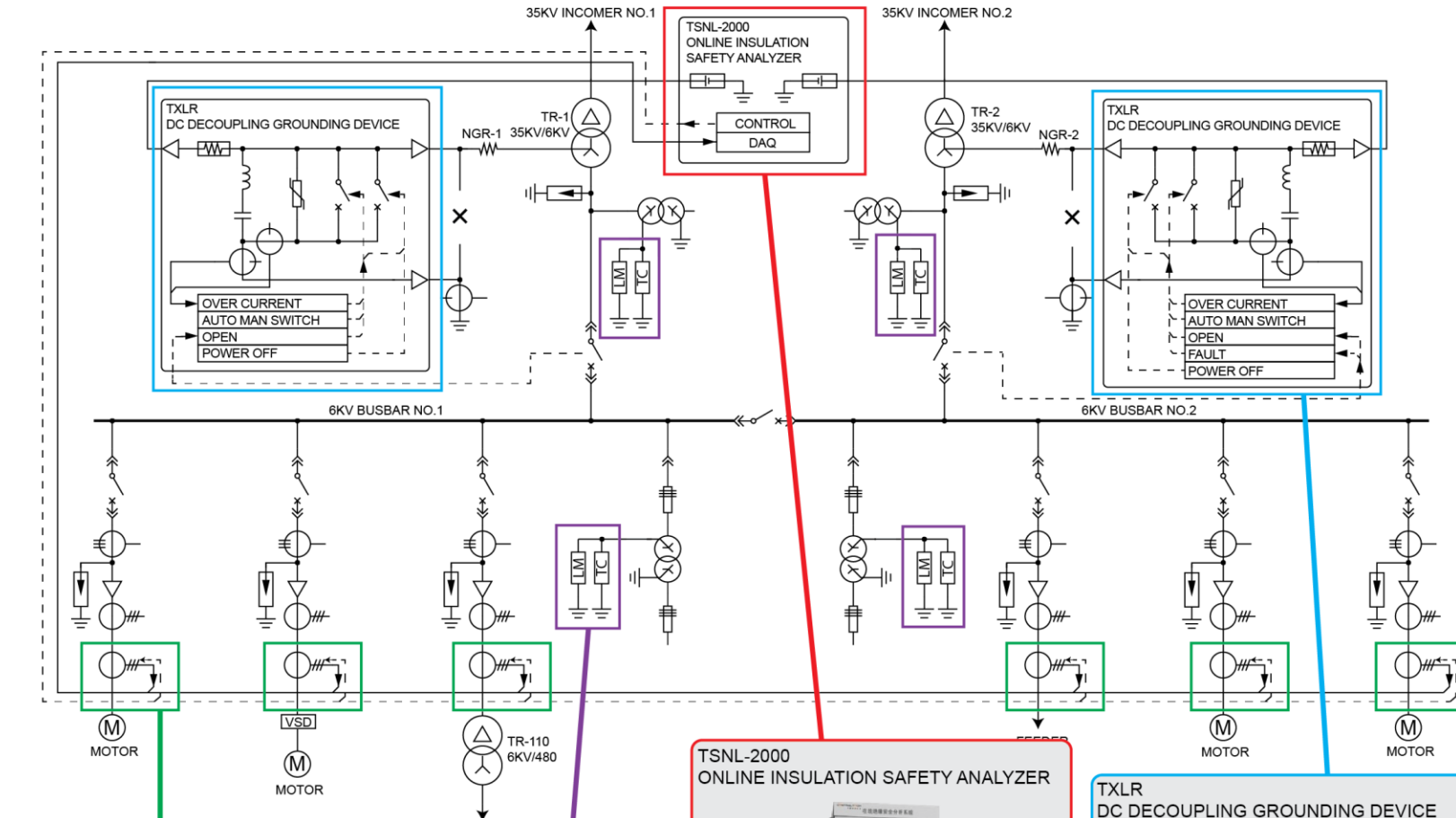
TSNL-2000 IMPLEMENTATION EXAMPLE
35 KV / 6 KV SUBSTATION NGR



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Application example—grounded through ASC system

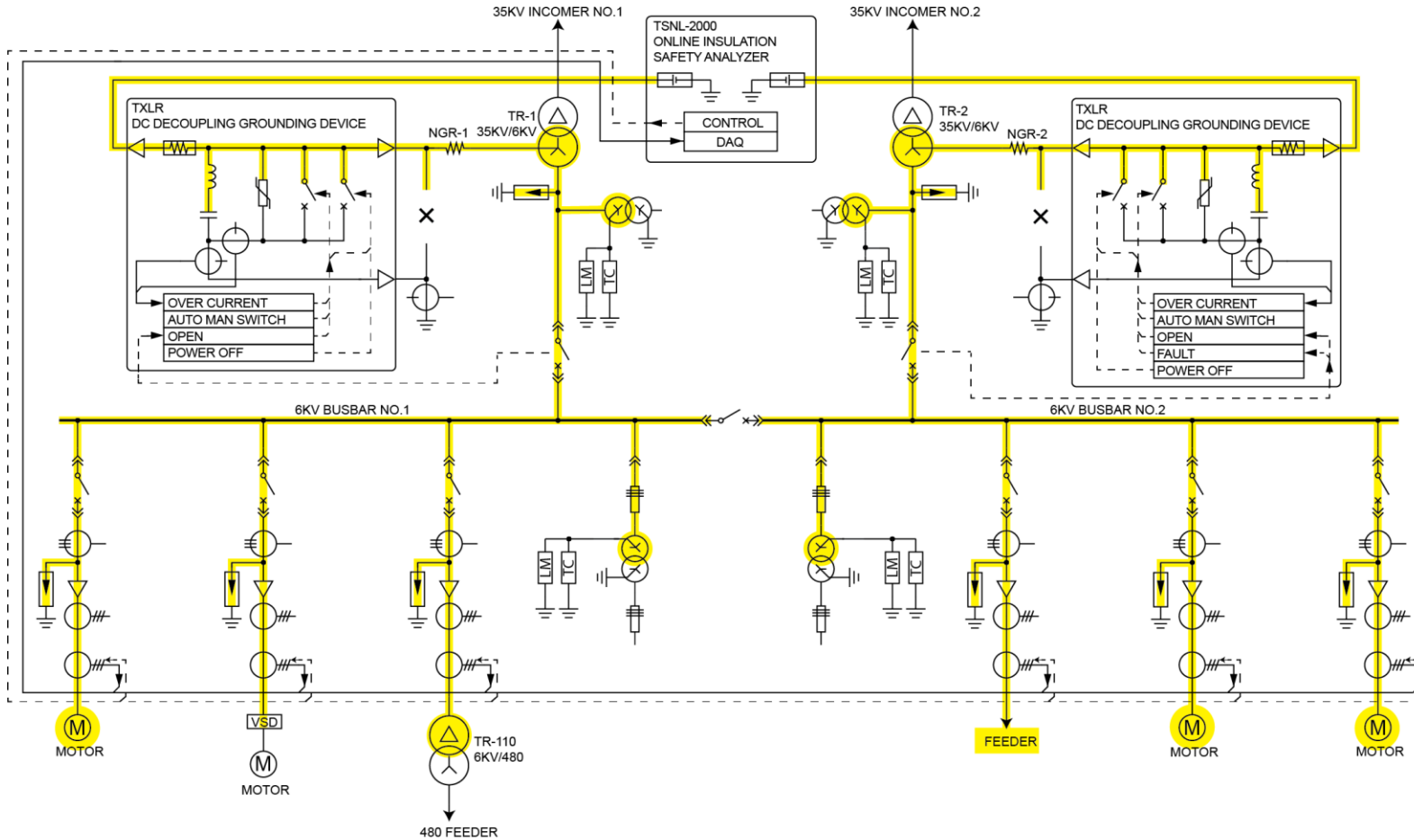
TSNL-2000 IMPLEMENTATION EXAMPLE 35 KV / 6 KV SUBSTATION NGR



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Insulation monitoring coverage

TSNL-2000 IMPLEMENTATION EXAMPLE
35 KV / 6 KV SUBSTATION NGR

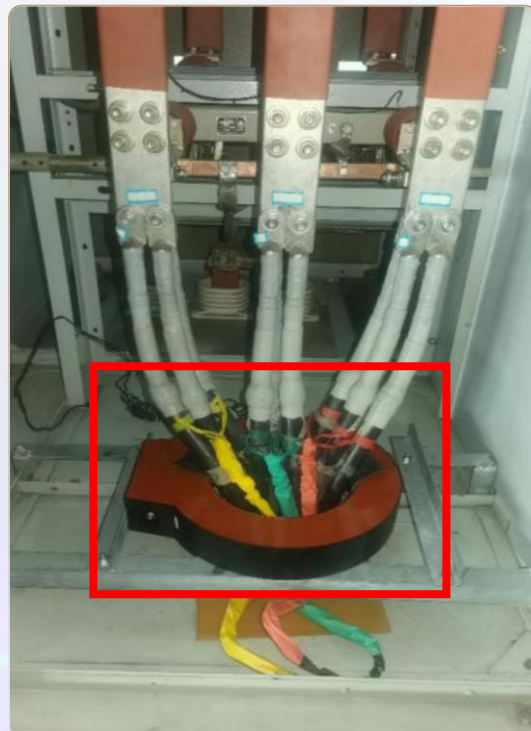


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	POWER FUSE

Installation examples



TSNL-2000 panel (left)
TXLR panel (right)



TSNL-2000T current
sensor



PT-type modules
LMCU (left)
TCDH (right)



Fusible Resistors

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TSNL-2000™

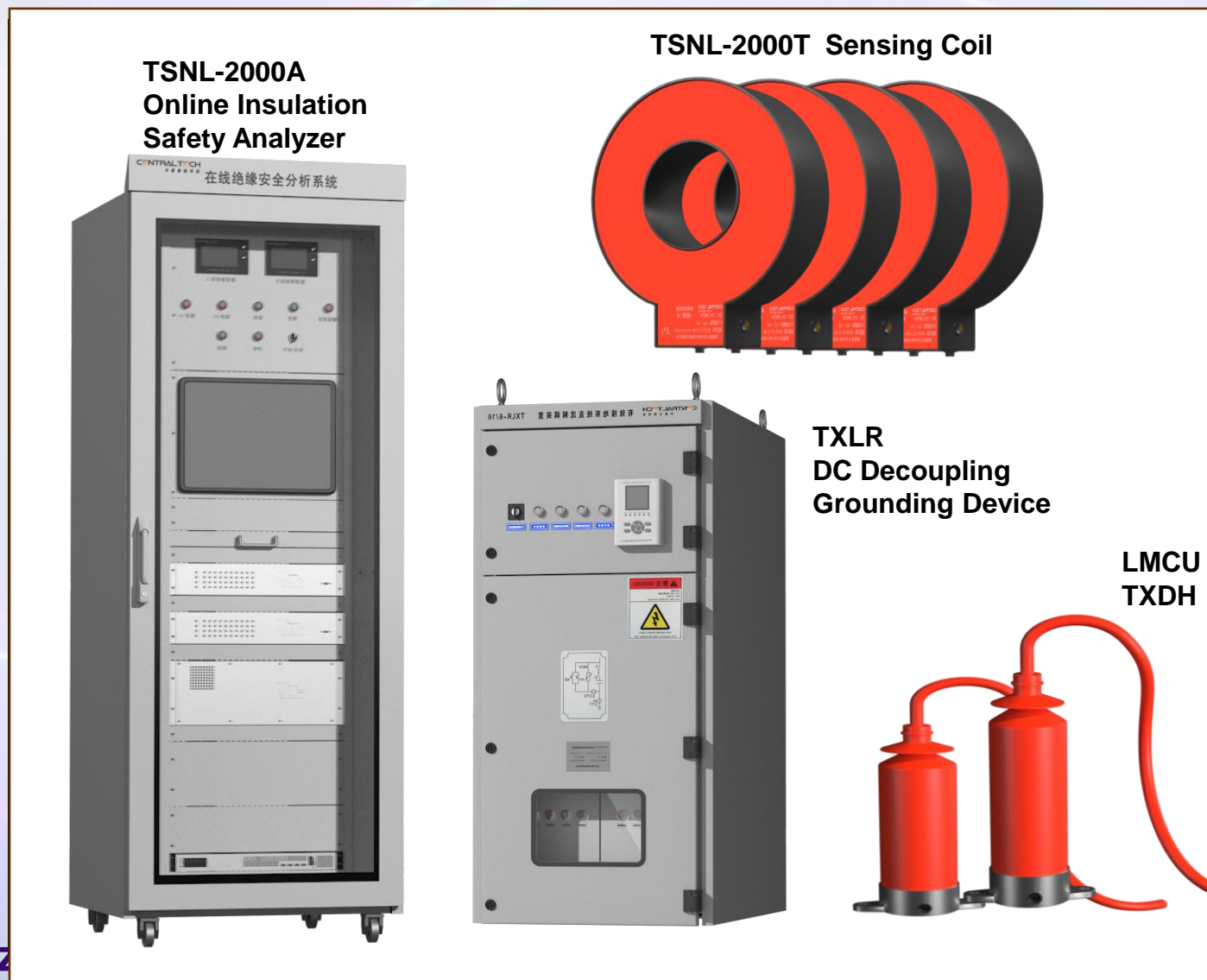
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TSNL-2000™ Online Insulation Safety Analysis System

Functions and Features

- **Online insulation monitoring**
Real-time continuous data.
- **System insulation**
Monitors the overall insulation of the entire system.
- **Branch insulation**
Monitors individual branch circuits.

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TSNL-2000 Specifications

Item	Parameters
Working Power Supply	AC220V-10%, +15%; DC220V-5%, +7%
Rated Power	DC800W, AC800W
Ambient Temperature and Relative Humidity	-10°C-40°C, ≤95%
Measuring Voltage	DC1500V
Insulation Measurement Range	0-200MΩ
Number of Measuring Circuits	4 circuits - 32 circuits/side
Effective DC Current Measurement Range	5μA-1mA
Resistance Resolution	0.1MΩ
DC Current Measurement Precision	Class 5 (error < 5%)
Insulation Resistance Error	< ±3%
Alarm Resistance Setting	1-99 (MΩ) panel setting
Inner Diameter of High-Precision Current Sensor	130 mm, 200 mm, 300mm;
Communication	RS-485, IEC-104 ZIGBEE protocols

Applications and Case Studies

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Case 1: 10kV cable joint insulation damage

Overview

TSNL -2000 Installation Date: October 20, 2020



Industry

Oil refining
and chemical



System

300,000 tons/year
polypropylene unit
10kV



Primary objectives

Large number of cables spreading
across a wide area.

01

IMPLEMENTATION

02

DETECTION

03

ACTIONS

04

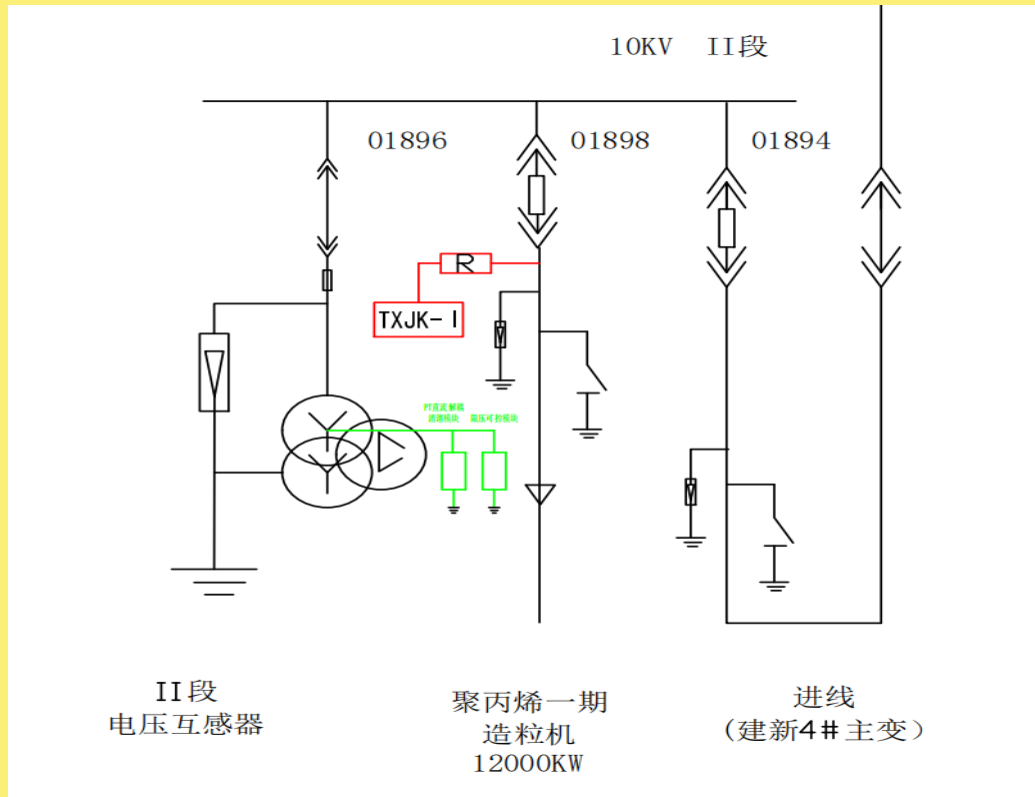
CONCLUSION

Insulation hazard: damaged cable joint on 10kV cable.



01

IMPLEMENTATION



TSNL-2000 system was installed on the **10kV power supply** of the **extrusion granulation unit** in the production facility.

02

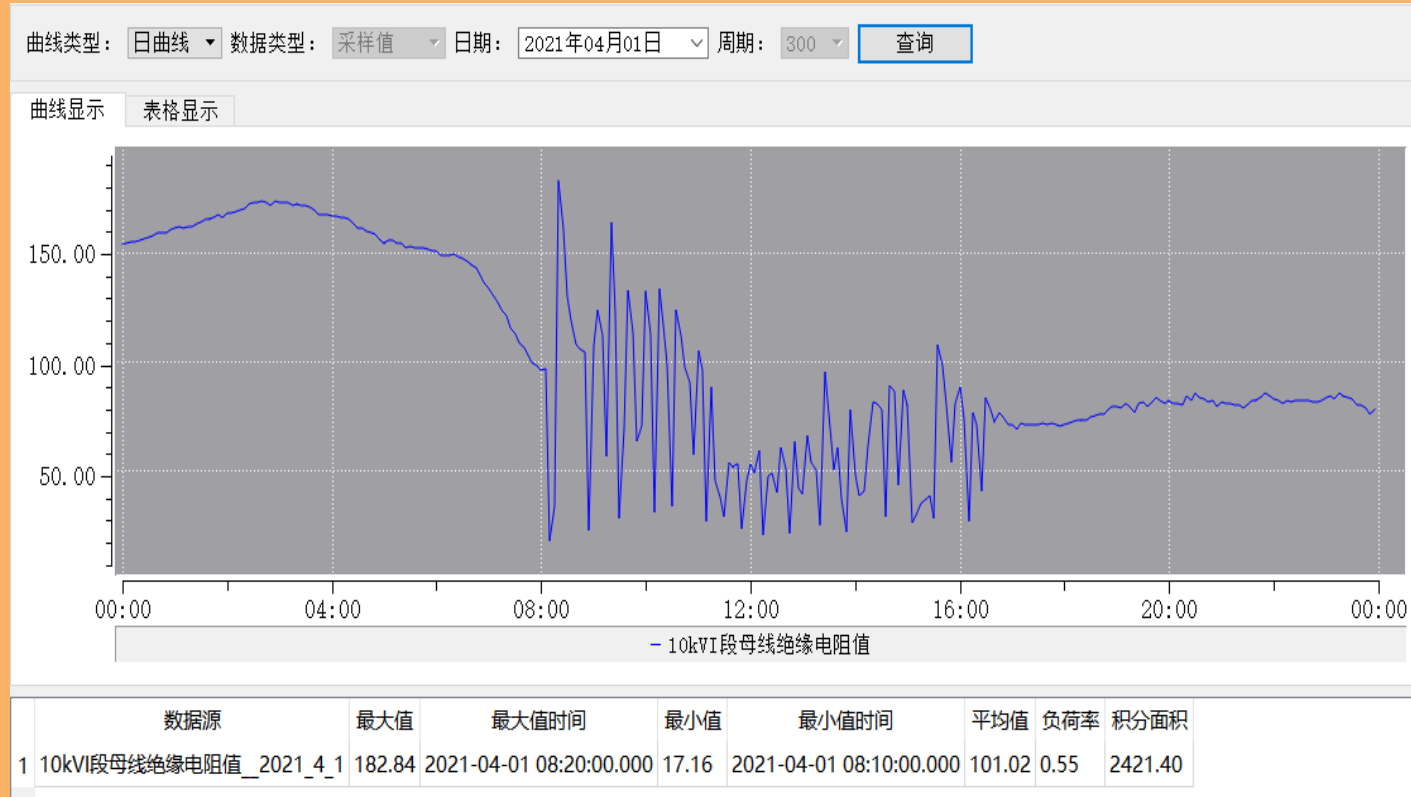
DETECTION

03

ACTIONS

04

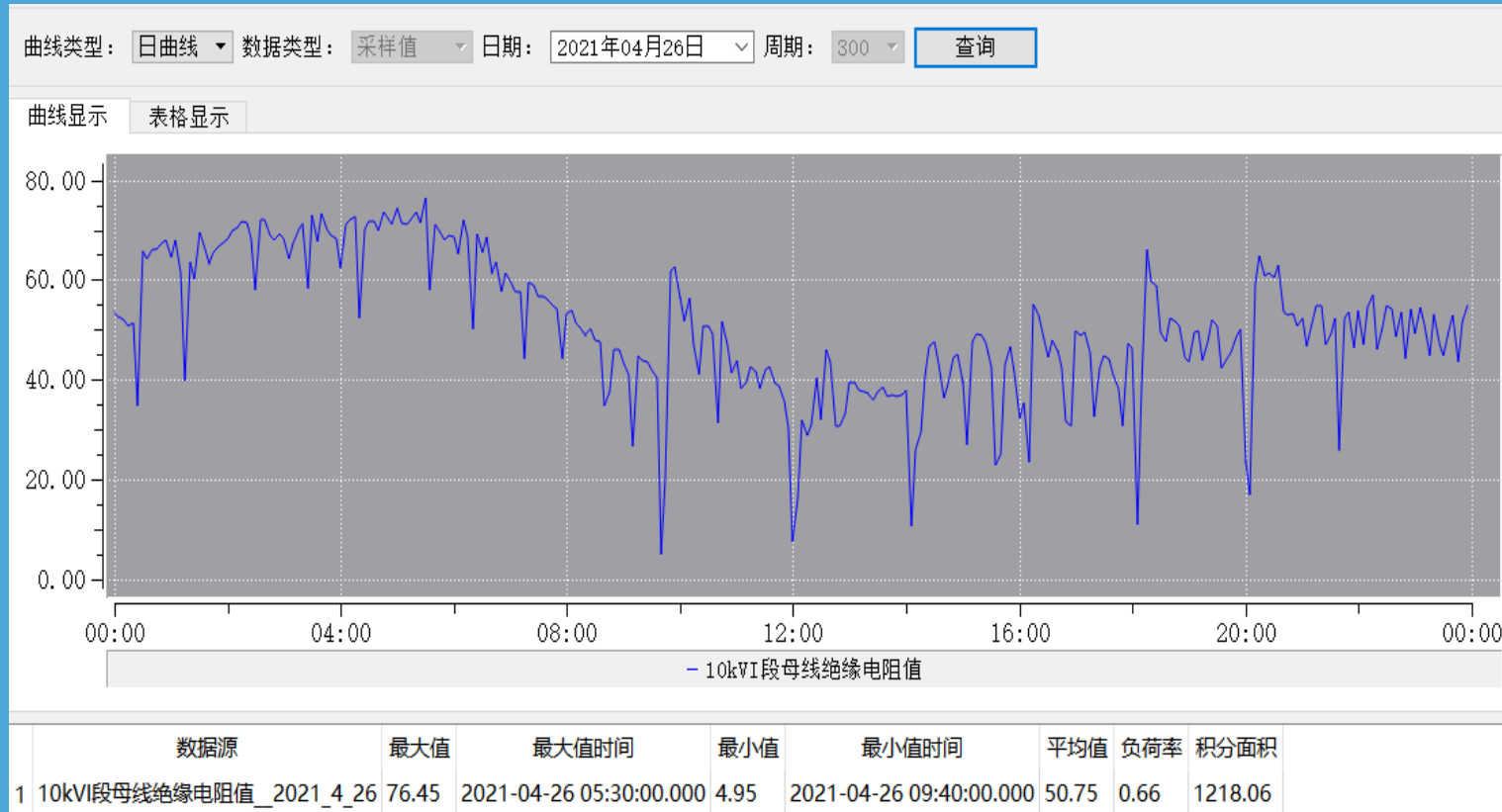
CONCLUSION



Around 2:30 PM on **April 1**, 2021, our system showed a **downward trend**.

By 5:00 PM on **April 2**, the system insulation resistance experienced significant **abnormal fluctuations**, with the lowest insulation resistance dropping to **9.66 MΩ**.

Afterward, the insulation resistance value **recovered** to approximately **90 MΩ**.



To ensure production continuity, the user closely monitored the system's insulation resistance.

From April 21 to April 26, the insulation resistance continued to show abnormal fluctuations.

The lowest insulation resistance value reached **4.95 MΩ**, which is below the standard threshold, indicating that the system's insulation was on the verge of failure.



April 29, the user completed the production task.

April 30, the user conducted an inspection of this 10kV system.



It was determined that **water had entered the cable middle joint** due to damage to the outer sheath.

Upon dissecting the cable middle joint, it was found that **corrosion had occurred**, and signs of scorch marks were observed, accompanied by single-phase discharge.

Case 2: High-voltage motor internal winding defect

Overview

TSNL -2000 Installation Date: November 11, 2018



Industry

Refining and
Chemical



Equipment

10 MW Motor



Primary objectives

High-voltage motors converts electricity into mechanical energy for production facilities, its reliability is critical in ensuring an efficient production.

01

IMPLEMENTATION

02

DETECTION

03

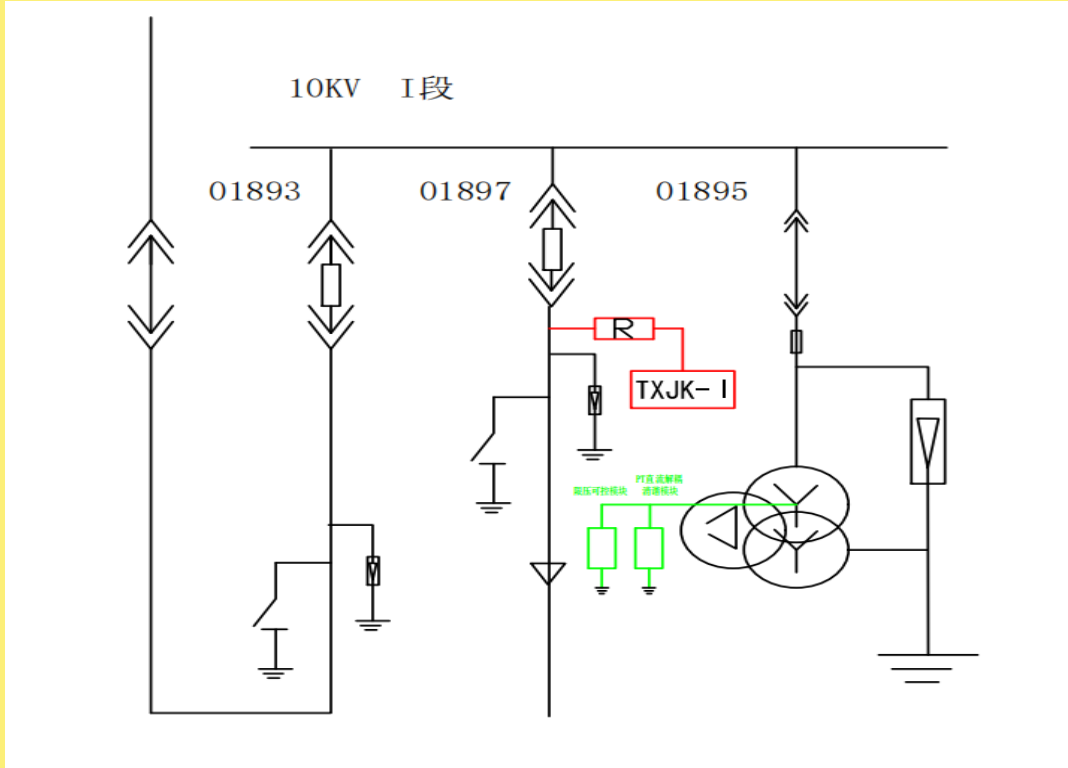
ACTIONS

04

CONCLUSION

01

IMPLEMENTATION



The product was installed on the power supply circuit of the high-voltage motor for the critical equipment in the facility.

Online monitoring of the insulation status of all primary equipment in the motor, as well as the 10kV equipotential electrical system, was conducted.

02

DETECTION

03

ACTIONS

04

CONCLUSION

02

DETECTION



On May 1st, 2019, the operators noticed that the online insulation safety analysis system indicated a **decrease in the insulation resistance of the motor circuit**.

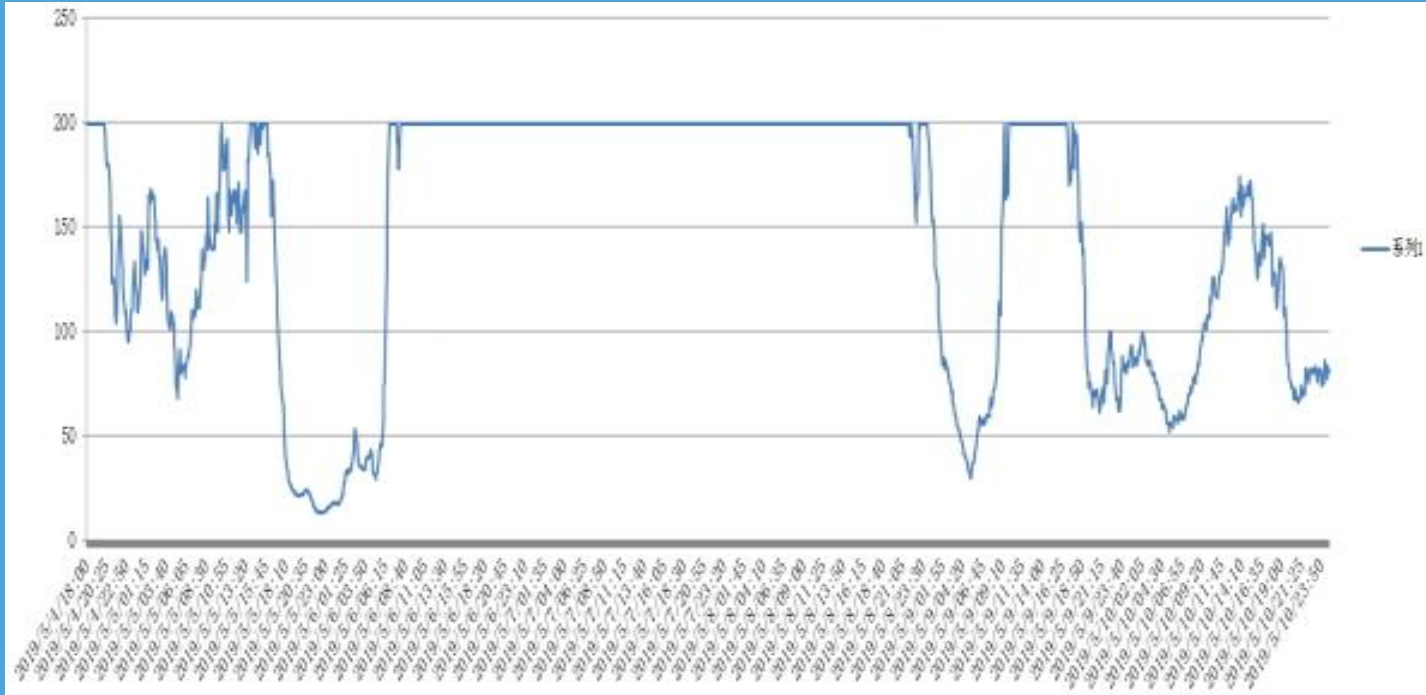
From 1:00 AM to 10:00 AM on that day, the circuit insulation resistance underwent two abnormal periodic decreases, after which the insulation resistance **returned to normal**.

03

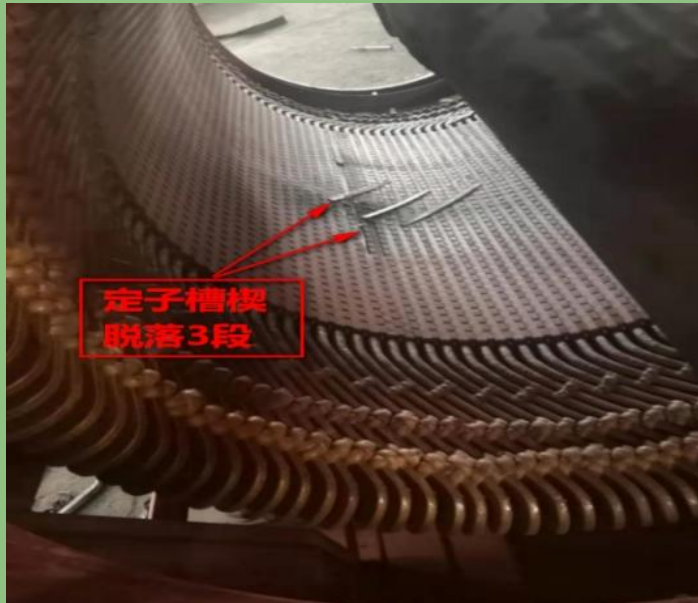
ACTIONS

04

CONCLUSION



From May 4 to May 10, the insulation resistance exhibited **abnormal frequent fluctuations**, with the lowest value dropping to around **15 MΩ**, and the situation showed a clear worsening trend.



The primary cause of the damage found inside the motor winding is due to manufacturing defects. TSNL-2000 system promptly detected the insulation hazard in the motor's stator windings, prevented an insulation failure, which could have led to a short circuit, arcing, and motor destruction. TSNL-2000 system was effective in diagnosing motor conditions and insulation defects.

Summary

*Insulation is a continuously
varying parameter*

*The insulation status is
unknown when the equipment is
powered up and running*

*It's a small probability to detect
insulation defects at a given
point in time.*

*Real-time online insulation
monitoring of electrical equipment*

*Insulation data enables
smarter management*

*Analyze the insulation variations
qualitatively and quantitatively.*

Online insulation data of power system

Efficiently reduced insulation faults from **over 80%** down to **less than 5%**.

CENTRALTECH Introduction

2007

Founded in 2007

2009

Certified as a national high-tech enterprise

2024

National-level “Specialized and Innovative Enterprise” certification



Microcurrent sensing measurement achieves a precision of **5 μ A**, setting a global benchmark.



Patents of Invention Patents Obtained

11

47



TSNL-2000
Online insulation safety analysis system

Global Breakthrough
Enable 7*24 hour on-line real-time monitoring of the insulation value of the electrical system in operation.

Industries

Petrochemical

Power Industry

Power Generation

Iron&steel metallurgy

New Energy

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16

Years

CONTINUOUS PROTECTION

200+

Customers+

WE SERVED FROM
DIFFERENT INDUSTRIES

2300

Insulation Hazards
WE HELPED OUR CUSTOMER
+ PREVENTED



Our Customers and Collaborators



中国石油



中国石化
SINOPEC



国家电网
STATE GRID



大全集团



中国华能
CHINA HUANENG



中国海油
CNOOC



国家管网
PipeChina



SIEMENS



CNMC
中国有色集团

特变电工
TBEA



中化
SINOCHEM

Schneider
Electric



Thank You!

Get in touch with us

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