Smart Switchgear & Cloud Service
Remote, but close
Contents

Online monitoring–iUniGear & iVD4

- Why and what
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- RF and networking technology
- Sensors technologies
- HMI
- Data transfer & storage
- Remote center
- Analysis and prediction

Cloud service

- Cloud service agreement
- Cloud service content
Advanced on-line monitoring tech. iUniGear & iVD4
Why we need switchgear on-line monitoring
Most frequent failure model

Mechanism fault
Insulation fault
Temperature rise fault
Temperature-insulation fault
Regular maintenance
The current solution for MV maintenance
To see is to believe
Maintenance strategies
Performance and failure consequence

Corrective maintenance
Preventive maintenance
Risk-based maintenance
Condition-based maintenance

Performance and reliability
Failure impact
What should be monitored
The most important to customers
iUniGear & iVD4
State-of-the-art tech realize the condition monitoring

Temperature rise monitoring
- Temperature of the tulips
- Temperature of the busbar
- Temperature of the cable connection
- Environmental temp. in LV compartment

Secondary accessories condition
- Charging time of motor
- Charging current of motor
- Working current of the shunt release coils
- Status of the aux. switches

Mechanism condition monitoring
- CB closing & opening time

Programmed operation
- Motorized truck
- Motorized earthing switch
Temperature rise monitoring
state-of-the-art technologies

Advantages:
- Easy use;
- Fast response;
- Water proof;

Disadvantages:
- Contact system will insert into contact box inside, inconvenience paste and observation;
- Need artificial measurement, increase burden of inspector;

Advantages:
- Non-contact;
- Easy use;
- Without visible light interference

Disadvantages:
- only receive linear reflected light signal, for non visual range cannot be observed;
- Need artificial measurement, increase burden of inspector;
Temperature rise monitoring
state-of-the-art technologies

Thermocouple/PTC/NTC

Advantages:
- High cost performance;
- Result accuracy, high precision;
- Continuous measurement, automatic alarm;

Disadvantages:
- Difficult installation and maintenance;
- Wired communication, difficult electrical isolation between high and low potential;
- Poor reliability, easy to false alarms;

Optical fiber

Advantages:
- Real-time, accuracy;
- Anti-high voltage, anti-corrosion;
- Continuous measurement;

Disadvantages:
- Expensive;
- Complex construction;
- High maintenance cost;
Temperature rise monitoring state-of-the-art technologies

**Advantages:**
- Low cost, Long transmission distance;
- Result accuracy, high precision;
- Wireless communication, easy to realize insulation between high and low potential;
- High frequency, PCB antenna, small size;
- Standard protocol, WIFI, Bluetooth, Zigbee;
- Standard encryption algorithm;
- Low power consumption;

**Disadvantages:**
- Weak anti-interference ability;
- Big antenna size;
- Poor confidentiality;
- Working frequency drift, poor stability;

**Disadvantages:**
- Short communication distance;
Temperature rise monitoring
Smart arm for VD4

Integrated Smart Arm
- Embedded electronics
- Elegant design
- Very safe
- Intelligent
- Easy to inspection or replace
- Easy for retrofit solutions

自供电CT
温传感器
无线测温模块
Temperature rise monitoring electronic component

Digital temperature sensor
- compact
- reliably
- Precision

Military IC
- all components selected for long-term working environment 40~125°C
- The design passed the heat accelerated aging test
Temperature rise monitoring
Self-powered CT

Smart arm for VD4
- Self-powered CT, battery-free design, avoid the below disadvantages
  - Short working time;
  - Explosion in high temperature environment;
  - Battery liquid leakage;
  - Insulation

Busbar and cable connection
- Open type CT
Temperature rise monitoring
Magnetic saturation waveform of self-powered CT
Temperature rise monitoring
Zigbee standard protocol + Private Protocol

Safe wireless RF technology
- High potential insulation
- Node handshaking
- Multi-node networking
- Data transfer
- Data routing
Monitoring of CB accessories
Physically isolated Hall sensor technology

- Hall sensor used
- Suitable for the monitoring for all the coils, motors…
- Measurement system physically isolated to CB control system
- No impact to normal operation or protection even the monitoring system fault.
HMI
To HMI and/or to substation management system

- Local HMI on the door provides the basic information of the main parameters, include the temperature and aux. parts measurement and calculation results.
- RS 485 and protocol opening to connect to Network Control Centre / Distributed Control System
Public network
GPRS or 3G

Reliable and convenient

- MDC4 via RS485 to public wireless transmission
- Support China Mobil, China Telecom and China Unicom
- Industrial class ARM platform
Data transmission and storage

Cloud storage

- Based on China telecom, there are main datacenters, providing cloud computing resources and services;
- According to DNS analysis, the user access request to the latest cloud storage location;

2015 ABB cloud storage

Beijing
Shanghai
Guangdong
Sichuan
HMI: www.ivd4.com + Mobil
On-line analysis and prediction system

- Famous and familiar interfaces
- Ease of use
- Increased confidence when commissioning switchgears
- Lower inspection cost
Monitoring, analysis & prediction
Temperature condition

The development of temperature rise fault is a process last for several hours or even days:

- Development
- Analysis
- Prediction
- Decision
- Action

I=500A,2h
I=800A,2h
I=1250A,2h
Monitoring, analysis & prediction
Secondary components

Current/voltage curves contain the rich information about secondary components and mechanism condition

Measurement
- MS: $I_{\text{curve}}$, $U_{\text{curve}}$, $t_{\text{Charging}}$
- MC: $I_{\text{Curve}}$, $U_{\text{Curve}}$
- MO: $I_{\text{Curve}}$, $U_{\text{Curve}}$
- Aux. switch: 1NO+1NC

Algorithm
- MS: $I_{\text{RMS}}$, $U_{\text{RMS}}$
- MC: $I_{\text{RMS}}$, $U_{\text{RMS}}$
- MO: $I_{\text{RMS}}$, $U_{\text{RMS}}$
- Time: $t_{\text{Opening}}$, $t_{\text{Closing}}$
Monitoring, analysis & prediction  
charging motor monitoring

Failure mode:

- Gear wheel broken.
  - Initial stage: One or two teeth broken, but motor could still be able to finish the charging
  - After several operations the entire gear pairs damaged completely
- Maintenance could be planned at convenient time

Charging current curve becomes jittering, charging time becomes more longer.
iUniGear & iVD4
Smart switchgear hardware

Switchgear retrofit
- busbar
- Coils
- Contact system
- Motorized truck
- Charging motor
- Motorized ES
- Cable connection

MDC4
HMI
Substation platform
WEB client
Mobile APP

iUniGear®
Smart grid solution

iVD4®
Smart grid solution

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Cloud service
Full service closed to you
Cloud service package
Full service base on remote + local

Cloud service base on:
- Smart panel
- Remote monitoring
- ABB specialist team
- Service footprint
- Local rapid response

Cloud service package value:
- Improve reliability
- Improve substation performance
- Reduce operation cost
- Raise s/s management level
Details of the cloud service package
Full customer support

Remote monitoring
Based on smart switchgear with sensors and wireless RF, ABB provides the real-time remote monitoring service

Routing inspection
to the substation by ABB service engineer with professional facilities

Rapaid response
in 2 or 4 hours service, base on the service station footprint

Technical support
Assign account manager for customers, who will response the requirements rapidly

Diagnose & maint.
to maximize the reliability and availability of equipment and systems

Warranty extension
to cloud service effective period

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 ... 30 |
|------|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|-----------|
| LC   | - | Run-in | Stable | Monitor | Unstable | Lf.extension |
| Maint. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Annually |
ABB specialist on-line Remote monitoring

When maintenance responsible receives the alarm, then contact customer and diagnose & maintain the switchgear devices

The parameters of on-field devices will be sent back ABB cloud data server by GPRS/3G

ABB remote center specialists monitor the asset condition and define the right actions
Remote center
“Cloud room” with multifunction

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
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<tbody>
<tr>
<td>On-line monitoring</td>
<td>On-line monitoring, analysis and decision made by ABB specialist team remotely</td>
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<tr>
<td>Remote issue permit-to-work</td>
<td>Via the 3G network, mobile phone and cloud room video system we issue the “permit-to-work” to site service engineers remotely</td>
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<td>400 hot line</td>
<td>400 hot line function combine with Remote PTW, cost efficiency</td>
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<tr>
<td>Service quality survey</td>
<td>Better customer care</td>
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<td>More stable service quality</td>
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<td>Remote tech. support</td>
<td>Improve the competence of our site service engineer</td>
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PPMV service footprint
Rapid response in **2h & 4h** service offering

Company Level
PPMV Level

Response in 2h
Response in 4h
ABB PPMV smart grid solution
Sales performance
Pilot project
Shandong Weihai Shangmao Substation

- Pilot Intelligent substation demonstration project
- Based on 3G ABB Online System
- Commissioning from 2011