Guide for the Technical Specification of IoT （Internet of Things） Intelligent Terminal within Switchgear

State Grid Xuji Group Co., Ltd.
1. Background
2. Requirements
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**Intelligent Construction Demand**

- **Temperature monitoring**
  Monitoring the environmental temperature of switchgear or Ring main Unit (RMU)

- **Cable temperature monitoring**
  Monitoring three phases cable temperature to pre-judge the cable health condition

- **Bus temperature monitoring**
  Monitoring the bus temperature to analyze the bus health

- **Video monitoring**
  Monitoring videos of the earthing switch position to realize “double confirmation” accordance with the remote communication state

- **Mechanical characteristics monitoring**
  Monitoring the breaker’s mechanical characteristics to analyze the operating conditions and lifetime, which will guide intelligent operation and maintenance of switchgear or RMU

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**Background**

- Contact explosion
- Switch overheating
- Cable joint melting
- Bus switch on fire
- Cable on fire

**Monitoring**

- Cable temperature monitoring
  Monitoring three phases cable temperature to pre-judge the cable health condition

- Bus temperature monitoring
  Monitoring the bus temperature to analyze the bus health

- Video monitoring
  Monitoring videos of the earthing switch position to realize “double confirmation” accordance with the remote communication state

- Mechanical characteristics monitoring
  Monitoring the breaker’s mechanical characteristics to analyze the operating conditions and lifetime, which will guide intelligent operation and maintenance of switchgear or RMU
Learning from functional mobilephone to smart mobilephone, the intelligent terminal could achieve universal hardware and flexible software configuration, as well as support functional expansion as needed, which combined with many kinds of traditional electrical terminal functions and APP software that contains different requirements.

Traditional electrical terminal

IoT intelligent terminal advantages

Share common resources such as CPU, storage and network, adequate scalability of software and hardware, standardized design.
Traditional detection

- High labor costs
- Patrol inspection is not timely, no early warning
- Much more blind spots in patrol inspection
- Terminal has limitations: inadequate software scalability, proprietary communication, non-standardized design, etc.
- More electric shock hazard exists in live inspection

Current monitoring

- lower labor and labor costs
- real-time monitoring, gives early warning to the faults
- Historical data query, trend analysis, fault diagnosis
- Potential failure points could be monitored with pre-judgement and analysis method
- Improves the efficiency of equipment operation and maintenance of switchgear and RMU
**Market requirements**

**GSMA** reports that the number of industrial IoT terminals will reach 6 billion in 2020 and 14 billion in 2025, with an average annual growth rate of 21%.

**ABB** adopts IoT technology to monitor equipment operation data and contact temperature in real time to help users to realize big data analysis and preventive maintenance.

**Schneider Electric** launches intelligent loop switchgear, based on EcoStruxure architecture of IoT to meet users' increasing demands for digital power distribution operation and management.

**Siemens of Germany** releases two kinds of gateway devices: "MindConnec Nano" and "MindConnect IoT 2040".

**GE America** provides data bus service for the IoT intelligent terminal through the "PredixMachine" device on the Predix platform.
Technical requirements

Smart switchgear demands

Flexibility
Simple to realize, offering up to 66% less cables and up to 10% less connectivity components.

Scalability
Users could download any functional APP software with universal hardware in the IoT intelligent terminal to realize evolving requirement.

Service continuity
Reliable and simple to service, offering up to 36% less maintenance cost.

Future proof
Offering upgrade and update solutions with zero downtime.

Standard requirements

There is no relevant standard to regulate intelligent terminal within switchgear.
Technical requirements

Power APP application center

IoT intelligent terminal

- Breaker statement monitoring
- Earthing switch monitoring

Mechanical characteristics monitoring
Temperature and humidity monitoring
Partial discharge monitoring
Arrester monitoring
Cable temperature monitoring
Video analysis

Artificial intelligence and machine learning function of IoT intelligent terminal:

- Network management
- Remote management
- Firmware management
- Container management
- APP management
- Diagnose log

APP1
APP2
APPn

virtualization container 1
virtualization container 4

APP1
APP2
APPn

Process management
Title


BS EN 62271-2004: AC Metal-Enclosed Switchgear and Controlgear for rated voltages above 1 kV and up to and including 52kV.


Correlation

This paper elaborates the technology of switchgear intelligent construction and proposes the use of intelligent terminals, which will accelerate the pace of the switchgear intelligent construction.

It is not applicable to the intelligent construction of switchgear and ring main unit (RMU).

The standard just defines the terms for switchgear products, but excludes the functional and technical specification for IoT intelligent terminal.

The standard is limited to the substation area and is not related to the intelligent terminal of terminals of switchgear and RMU.
Provides general functional and technical specification for IoT intelligent terminal (as a device) used in intelligent switchgear and RMU, and the system voltage is up to 35kV.

Addresses various functions and requirements of its environmental aspect, communication and information exchange interface, power supply, hardware and software platform, and advanced application.

Offers design, manufacturing, operation and testing for intelligent switchgear and RMU.
Entities involved are expected to include:

- State Grid Xuji Group Co., Ltd.
- China Electric Power Research Institute.
- China Southern Power Grid Academy of Science.
- State Grid Xiongan New Area Electric Power Supply Company.
- Newcastle University Upon Tyne.
- Tianjin University.
- Xi'an Jiao Tong University.
- North China University of Technology.
- Datang Telecom Technology Co., LTD.
- Schneider Electric SA.
- HUAWEI Technologies Co., LTD.