ABB Ability™ Condition Monitoring for switchgear

SWICOM

Reliable Asset Management
Ongoing digital revolution

Industrial revolutions are faster and faster

1712 – Industry 1.0
Thomas Newcome builds the first steam engine

1870 – Industry 2.0
Electricity is used for Industrial Production

1969 – Industry 3.0
Programmable logic

Today – Industry 4.0
Communications between people, services, and things
Current Market

- Focus on switchgear, breakers and relays
- Minimum life of 30 years for primary equipment and 15 years for electronic equipment
- Robust with low failure rates
- Higher consequence in case of failure

ABB Ability™

ABB offers more with digital solutions:
- Sensing equipment on board
- Software based solutions
- Communication between different layers and tools

Electrical distribution digitalization: an ABB Ability™
Strategy
Values and expected benefits
Asset management
Find the optimum balance

**Effective asset management**

Effective asset management requires investment planning. The owners need to be aware of:

- Assets condition
- Risk level
- Failures consequences
- Life cycle status
- Retrofit investments

**Optimal maintenance strategy**
Value and savings at fingertips with advanced maintenance strategies
Smart asset management

Experience intelligence

Why should I embrace ABB Ability™?

- **Reduce total cost of ownership:**
  Optimization of maintenance schedule and increase work force efficiency

- **Maximize Uptime:**
  Avoid unplanned outages which directly effect revenue generation

- **Improve safety:**
  Reducing catastrophic failures which impact human and asset life

![Diagram showing ABB Ability with features]

- Reduce total cost of ownership
- Maximize uptime
- Improve safety

**ABB Ability**

- Condition monitoring
- Remote diagnostics
- Predictive analytics
Reduce total cost of ownership

Optimizing maintenance

100%
Unplanned labor cost doubles
Plan maintenance activities based on real-time data diagnostic and prediction

30%
Decrease the duration of the time required for maintenance activities

End user value

<table>
<thead>
<tr>
<th>Asset type</th>
<th>Maintenance type</th>
<th>Frequency of action</th>
<th>Preventive / per asset</th>
<th>Condition / per asset</th>
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</thead>
<tbody>
<tr>
<td>Circuit breaker</td>
<td>Visual/Basic</td>
<td>2 years</td>
<td>2 h</td>
<td>0 h</td>
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<tr>
<td></td>
<td>Advance</td>
<td>5 years</td>
<td>2 h</td>
<td>1.4 h</td>
</tr>
<tr>
<td>Switchgear</td>
<td>Visual</td>
<td>0.5 years</td>
<td>0.5 h</td>
<td>0 h</td>
</tr>
<tr>
<td></td>
<td>Basic</td>
<td>5 years</td>
<td>0.75 h</td>
<td>0 h</td>
</tr>
<tr>
<td></td>
<td>Advance</td>
<td>10 years</td>
<td>2.5 h</td>
<td>1.75 h</td>
</tr>
</tbody>
</table>

$336 per annum
$168 per annum

40%
Opex cost reduction
Maximize uptime

Avoid unexpected failures

Before failure happen

- Digitalization informing before the system fails
- Know-how about the current asset
- Avoid possible failures help reduce production and asset loss

$1.2M PER HOUR*
AVERAGE DOWNTIME COSTS FOR AN AUTOMOTIVE INDUSTRY

$740k PER OUTAGE*
AVERAGE DOWNTIME COSTS FOR DATA CENTERS

$4.4M PER DAY*
120,500 BARRELS OF OIL LOST PER DAY OIL & GAS SEGMENT

$150M PER OUTAGE
AIRLINE LOST A SWITCHGEAR WITH 3.7% STOCK DROP IN 2 DAYS IN 2016

$100k PER PANEL
STEEL WORKS LOSS PER YEAR PER PANEL

$20k PER PANEL
ANNUAL LOSS IN SEMI-CONDUCTOR PRODUCTION

*Shown: aggregated statistics for medium voltage (Source: Hartford Steam Boiler)

*A 1999 Electric Power Research Institute (EPR) study pegged total direct and indirect costs of an arc flash incident
*Cost of Data Center Outages (D) Ponemon Institute
*The Economic Impact of August 2003 Blackout (E) done by ELCON
*Copper Institute (C)
Improve safety
Avoid unexpected failures

Operate more safely
Keep your personnel out of the arc flash zone

Personnel must enter arc flash zone. 4000 injuries occur in the US each year *

Remote communications enabled, data can be safely transmitted to a remote location

$1\text{M} \text{ to } 15\text{M}$
POTENTIAL COST OF ONE ARC FLASH INCIDENT*

ANNUAL DEATHS IN US ALONE ARE CAUSED BY ENERGIZED ELECTRICAL EQUIPMENT

~300

80%

OF ALL ELECTRICAL ACCIDENTS ARE CAUSED BY ARC FLASH INCIDENTS

19,000 °C (35,000° F) Hotter than you can imagine
Arc Flash temperatures are hotter than the sun.

1,100kmph (700 mph) Projectile-producing pressure
Arc flash can throw workers across a room. Metal and equipment become shrapnel.

+2,000 burns More than one way to burn you
Each year 2,000+ people seek treatment for serious Arc flash burns.

3 meters (10 feet) Too close for comfort
Arc flash can reach out 3 meters to take a life. Serious-injury zone is even larger.

140 dB An assault on your senses
Light and sound bursts can cause vision and hearing loss.


*A 1999 Electric Power Research Institute (EPRI) study pegged total direct and indirect costs of an arc flash incident
Perceived benefits
Costs and savings balance

Availability
Reliability
Predictability
Customers approach

“We need to track the health condition of our assets, and predict potential failure. Solve a failure here can be very complex. […] For our budgeting and planning it is very important to get best estimation of remaining useful life”

Electrical Services Manager,

“This is the most important attraction...... We need highest availability and predictability […] Here it is not a matter of loss production [...]. ABB has to work with engineers and consultants, to ensure that new switchgear tenders will contain diagnostic.”

Director of Operations
Electrification ecosystem

A digital world

- **Predictive**
  - ABB Ability™ Data Analytics for electrical systems (ESDAY)

- **Algorithm Layer**

- **Assessment without sensors**
  - ABB Ability™ Life Cycle Assessment for electrical systems (MySiteCondition)

- **Condition monitoring with sensors**
  - ABB Ability™ Condition Monitoring for breakers (MySiteCare)
  - ABB Ability™ Condition Monitoring for switchgear (SWICOM)

- **IoT 4.0 cloud solution**
  - ABB Ability™ Asset Health for electrical systems (MyRemoteCare)
Electrification ecosystem
A digital world

**ABB Ability™ platforms**

1. **MyRemoteCare**: the cloud based condition monitoring dashboard
2. **MySiteCare**: all existing MV switchgear can be digitally enabled
3. **SWICOM**: all new MV switchgear are digitally enabled
4. **MNS Digital** LV switchgear
5. **EDCS**: electrification performances can be further expanded
Electrification ecosystem
A digital world

**ABB Ability™ platforms**

1. **SWICOM:**
   - Main target: new switchgear\(^1\)
   - Primary sensing equipment: IEC 61850 based protection relays
   - Setup: one device per lineup

2. **MySiteCare:**
   - Main target: existing switchgear\(^2\)
   - Primary sensing equipment: itself
   - Setup: one device per panel

Both can be connected to other sensors e.g. for temperature monitoring.

1. Also existing switchgear when equipped with IEC 61850 based protection relays either natively or after a relays retrofitting program.
2. Also new switchgear when not equipped with suitable IEC 61850 based protection relays.
Electrification ecosystem

A digital world

**ABB Ability™ Condition Monitoring for switchgear - SWICOM**

- IoT enabler for all switchgear lineups (primary and secondary distribution AIS and GIS)
- Building block of Industry 4.0-IoT Cloud solution by ABB
- Relion’s relays on IEC61850 as primary sensing infrastructure
- Ready for additional sensors on demand like temperature sensors
- One unit handles a whole switchgear lineup and even up to 24 panels
- It can be installed on ABB and non-ABB medium voltage assets
ABB Ability™ Condition Monitoring for switchgear
SWICOM
Switchgear monitoring

- On premises solution
- Circuit breaker monitoring retrieving data from the relays:
  - Opening and closing times estimation and analytics
  - Operation, trip counting etc.
  - Contact wearing etc.
- Health indication and diagnosis on the touch HMI and mobile App
- Extension to ABB cloud possible
Advanced switchgear monitoring

- Temperature sensors across the panels
- Covering failure modes in busbar, circuit breaker and cables compartments
- Flexible installation
- IEC 61850 not requirement for this specific purpose
- Other sensors also possible e.g. ambient temperature and humidity
- Assets condition is visible on site via a touch HMI
- A mobile app provides data via smart devices
- Also SCADA connection through Ethernet TCP/IP is possible
- SWICOM connects to the MyRemoteCare cloud based dashboard showing the asset health status remotely
More and more features

Human Machine Interface
- Lineup overview
  - Connected Bay
  - Status of every Bay (traffic lights)
- Overall status (LED) panel details
  - KPIs (health indexes)
  - Measurements and Events

Mobile Application
- Point to Point secure Wi-Fi connection
  - In front of the panel Wi-Fi enabling
  - Single access (security restrictions)

Local files storage
- Documents downloading and reading from integrated SD-Card
  - Drawings
  - User manuals
  - Movies
  - Procedures...

Always available
- USB powered by PC, mobile, tablet or battery pack
  - HMI and Mobile Applications running also without auxiliary
  - Data and files accessible to users also with hands-on unpowered equipment during maintenance or repairing
Condition monitoring

Wireless temperature sensors
Condition monitoring

Temperature monitoring

Arc flash hazards

- Connection faults
- Insulators degradation
- Overload
- Aging
- Oxidation

Avoid unwanted outages
Condition monitoring

Temperature monitoring

**SAW technology solution**

- Wireless battery-less sensors
- Analysis and connectivity
- Easy to install for brown and green field
Condition monitoring

Temperature monitoring applications

1. Cable terminations temperature monitoring on GIS (main busbar are also applicable when outside the gas tank)
2. Circuit breaker fixed contacts temperature monitoring on AIS (cables and main busbar are also applicable)
Temperature monitoring applications

Retrofitting circuit breaker fixed contacts temperature monitoring (cables and main busbar are also applicable)
Condition monitoring

Temperature monitoring

**Hot-spots thermal monitoring**

SWICOM algorithm combines properly two principles:

- Temperatures comparison: looking for temperature differences among phases
- Temperature influence: compare the monitored temperature with ambient temperature detecting hot spot conditions also at low load

Measurements and analytics results are available on SWICOM locally and MyRemoteCare remotely.
Condition monitoring

Temperature monitoring

**Operation of SAW**

- The transceiver sends an electromagnetic signal to the sensor (~ mono-static RADAR).

- The antenna of the sensor captures the signal, IDT converts it into a Surface Acoustic Wave and reflects these modified signals back to the transceiver.

- The transceiver computes, processes and translates the signal into an exploitable data: temperature from -25 to 150°C.
SAW sensors

The inside life
MyRemoteCare

Assets health and performance management
MyRemoteCare
Assets health and performance management

Typical journey

- Dedicated and secure private network
- State-of-the-art cyber security
- One way communication without control capability
- Warning and alarms delivered to operators
- Immediate support from ABB
- Automated reports as per customer wish

Secure & fast support
MyRemoteCare
Assets health and performance management

**The power of cloud analytics**

- Avoid unscheduled downtime: predict faults before they happen
- Optimize maintenance: condition-based maintenance
- Improve asset life-cycle
- Dashboard, reports and alert notifications available on laptop, tablet and smartphone
- Cloud application to run advanced analytics: algorithms calculating the Probability Of Failure (POF) and Remaining Useful Life (RUL)
- Circuit breakers and switchgear health condition analysis and remote support by ABB Service
- Cloud application: very low TCO, always updated, secure

The power of cloud analytics