Preventative Maintenance & Outage Approach
Services for Safe, Smart, & Sustainable Electrification
Topics for Discussion

- Service at Glance & Core Pillars
- Equipment Lifecycle Considerations
- Maintenance, Lifecycle Management & Extension Approach
- Suggested Spares Strategy
- Service Support Agreements
- Life cycle process
- Q&A
Service at a Glance

**Vision**
- Provide a superior customer experience both internal & external

**Life Cycle Services**
- 1. Engineering and consulting
- 2. Maintenance
- 3. Spares and consumables
- 4. Repairs
- 5. Training
- 6. End of life services
- 7. Extensions
- 8. Retrofits
- 9. Replacement
- 10. Advanced services (Smart Asset Management)
- 11. Support of agreements (Power of Care)

**ABB Ability™**
- Start-up and maintenance services
- Safety
- Availability
- Reliability

**Our Mission**
- Reduce total cost of ownership
- Maximize revenue for our customers
- Provide safe, smart, and reliable solutions for the entire asset life cycle

---

©ABB August 30, 2022 | Slide 3

We reserve all rights in this document and in the subject matter and illustrations contained therein. Any reproduction, disclosure to third parties or utilization of its contents – in whole or in part – is forbidden without prior written consent of ABB.
US Electrification Service

Core Pillars

Complete One-Line Solution for Low and Medium Voltage

**Electrical Power Distribution Field Services**
- Preventative Maintenance
- Installation and Commissioning
- Customer Training
- Disaster Recovery
- Testing Services

**Power Consulting Services**
- Arc Flash Mitigation Solutions
- Arc Flash Studies
- Short Circuit Current Limiting Devices
- Safety Personnel Training

**Life Cycle Extension**
- Breaker Retrofits / Retrofills
- Upgrades
- Protection and Control Upgrades
- Switchgear Add-ons and Upgrades
- Repairs

**Performance Enhancement**
- ABB Ability™ energy and asset manager
- Condition Based Assessment Studies
- Real Time Equipment Monitoring (temperature, humidity, partial discharge)
- Remote Service Offerings
- Service Agreements
Why invest in Preventative Maintenance?

- Improving personnel and equipment safety
- Avoiding costly downtime
- Reducing service interventions
- Reducing operational costs
- Sustainability of electrical assets
Preventative Maintenance

Maintenance is carried out at predetermined intervals or according to prescribed criteria, aimed at reducing the failure risk or performance degradation of the equipment.

Maintenance checks include:
- Visual checks
- Apparatus cleaning
- Mechanical components lubrication
- Testing
- Worn parts replacement
- Functional tests execution

Maintenance cycles are planned according to the need to take the device out of service. The incidence of operating faults is reduced.

Testing

Any internal failure may have a significant impact, mainly because restoration is complicated and lengthy. ABB testing services work to prevent failures from happening and catch them early on.

Relay Calibration
- Calibration testing pinpoints a defective relay before it fails to act during a fault
- Shows where power system needs to be adjusted

Hi Potential (Hi-pot)
- Dielectric Withstand test, best way to uncover workmanship and assembly defects in an electrical product that can lead to insulation breakdown

Partial Discharge (PD)
- Provides advanced notice of pending insulation failure
Equipment Lifecycle Extension Considerations

Typical Equipment & Safety Challenges

Equipment
- Equipment uptime
- Age (service years)
- Current Maintenance efforts no longer effective (time or usage based)
- Availability of parts and spares
- Enablement of Digital monitoring & accessibility
- Reaching predictive capability

Safety & Personnel
- Equipment doesn’t meet current safety requirements
- Protection of operators & maintenance workers
- Ability to support equipment (aging workforce, new technology)
Equipment Lifecycle Extension Considerations

ABB Approach

Evaluate
- Baseline equipment – data collection, asset health evaluation, lifecycle review
- Review shared database of condition findings
- Sharing of continuous improvement opportunities
- Consider solutions approach based on site constraints and safety

Maintain
- Initiate/optimize proactive maintenance programs
- Routine
- Condition-based
- Predictive
- Remote Assistance

Monitor
- Look at condition monitoring solutions
- Support transition from basic monitoring to predictive

Extend
- Intentional spare strategy
- Structured lifecycle extension plan that integrates improved safety and standards compliance
Life Cycle Extension Solutions

ABB’s worldwide leadership and manufacturing excellence, in medium and low voltage products, allows ABB to provide a variety of aftermarket solutions and services for both conventional and nuclear safety related applications.

**Low Voltage Solutions**
- MCC bucket replacements
- MCC VFD & Starter upgrades
- ACB Breaker upgrades
  - Direct Replacement
  - Cradle-in-Cradle
  - Hard Bus
- Trip Unit upgrades & conversion kits
- Power Break & HPC upgrades
- Circuit Breaker Evaluation & Repair
  - Legacy ABB & GE Shops

**Medium Voltage Solutions**
- MCC
  - Air to Vacuum conversion kits
  - Relay upgrades
- LIS – Arc Flash remediation upgrade
- Roll-in Replacements
- Hard-bus Retrofit
- Arc Furnace breaker upgrades
- Relay panel upgrades
- UFES Arc Protection
- Fault Current Limiters
Migration to Digital & Predictive
Electrification ecosystem

Migration to a digital world

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)

Predictive
ABB Ability™ Data Analytics for electrical systems

Algorithm Layer
ABB Ability™ energy and asset manager
Connections for the health of your equipment

- Smart breaker technology
- Process engineering
- Perform primary protections and advanced metering
  - Main protections
  - Embedded current and voltage sensors
- Advanced communications
  - Embedded communications such as Modbus, IEC 61850, and EtherNet/IP

- Energy management
- Reduce energy consumption
  - Energy metering and Power Quality
  - Spread connectivity
  - Avoid waste
- Energy billing optimization
  - Tariff optimization
  - Load shifting/Peak shaving
  - Cost allocation

- Predictive maintenance
- Health assessment
  - ABB or legacy GE installed switching device status based on condition monitoring, extending lifecycle
- Operation strategy
  - Scheduling maintenance to ensure stable running without unexpected shutdown
  - Alerting via email/SMS

- Smart facility management
- Intelligent protections
- Smart operation and maintenance
## Condition-based Assessment Studies Process

Asset assessment divided into five major steps

### Specified

<table>
<thead>
<tr>
<th>Prepare</th>
<th>Classify</th>
<th>Analyze</th>
<th>Report</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer requirement</td>
<td>On-Site</td>
<td>Post-Site</td>
<td>Post-Site</td>
<td>On-Site</td>
</tr>
<tr>
<td>Project definition</td>
<td>Data collection</td>
<td>Data evaluation</td>
<td>Data analysis summary</td>
<td>Presentation of report</td>
</tr>
<tr>
<td>Asset selection</td>
<td>Asset inspection</td>
<td>Data formatting and processing</td>
<td>Condition index and risk report</td>
<td>Development of a remediation plan</td>
</tr>
<tr>
<td>Evaluation of importance of asset in network</td>
<td>Performance tests</td>
<td>Statistical analysis</td>
<td>Risk mitigation proposal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Historical data</td>
<td>Reliability-Risk assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Operator interviews</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Specify**

- Data collection
- Asset inspection
- Performance tests
- Historical data
- Operator interviews

**Classify**

- Post-Site
  - Data evaluation
  - Data formatting and processing
  - Statistical analysis
  - Reliability-Risk assessment

**Analyze**

- On-Site
  - Presentation of report
  - Development of a remediation plan

**Report**

- Post-Site
  - Data analysis summary
  - Condition index and risk report
  - Risk mitigation proposal

**Action**

- On-Site
  - Presentation of report
  - Development of a remediation plan

---

**Keep your asset running – Operational stability**
Low Voltage Switchgear Enhancements for Realtime Monitoring

ABB Ability™ Energy and Asset Manager

External solution

- Connect devices to Ekip E-Hub DIN rail module
- High flexibility and extended retrofitting
- Easy and fast configuration via Ekip Connect wizard

Plug & play:

- LV Circuit breakers, Ekip E-Hub, Ekip UP
- Fusegear
- Arc-guard, grid-feeding relays
- Energy and Power meters, Branch monitoring
- Signaling units, analog inputs, pulse meters
- MV relays
Medium Voltage Switchgear Enhancements
SWICOM™ - Switchgear temperature, humidity and partial discharge monitoring

A monitoring and diagnostics solution for LV and MV Switchgear and MCC (motor control center) with the following sensor packages:

- Wireless solution for temperature and PD monitoring
  - SAW sensors
  - UHF measurements
- Wired solution for temperature monitoring
  - IR sensors
  - Thermistor sensors for LV MCC buckets
- Wired solution for humidity monitoring (in combination with both above)

Spot problems as soon as they develop; reduce unplanned outages

- Available in NEW switchgear as well as a RETROFIT
- Provides local and remote monitoring
- Suggest monitoring aging or difficult for personnel to get to equipment

- Also available in ABB switchgear up to 27 kV
- Consult the Services team further for 38 kV applications
Medium Voltage Switchgear Enhancements

IR Sensor Temperature Sensing System

- IR sensor has non-conductive plastic body
- Sensors do not require external power
- Sensors provide rise over ambient (DT) reading
- Sensors have lifetime calibration
- Sensors are UL recognized & CE certified
Medium Voltage Switchgear Enhancements
Partial Discharge Monitoring

- Measurement is based on UHF technology
- The antennas used for temperature with a humidity sensor is used to detect partial discharge
- Suitable for ANSI/IEC

12 Sensors per panel configuration (full)
Modernization
How to further extend equipment’s lifetime

Switchgear modernization

Upgrade solutions
- Arc fault protection
- Remote breakers racking
- Auxiliary equipment renewal
- Interlocking and safety features
- Condition monitoring

Retrofit solutions
- Relay replacement
- Circuit breaker replacement
Reducing the risk of failure

The right mix

Managing conditions
Depending on the location of the equipment it is not always possible to control environmental conditions.

Right maintenance
Tailored to your assets, according to your equipment’s conditions.

Safer electrical equipment – for everybody!
Lower overall downtimes
Higher lifetime of your equipment

Condition monitoring
Online monitoring
Remote support
Predictive algorithms

Modernization
Upgrades and retrofits
Enabled by ABB Remote Assistance
Site support from a distance
Electrification Service Remote Assistance

Augmented reality solution enabling real remote collaboration

Remote Assistance is a live video sharing solution that improves interaction by allowing remote experts to interact with field personnel and ‘see what they see’.

On-site technician in need of support for maintenance, troubleshooting, technical information...

Video connection with ABB expert

Active interaction through AR* functionalities, static drawing, zoom, flash, etc.

Done!

Augmented reality to bring ABB expertise and knowledge when and where you need it

*Augmented Reality
Electrification Service Remote Assistance

A unique solution for different levels of support

- Repairs & Trouble shooting
  - Remote equipment inspection
  - Repair procedures

- Maintenance support
  - Support on demand for maintenance
  - Guided maintenance steps

- Technical information
  - Step by step procedures
  - Information on equipment operation and use

- Spares identification
  - Identification of the correct spare parts to be replaced

- Monitoring and diagnostic KPI analysis
  - Diagnostics of M&D* KPI and results

- Installation and commissioning support
  - Support on demand for installation and commissioning activities

Keep your installation up and running with the remote support of ABB experts

*Monitoring and diagnostic
Spares Strategy
ABB Recommended & Critical Spares Strategy

- After site audits (as part of initial data collection or more extensive audit)
- Inventory available spares across fleet
- Initiate program to evaluate/re-certify spares (as needed)
- Provide fleet critical spares recommendations
- Locate & store strategically to respond to potential outage situations
Customer Support Agreements
### ABB Power Care

Structured offering for support agreements with ABB Services

<table>
<thead>
<tr>
<th>Power Care</th>
<th>Entry Level</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skills Development Services</td>
<td>Product Training List</td>
<td>Product Training</td>
<td>Application Training</td>
<td>Coaching Services</td>
</tr>
<tr>
<td>Emergency Maintenance Services</td>
<td>Single Point of Contact &amp; Agreed T&amp;Cs</td>
<td>Technical Support with agreed response time</td>
<td>Call-out Support with agreed response time</td>
<td>Spare Parts Assessment and Management</td>
</tr>
<tr>
<td>Diagnosis &amp; Condition Assessment</td>
<td>Documentation of Installed Base and Preliminary Survey</td>
<td>Asset Condition and Risk Assessment</td>
<td>Asset Monitoring</td>
<td>Remote Asset Monitoring</td>
</tr>
<tr>
<td>Delivered Maintenance Services</td>
<td>Periodic Technical Assessment</td>
<td>Product Services</td>
<td>Advanced Product Services</td>
<td>Full Switchgear Services</td>
</tr>
</tbody>
</table>
Life Cycle Phases
### Lifecycle Phase Breakdown

**Active phase**
- Available for sales
- Full manufacturing
- Actively promoted in assigned countries
- Available to all (authorized) customers
- Full technical and customer support available
- Periodically enhanced through R&D and product improvements
- Fulfill availability of a spare parts
- Extended warranty available for application

**Classic phase**
- Product is still available, but not extensively promoted (a substitution product will be identified with cross-reference in most cases)
- No further enhancements and developments
- Spare parts fully available

**Limited phase**
- Product is no longer actively promoted by the sales force
- Service support is ensured, including retrofit kits, spare parts and accessories
- Product is no longer manufactured or limited production might be available
- Life extensions may be available under a Customer Support Agreement, which provide "Active Phase"-like support from ABB Service team

**Obsolete phase**
- Product is withdrawn from sales
- No longer manufactured as a complete product
- Retrofits kits, where applicable, are available for most applications
- Spare parts availability may diminish over time with decrease in production volumes

---

1. Privileged & confidential – prepared for review by counsel. INTERNAL DISTRIBUTION ONLY
We reserve all rights in this document and in the subject matter and illustrations contained therein. Any reproduction, disclosure to third parties or utilization of its contents – in whole or in part – is forbidden without prior written consent of ABB
Service Agreements

Maintaining Equipment

- Equipment reliability will decrease as the equipment ages. If not properly maintained the risk for an unexpected failure dramatically increases.
- After a long useful life, all electrical equipment will start to show its’ age, in that case an upgrade or retrofit can be utilized to further extend its useful life as well as increase performance with the latest technology available.
- Regularly maintaining and upgrading equipment will increase overall safety with reduced risk for arc faults, as well as meeting new safety requirements.

<table>
<thead>
<tr>
<th>Active</th>
<th>Classic</th>
<th>Limited</th>
<th>Obsolete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Agreements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installation and commissioning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installation &amp; Safety</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spare parts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repairs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering and consulting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extensions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upgrades</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retrofits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>End of life services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replacements</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Supported Products

<table>
<thead>
<tr>
<th>Status</th>
<th>Active</th>
<th>Classic</th>
<th>Limited</th>
<th>Obsolete</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Product is actively marketed and sold</td>
<td>Product will be replaced but is still available for sales, mainly for spares and expansion projects</td>
<td>Limited manufacturing/stock availability</td>
<td>Product is no longer available nor sellable</td>
</tr>
</tbody>
</table>

- **Product available for sales**: •
- **Spares availability**: •
- **Product on stock**: •
- **Available in online tools**: •
- **Maintenance and repair**: •

### Switchgear

<table>
<thead>
<tr>
<th>Low Voltage</th>
<th>Med Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ReliaGear SG</td>
<td>SafeGear</td>
</tr>
<tr>
<td>MNS SG AR</td>
<td>Advance</td>
</tr>
<tr>
<td>Entellisys 5.6</td>
<td>SecoGear</td>
</tr>
<tr>
<td>Entellisys</td>
<td>PowerVac</td>
</tr>
<tr>
<td>Max SG</td>
<td>HKII</td>
</tr>
<tr>
<td>K-Line</td>
<td>HK</td>
</tr>
<tr>
<td>AKD-20</td>
<td>MagneBlast</td>
</tr>
<tr>
<td>AKD 10, 8, 6, 5</td>
<td></td>
</tr>
<tr>
<td>K-Line Plus</td>
<td></td>
</tr>
<tr>
<td>MB</td>
<td></td>
</tr>
<tr>
<td>LK</td>
<td></td>
</tr>
</tbody>
</table>

### Switchboards

<table>
<thead>
<tr>
<th>Low Voltage</th>
<th>Med Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ReliaGear SB</td>
<td>Molded Case</td>
</tr>
<tr>
<td>PowerBreak II</td>
<td>Tmax XT</td>
</tr>
<tr>
<td>AV3</td>
<td>Spectra</td>
</tr>
<tr>
<td>Insulated Case</td>
<td>PowerBreak II</td>
</tr>
<tr>
<td>PowerBreak I</td>
<td>PowerBreak</td>
</tr>
</tbody>
</table>

### Circuit Breakers

<table>
<thead>
<tr>
<th>Low Voltage</th>
<th>Med Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>AMVAC</td>
</tr>
<tr>
<td>EMAX2</td>
<td>ADVAC</td>
</tr>
<tr>
<td>Entelliguard</td>
<td>VMAX</td>
</tr>
<tr>
<td>New EMAX</td>
<td>SecoVac</td>
</tr>
<tr>
<td>K-Line</td>
<td>PowerVac</td>
</tr>
<tr>
<td>KDON</td>
<td>VHK</td>
</tr>
<tr>
<td>K-Line Plus</td>
<td>VHK-X</td>
</tr>
<tr>
<td>EMAX</td>
<td>HK</td>
</tr>
<tr>
<td>WavePro</td>
<td>MagneBlast</td>
</tr>
<tr>
<td>AKR</td>
<td></td>
</tr>
<tr>
<td>AK</td>
<td></td>
</tr>
<tr>
<td>MB</td>
<td></td>
</tr>
<tr>
<td>LK</td>
<td></td>
</tr>
</tbody>
</table>

### Motor Control Centers (MCCs)

<table>
<thead>
<tr>
<th>Low Voltage</th>
<th>Med Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ReliaGear MCC</td>
<td>LimitAmp</td>
</tr>
<tr>
<td>MNS MCC AR</td>
<td>SafeAmp</td>
</tr>
<tr>
<td>E9000</td>
<td>MCC</td>
</tr>
<tr>
<td>8000 Series</td>
<td>Advance</td>
</tr>
<tr>
<td>7700 Series</td>
<td></td>
</tr>
</tbody>
</table>

### Outdoor Breakers

<table>
<thead>
<tr>
<th>Med Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMAG</td>
</tr>
<tr>
<td>V Breaker</td>
</tr>
<tr>
<td>R Breaker</td>
</tr>
</tbody>
</table>

### Load Interrupter Switches (LIS)

<table>
<thead>
<tr>
<th>Med Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>BreakMaster LIS</td>
</tr>
<tr>
<td>BreakMaster V</td>
</tr>
</tbody>
</table>
## ABB Services & Call Center

**+1 888 434 7378 or +1 540 387 8617**

### General Services
- Local Service & Sales Team Initiated
- Installation, startup and commissioning
- Feasibility/engineering studies
- Assessment/inspection/testing
- Preventative Maintenance
- Outage support
- Repair and product replacement
- Training

### Call Center
- Toll Free & Direct Dial Numbers
- 24 x 7 x 365 emergency services and parts
- Calls for equipment under warranty
- Field Engineer or Tech Dispatch
- Time & Material Quotes @ Published rates

### Contract Customers
- Toll Free & Direct Dial Numbers
- Assigned a customer profile
- List of equipment covered
- Notes on customer drawings & configuration
- Customer notification email list
- Primary and Secondary Field Engineers contacted to support
- Escalation procedure to local Service and Account Managers as needed
- Contract rates for dispatch