Preventative Maintenance & Outage Approach

Services for Safe, Smart, & Sustainable Electrification

9AKK108467A2408_Rev A_August 2022

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

11. Support of agreements (Power of Care)

10. Advanced services (Smart Asset Management)

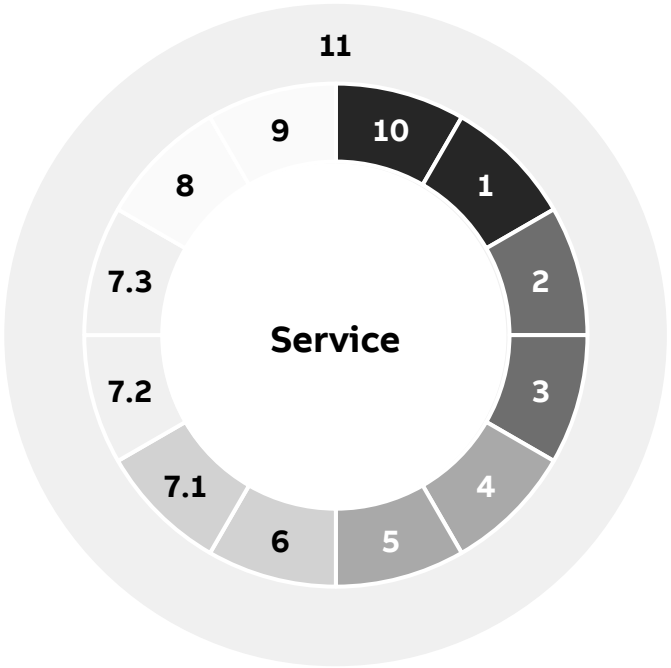


ABB Ability™

Safety

Reliability

9. Replacement

8. End of life services

7.3. Retrofits

7.2. Upgrades

7.1. Extensions

6. Engineering and consulting

Life Cycle Services

1. Installation and commissioning (I&C)

2. Training

3. Spares and consumables

4. Maintenance

5. Repairs

Availability

Start-up and maintenance services

Our Mission

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

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

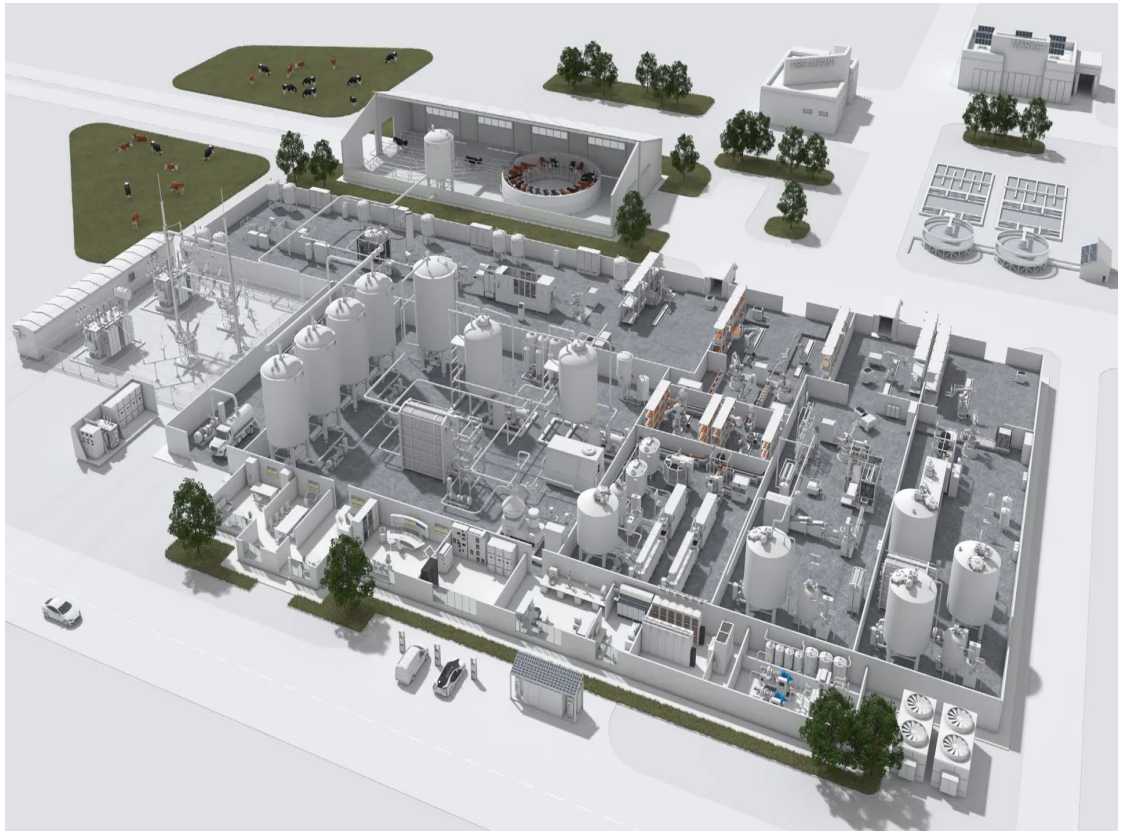
Life Cycle Extension
- Breaker Retrofits / Retrofills
- Upgrades
- Protection and Control Upgrades
- Switchgear Add-ons and Upgrades
- Repairs

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

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



Maintenance & Testing Services

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 & accessability
- Reaching predictive capability

Safety & Personnel

- Equipment doesn’t meet current safety requirements
- Protection of operators & maintenance workers
- Abillity 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

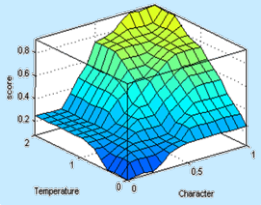
Electrification ecosystem

Migration to a digital world

Predictive

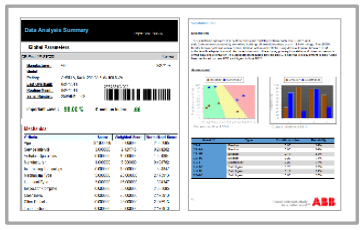
ABB Ability™ Data Analytics for electrical systems

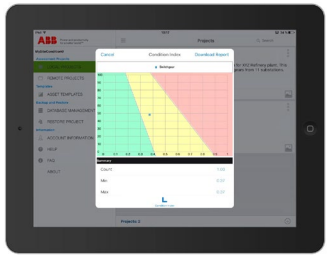
Algorithm Layer



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)

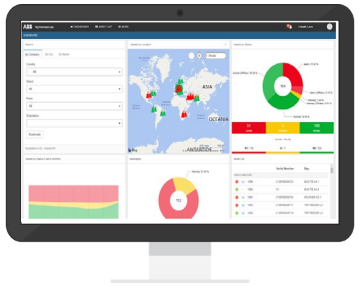


ABB Ability™ energy and asset manager

Connections for the health of your equipment

Smart breaker technology
process engineering

Energy management

Predictive maintenance

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

Reduce energy consumption
Energy metering
and Power Quality
Spread connectivity
Avoid waste

Energy billing optimization
Tariff optimization
Load shifting/Peak shaving
Cost allocation

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

Intelligent protections

Smart
facility management

Smart
operation and maintenance

Condition-based Assessment Studies Process

Asset assessment divided into five major steps

Specify

Prepare

- Customer requirement
- Project definition
- Asset selection
- Evaluation of importance of asset in network

Classify

On-Site

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

Analyze

Post-Site

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

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

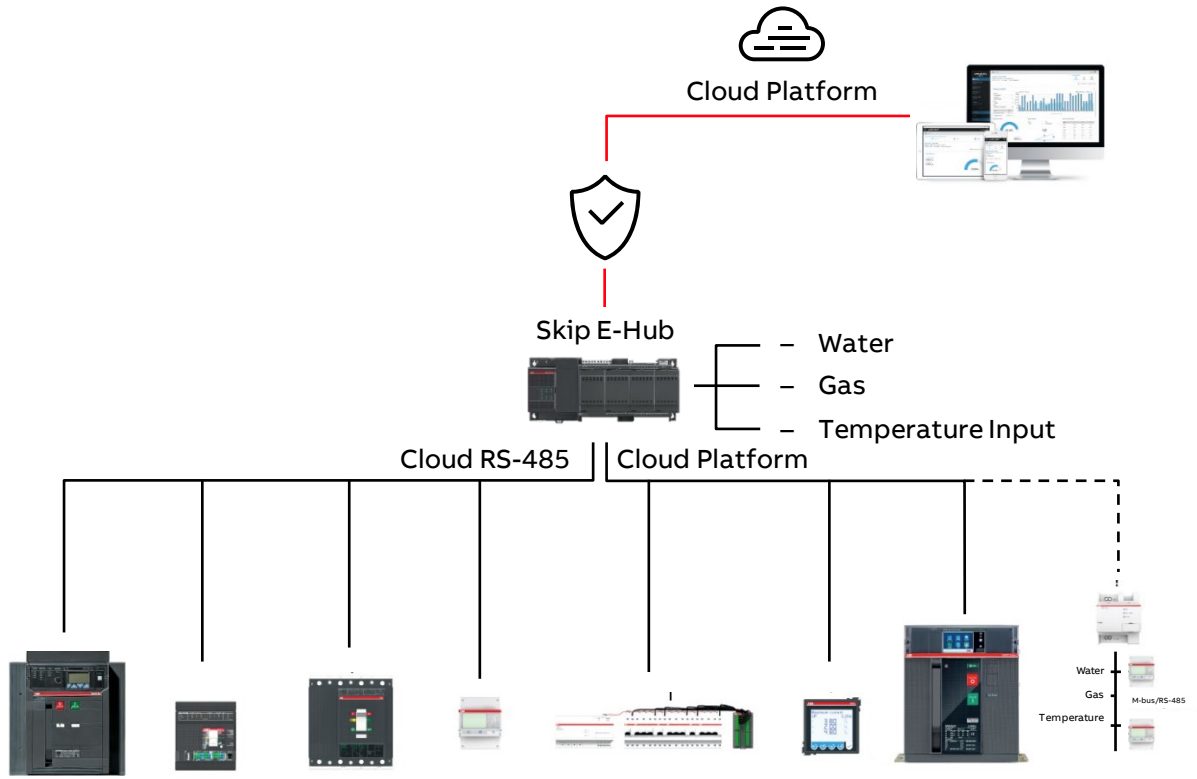
ABB Ability™ Energy and Asset Manager

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

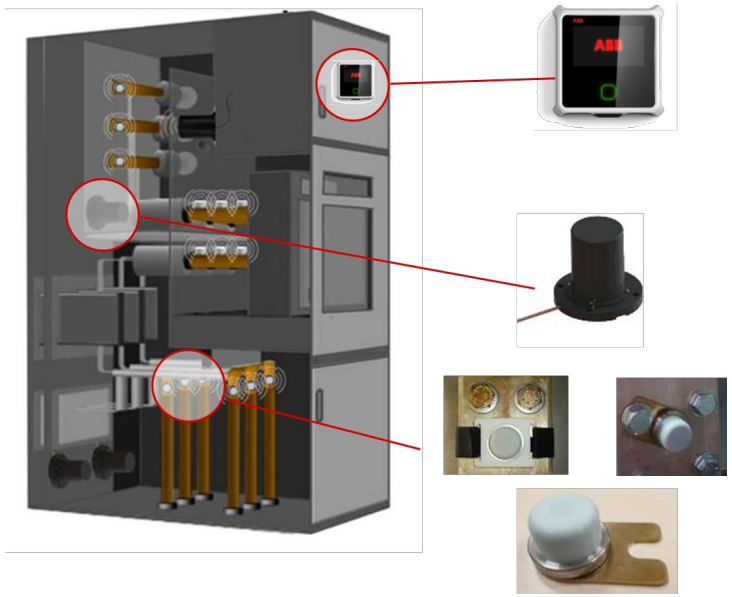


Medium Voltage Switchgear Enhancements

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)



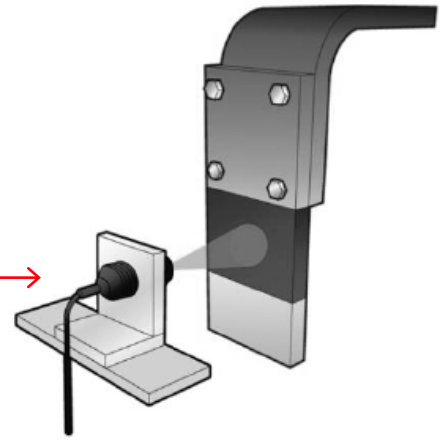
Spot problems as soon as they develop; reduce unplanned outages

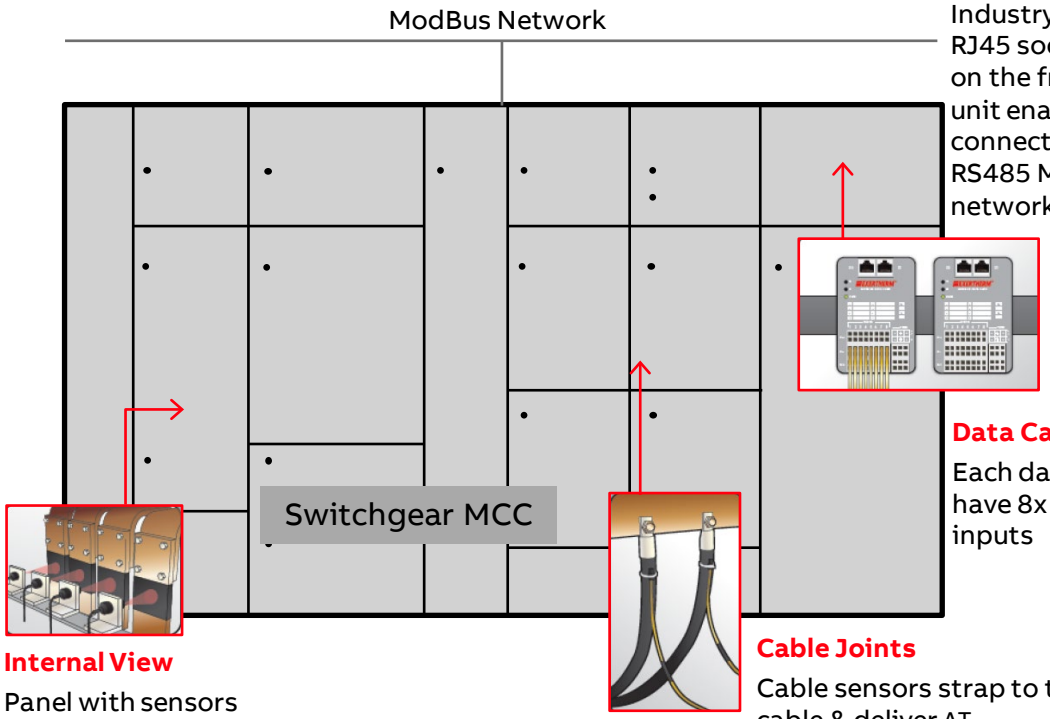
- Available in NEW switchgear as well as a RETROFIT
- Provides local and remote monitoring
- Suggest monitoring aging or difficult for personnel to get to equipment
- Also available in ABB switchgear up to 27 kV
- Consult the Services team further for 38 kV applications

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





Network connection

Industry standard RJ45 sockets located on the front of the unit enable simple connection to a RS485 ModBus network

Data Card

Each data card can have 8x sensor inputs

Internal View

Panel with sensors shown in position

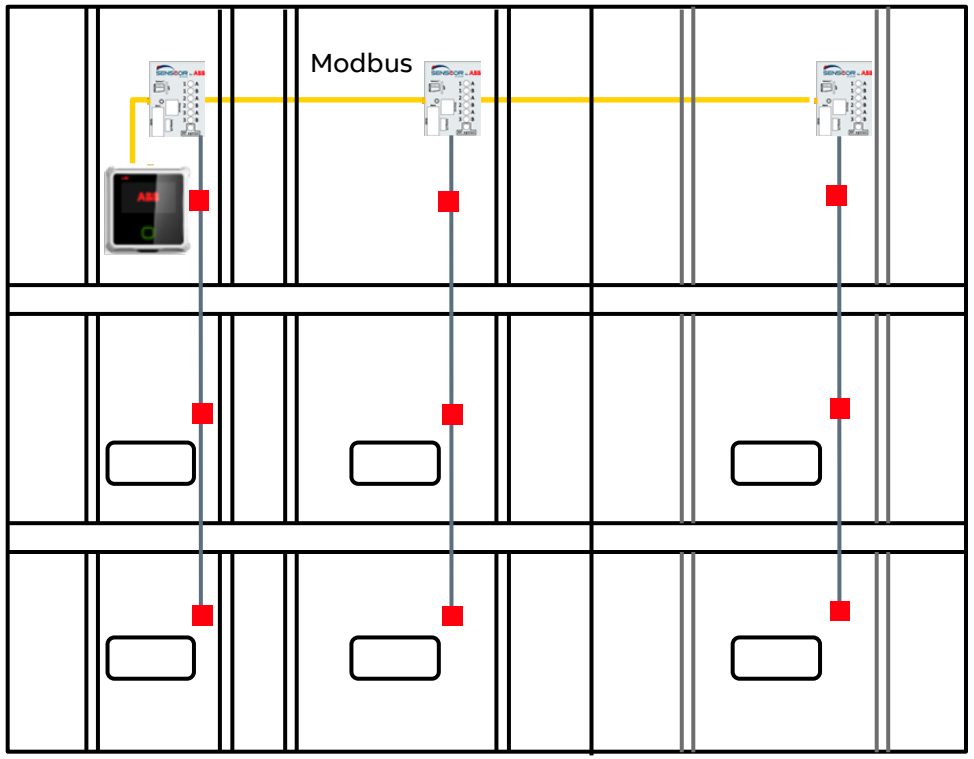
Cable Joints

Cable sensors strap to the cable & deliver ΔT

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

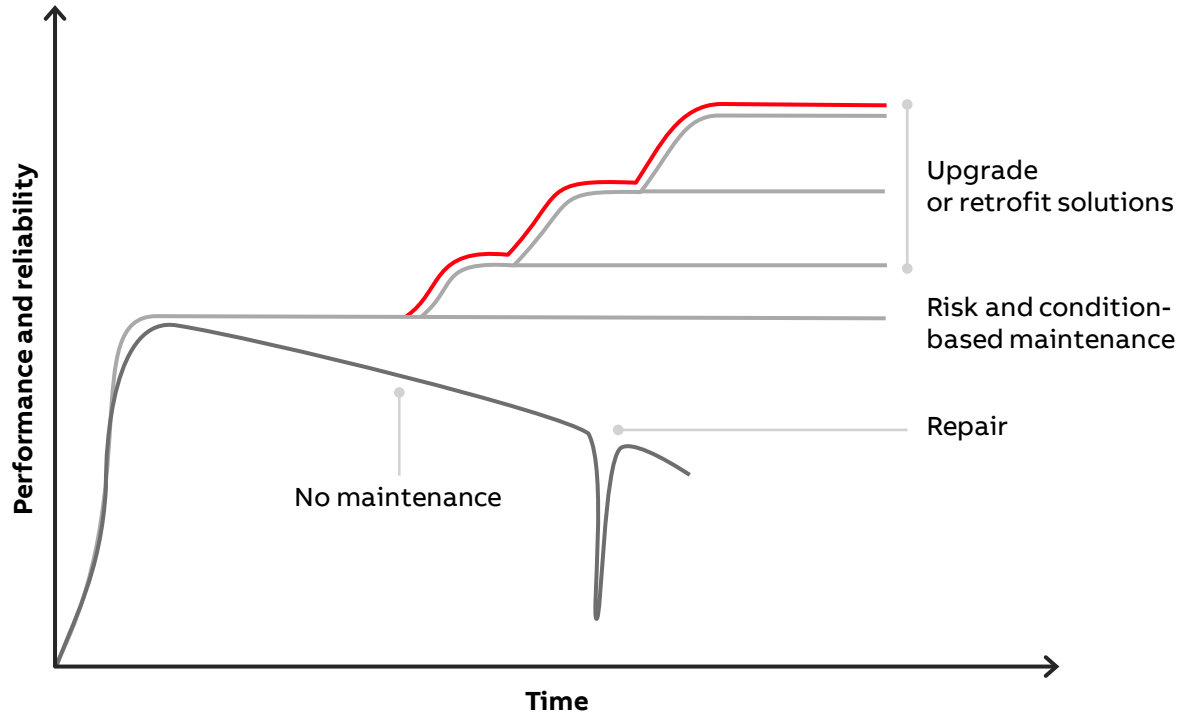
Switchgear modernization

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

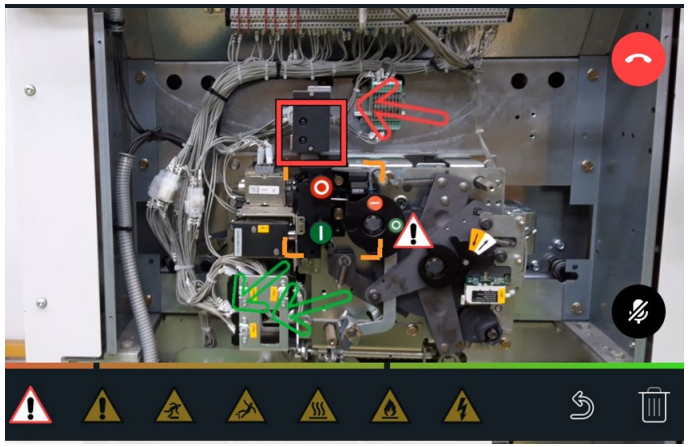
Remote Assistance is a live video sharing solution that improves interaction by allowing remote experts to interact with field personnel and ‘see what they see’

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	Maintenance support	Technical information	Spares identification	Monitoring and diagnostic KPI analysis	Installation and commissioning support
Remote equipment inspection Repair procedures	Support on demand for maintenance Guided maintenance steps	Step by step procedures Information on equipment operation and use	Identification of the correct spare parts to be replaced	Diagnostics of M&D* KPI and results	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

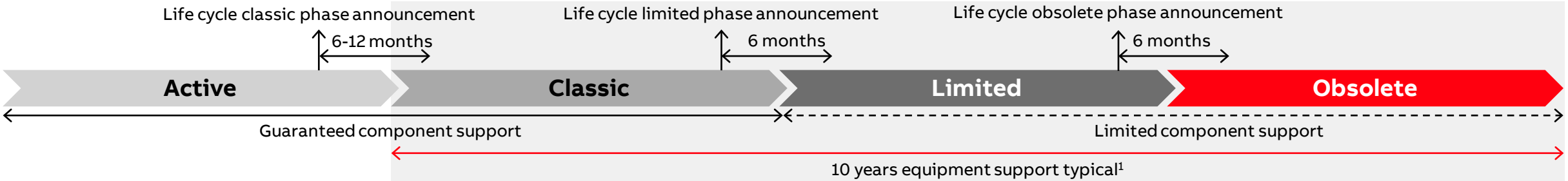
ABB Power Care

Structured offering for support agreements with ABB Services

Power Care	Entry Level	Level 1	Level 2	Level 3
Skills Development Services	Product Training List	Product Training	Application Training	Coaching Services
Emergency Maintenance Services	Single Point of Contact & Agreed T&Cs	Technical Support with agreed response time	Call-out Support with agreed response time	Spare Parts Assessment and Management
Diagnosis & Condition Assessment	Documentation of Installed Base and Preliminary Survey	Asset Condition and Risk Assessment	Asset Monitoring	Remote Asset Monitoring
Self-Maintenance Services	Installed Base Life Cycle Status Report	Manuals and Instructions On-line	On-Line Support for Self-maintenance	File Storage
Delivered Maintenance Services	Periodic Technical Assessment	Product Services	Advanced Product Services	Full Switchgear Services

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

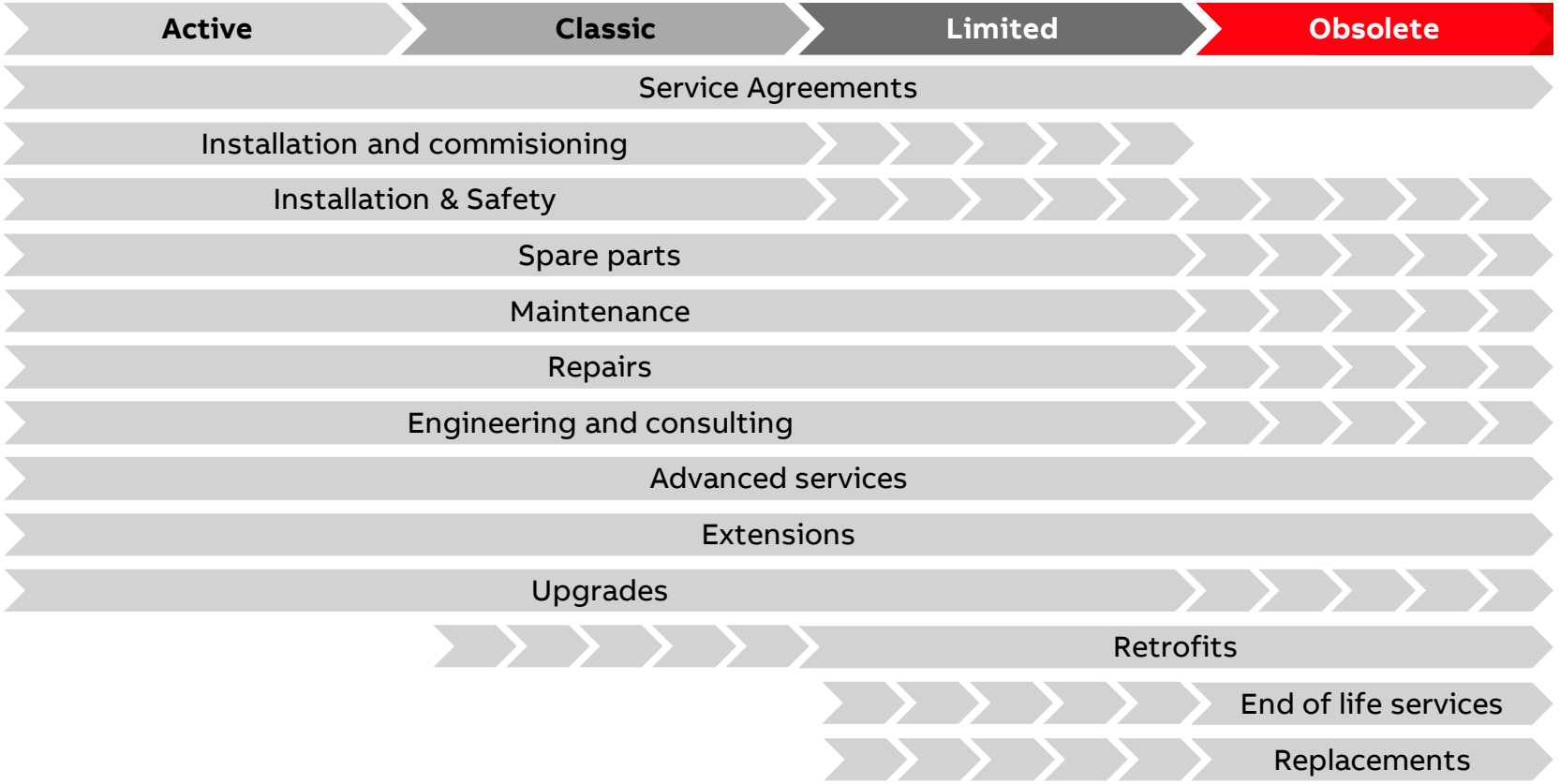
- Product is withdrawn from sales
- No longer manufactured as a complete product
- Retrofits kits, where applicable, are available for most applications
- Spare parts availability may diminish over time with decrease in production volumes

1. Privileged & confidential – prepared for review by counsel. INTERNAL DISTRIBUTION ONLY

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



Supported Products

	Active	Classic	Limited	Obsolete
Status	Product is actively marketed and sold	Product will be replaced but is still available for sales, mainly for spares and expansion projects	Limited manufacturing/ stock availability	Product is no longer available nor sellable
Product available for sales	●	●	**Not guaranteed**	●
Spares availability	●	●	●	**Not guaranteed**
Product on stock	●	●	**Not guaranteed**	●
Available in online tools	●	●	●	●
Maintenance and repair	●	●	●	**Not guaranteed**

Switchgear		Switchboards	Circuit Breakers		
Low Voltage	**Med Voltage**	**Low Voltage**	**Low Voltage**		**Med Voltage Vacuum/Air**
ReliaGear SG	SafeGear	ReliaGear SB	**Molded Case**	**Power**	AMVAC
MNS SG AR	Advance	PowerBreak II	Tmax XT	EMAX2	ADVAC
Entellisys 5.6	SecoGear	AV3	Spectra	Entelliguard	VMAX
Entellisys	PowerVac	PowerBreak I	**Insulated Case**	New EMAX	SecoVac
Max SG	HKII		PowerBreak II	K-Line	PowerVac
K-Line	HK		PowerBreak	KDON	VHK
AKD-20	MagneBlast			K-Line Plus	VHK-X
AKD 10, 8, 6, 5				EMAX	HK
K-Line Plus				WavePro	MagneBlast
MB				AKR	SecoVac R
LK				AK	
				MB	
				LK	

Motor Control Centers (MCCs)		Outdoor Breakers	Load Interrupter Switches (LIS)
Low Voltage	**Med Voltage**	**Med Voltage**	**Med Voltage**
ReliaGear MCC	LimitAmp SafeGear MCC	RMAG	BreakMaster LIS
MNS MCC AR	Advance MCC	V Breaker	BreakMaster V
E9000		R Breaker	
8000 Series			
7700 Series			

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


ABB