Modular Capacitor Systems

Reactive Compensation
Needs...

- **Customer**
  - A solution to suit Modular Substations
  - Relocatable assets
  - More value for money

- **ABB**
  - A more competitive solution
  - Minimise expensive installation and commissioning costs, especially in remote locations
Design Criteria…

- Designed for transmission voltages (145kV)
- Output power <100Mvar
- Integrate primary-secondary systems
  - Circuit breaker, Capacitor, Reactor, CT, Protection…
- Maximise factory assembly/testing
- Minimise site work
- ↑ COST-EFFECTIVENESS compared to conventional systems
Modular Capacitor System
Features

- Modular design
  - PASS MØ switchgear skid
  - Capacitor skids
  - Integrated control and protection
- Easy installation
- Relocatable
Arrangement

PASS MØ Skid

Capacitor Skid
Electrical Schematic

PASS MØ Skid

Capacitor Skids
PASS (Plug And Switch System) Concept

1. Combined Disconnect-Earthing Switch
2. Circuit Breaker
3. Combined Current/Voltage Sensor
PASS MØ Switchgear

- Ratings
  - 72.5 – 170kV, 50/60Hz
  - 2500A
  - LIWV: 325 → 750kV
  - PFWV: 140 → 325kV
  - 40kA for 1 sec
  - 100kA peak withstand

- All functions encapsulated in a grounded Aluminium tank with pressurised SF6 gas
PASS MØ Switchgear - Benefits

- Integrated high voltage bay
- Compact design
  - Requires less substation real estate
  - Low-profile design
- Risk minimisation
  - Reduced short circuit forces → fewer/shorter connections
  - Pollution affects → fewer outdoor bushings & insulators
PASS MØ Switchgear - Benefits

- Cost savings
  - Material
    - Steel structures, foundations, grounding material,
  - Flexible connection to existing busbar → little busbar design necessary
  - PLUG connection to control & protection
    - Reduced installation & commissioning time
    - Optical fibre → supervision, control, protection
    - Auxiliary power → drive mechanism
  - Low maintenance
Reactive Compensation

- Integrated skid base
  - Capacitor, Reactor, CT
  - Galvanised racks/bases
- Bank design
  - Customisable protection schemes
- Cost savings
  - Pre-engineered
  - Minimum site erection
Power Capacitors

- Australian manufacture
- Internal fusing
- Durable
  - Grade 304 stainless steel
  - TIG welded, no filler rod
- Folded edge technology
  - Minimises P.D.
- AS2897 & IEC60871
- Designed & manufactured to ISO 9001
Reactors

- Trench quality
- Air core
- In-rush or Detuned
- Modern encapsulated winding technology
- Designed & manufacture to ISO 9001
Integrated Protection & Control (IPC)

- Concept design
- Customisable IPC schemes
- Outdoor stainless steel enclosure (IP65)
  - Air conditioning, thermostat control
- Factory tested ....
  - Assembly, wiring & testing
  - Time saved in site installation & commissioning
Block Diagram

PASS Skid

- Analog signals
- Binary signals (Optical Fibre)

Protection & Control Cubicle

- Analog signal
- AC/DC Supply
- Binary signals (Optical Fibre)

Capacitor Skids

Control Room
Control

- Remote Terminal Unit (RTU)
  - Brand flexibility → ABB, Foxboro, Harris
  - Operation
    - Circuit breaker
    - Combined disconnect earth switch
  - Instrumentation
  - Supervision (via status contacts)
  - Alarms (circuit breaker & protection relays)

- ABB Switch SYNC relay
  - Minimise switching transients
Protection

- Overcurrent & Earth Fault
  - SET 1 → ABB SPACOM (SPAJ 140C)
  - SET 2 → Schweitzer SEL

- Overvoltage
  - SPAU 121C

- Unbalance & Harmonic Overload
  - SPAJ 160C

- Circuit breaker failure
  - RAICA
Integrated Protection & Control Benefits

- Customisable IPC schemes
  - In-house team of ABB protection engineers

- PLUG! System
  - Time saving in installation and commissioning
  - Minimum interfacing

- Cost savings
  - Design costs in integration to the existing system
Transportation

- The skid bases were designed with transportation in mind…

- Two skid bases per “drop-deck” trailer
Easy Installation

- Fit concrete footings
- Fix capacitor & switchgear skids
- Erection of insulators
- Interconnection cables between skids
- PLUG! control and protection cables
## Price Comparison for 20Mvar, 132kV

<table>
<thead>
<tr>
<th>System Type</th>
<th>Equipment Cost</th>
<th>Installation &amp; Commissioning Cost</th>
<th>Total Cost</th>
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<tbody>
<tr>
<td>Conventional System</td>
<td>USD $265,000</td>
<td>USD $150,000</td>
<td>USD $415,000</td>
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<tr>
<td>Modular Capacitor System</td>
<td>USD $300,000</td>
<td>USD $90,000</td>
<td>USD $390,000</td>
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Key Benefits

- Avoid “Stranded Assets”
- Saving in real estate → compact design
- Minimise the risk of site liabilities
  - Lower preparation and installation duration
  - Simple interface with the existing system
- Cost savings realised from a modular design
  - Installation of primary & secondary systems
  - Overall design and project time
- Peace of mind…
  - ABB know-how & experience
Modular Capacitor Systems

The future of reactive compensation for transmission systems...