ABB High Voltage Products
Combined Instrument Transformer
PVA123
ABB Group in Poland
Basic facts

- Headquarters: in Warszawa
- About 2600 employees working in Poland
- Revenues in 2010: MUSD 514,-
- 77% of revenues are generated by sales of power products and systems
- 56% of production amounting to more than MUSD 287,- is exported worldwide
- Recent large investments:
  - new factory for production of electric motors commissioned in 2009
  - new factory for production of power electronics commissioned in 2010
ABB Group in Poland
Power Products & Power Systems Divisions

- Lebork: Power Systems
- Przasnysz:
  - HV, MV, LV Apparatuses including:
    - HV & MV Instrument transformers
    - MV Circuit Breakers
    - Switchgear
    - Switch disconnectors
- Wroclaw: Utility Automation
- Poznan:
  - Switchgear
  - Switch disconnectors
- Krakow: Power Systems
- Lodz:
  - Power transformers
  - Distribution transformers
  - Insulation Kit Center
- Warszawa: Power Systems
- Rzeszow: 130 km
- Szczecin: 110 km
- Gdansk:
ABB Group in Poland
Factory in Lodz

POWER TRANSFORMERS
- power transformers up to 300 MVA and 500 kV; generator step-up and power substations
- markets: Central and Eastern Europe, Benelux, Germany, Switzerland, Austria, France, Ireland and Scandinavia
- back-up factory for North America

DISTRIBUTION TRANSFORMERS
- oil filled distribution transformers rated from 30 to 2300 kVA
- market: Europe

INSULATION KIT CENTRE
- delivery of insulation kits and elements to all ABB power transformers factories in Europe
- power transformers factories decreased their cycle times and lowered costs thanks to receiving prefabricated insulation kits from Lodz factory
ABB Group in Poland
Factory in Przasnysz

- set up in 1970 as a subsidiary of an electro-technical company ZWAR operating since 1918
- 300 employees
- focus factory for HV, MV and LV electrical apparatuses
- large portion of production is exported worldwide

HIGH VOLTAGE APPARATUSSES
- focus factor for combined instrument transformers
  123 kV, global delivery
- current and voltage instrument transformers
  123 kV for domestic market and Germany

MEDIUM VOLTAGE APPARATUSSES
- indoor switch disconnectors, global sales
- voltage and special purpose current instrument transformers, global sales
- circuit breakers, domestic market
- fuses, global sales

LOW VOLTAGE APPARATUSSES
- LOVOS surge arresters
- low voltage instrument transformers
ABB Group in Poland
Aleksandrow Lodzki – LV motors

- Production of standard industrial low voltage motors
- Three fully computerised manufacturing lines to produce low voltage electric motors, 80 mm to 355 mm in size, with power from 0.25 to 250 kW
- Used for powering fans, pumps and turbines
- Many adapted to operation in hazardous environment [flammable or explosive]
- Vast portion of production is exported worldwide
- The factory is important production centre of „Made in ABB” electric motors
ABB Group in Poland
Aleksandrow Lodzki – Power electronics

- Medium voltage drives for optimum use of electric energy
- 3 kV DC traction converters for clean ecological railway transport
- Medium voltage converters for wind power applications
- Logistic center and main warehouse for LV products in Poland

- Newly built factory, investment worth US$ 36.3 Million
- Production started in October 2010
- 130 employees
Combined PVA123
HV IT family
Combined PVA123

Combined solution – advantages

Combined solution integrates current and voltage transformers in one casing; this means significant cost reduction:

- Lower initial investment by purchasing one unit instead of two separate transformers
- Only one supporting structure is needed
- Lower transportation cost
- Lower installation cost
- The only solution at a substation where space is at a premium
Combined PVA123
Top core design – advantages

- In top core design the current module is located in transformer’s head and voltage module – in its bottom tank.

- This solution makes it possible to achieve high values of short circuit currents [both thermal and dynamic] as well as vast range of rated primary currents and outputs of secondary windings.

- Many customers prefer this solution.
Combined PVA123
Construction

1. Bottom tank
2. Insulator
3. Head
4. Expansion bellows with cover
5. Current module
6. Voltage module
7. Secondary terminal box
8. Primary terminal P1
9. Primary terminal P2/A
10. Insulating oil
11. Earthing terminal
Combined PVA123
Construction – advantages

- Silicone rubber or porcelain insulators [with cemented flanges]; long creepage distances as standard
- Stainless steel expansion bellows
- Housing made of high quality aluminium alloy
- All external parts made of corrosion resistant materials
- Hermetic housing, o-ring gaskets used for sealing
  - safe sealing, safe for environment
  - corrosion proof
  - safe oil expansion system
Combined PVA123
Construction – advantages

- As standard we offer flat primary terminals made of aluminium, 100 mm or 200 mm width.
- Pin type primary terminals, made of copper or aluminium, Ø 30 mm or 40 mm, are available on request.
Combined PVA123

Construction – advantages

- Voltage coil screen
- Current coil screen
- Current secondary terminals
- Voltage secondary terminals
- Ventilation screen
- Lock
- Earthing strip or oil pressure signalling system terminals [option]
- Cover for sealing [option]
Combined IT PVA123

Introduced construction changes – voltage coil

Before

Now

- fully symmetric coil
Combined IT PVA123

Introduced construction changes – voltage coil

• optimized, multi screen bushing; very low axial & radial electric stresses

Before

Now
Combined IT PVA123

Introduced construction changes – voltage coil

- winding wire Ø 0.18 mm in double enamel insulation in accordance to IEC 60317-13

Before

Now
Combined IT PVA123

Introduced construction changes – voltage coil

- Homogenous, compact main paper – oil insulation; no local electric stresses, long term operation is assured
- Gradual inter-layer insulation that matches actual potential differences at layers
Combined IT PVA123

Introduced construction changes – voltage coil

- the only insulation medium is oil and paper

Before

Now
Combined IT PVA123

Introduced construction changes – voltage coil

- full external screening of voltage coil; external edges [e.g. core] influence on operational electric conditions of main coil insulation is eliminated

Before

Now
Combined IT PVA123

Introduced construction changes – voltage coil

- optimised, Al casted HV screen;
  electric field stresses around winding are removed

Before

Now
Combined IT PVA123

Introduced construction changes – current coil

- Fully symmetric coil

Before

Now
Combined IT PVA123
Introduced construction changes – current coil

- optimized, multi screen bushing; very low axial & radial electric stresses
Combined IT PVA123

Introduced construction changes – current coil

- Homogenous, compact main paper – oil insulation; no local electric stresses, long term operation is assured
Combined IT PVA123

Introduced construction changes – current coil

- The only insulation medium is oil and paper
Combined IT PVA123

Introduced construction changes – current coil

- Oval shape of cores' box; optimal electric field distribution on external surface is assured
Combined PVA123
Production process

- All purchases and storage according to MRP system
- Whole production process under ITSet system control
Combined PVA123
Production – coil winding and drying

Winding and drying in own most modern winding shop.

All purchases and storage according to MRP system; identification of key materials and parts for production fully assured.
Combined IT PVA123
Whole process under one roof – own winding shop

• insulation continuity control system

Commissioning of winding shop – February 2012
Combined IT PVA123
Whole process under one roof – own winding shop

Commissioning of winding shop – February 2012
Combined PVA123
Production – assembly

Coil winding and drying

Assembly

Whole production process is under ITSet System control
Combined IT PVA123
Production – assembly
Combined PVA123
Production – oil filling and impregnation

Coil winding and drying  Assembly  Impregnation

Every single operation registered in ITSet system
combined PVA123 production

- Coils are dried in high vacuum over a time period that is set out according to insulation dampness and paper depolymerisation.
- Precise vacuum control inside transformer before impregnation.
- Impregnation is pressurised.
- Highly efficient process.
Combined PVA123
Production – leakage test and routine testing

Results of routine testing are automatically registered in ITSet system
Combined IT PVA123
Routine testing

- 50 – 150 Hz converter control desk
- High voltage & p.d. station
- Integrated production control system ITSet
- Legalization for metering – PL GUM and soon DE PTB
Combined PVA123
Production – packing and transportation

Coil winding and drying
Assembly
Impregnation
Leakage test and routine testing
Packing and transportation

Combined PVA123 can be transported in either vertical or horizontal position
Combined PVA123
Quality assurance system – ITSet

ITSet = Instrument Transformer Scheduling, Executing, Tracking
Combined IT PVA123
Parameters

- Basic Insulation Level: 123 / 230 / 550 kV
- Applicable Standards: IEC 60044-1, IEC 60044-2, IEC 60044-3
- Rated primary currents: from 50 to 3000 A
- Rated 1s thermal current: 10 – 20 – 40 – 63 kA
- Rated secondary current: 1 A or 5 A
- Voltage factor: 1.5 / 30 s, 1.9 / 8 h
- Rated frequency: 50 Hz

Paper – oil insulated IT; mineral oil for impregnation does not contain chlorine compounds [PCB] or any other toxic substances – impact on environment is minimized. The oil meets IEC 60296 Standard requirements.
Combined IT PVA123
Parameters – current module

Rated primary currents at:
- non reconnectable 50 A up to 3000 A
- reconnection 1:2 50 – 100 A up to 1500 – 3000 A
- reconnection 1:2:4 50 – 100 – 200 A up to 600 – 1200 – 2400 A

Rated secondary currents: 1 A or 5 A

Rated continuous thermal current: 120% or 150% or 200%

Rated 1 s thermal current at:
- non reconnectable 63 kA
- reconnection 1:2 50 kA
- reconnection 1:2:4 40 kA

Total rated output: 2.5 VA up to 90 VA

Metering accuracy classes: 0.2; 0.2S; 0.5; 0.5S; 1; 3 for FS5 & FS10

Protection accuracy classes: 5P; 10P for ALF 5 – 10 – 15 – 20 – 30
## Combined IT PVA123

### Parameters – voltage module

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated primary voltage:</td>
<td>110/√3 kV</td>
</tr>
<tr>
<td>Rated secondary voltage:</td>
<td>100/√3; 100/3; 110/√3; 110:3 V</td>
</tr>
<tr>
<td>Voltage factor:</td>
<td>1.5/30 s or 1.9/8 h</td>
</tr>
<tr>
<td>Metering accuracy classes / total rated output:</td>
<td>0.1 up to 75 VA</td>
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<tr>
<td></td>
<td>0.2 up to 150 VA</td>
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<tr>
<td></td>
<td>0.5; 1; 3 up to 300 VA</td>
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<tr>
<td>Protection accuracy classes / total rated output:</td>
<td>0.1 and 3P up to 75 VA</td>
</tr>
<tr>
<td></td>
<td>0.2 and 3P up to 150 VA</td>
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<tr>
<td></td>
<td>0.5 and 3P up to 300 VA</td>
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<tr>
<td></td>
<td>1 and 3P up to 500 VA</td>
</tr>
<tr>
<td>Residual winding accuracy / total rated output:</td>
<td>3; 3P and 6P up to 120 VA</td>
</tr>
</tbody>
</table>
Combined IT PVA123
Combined solution - advantages

Integrates current and voltage transformers in one casing;

- Significant cost reduction
- Lower initial purchasing cost; one order instead of two separate orders
- Only one supporting structure is needed
- Lower transportation cost
- Lower installation cost
- The only solution at a substation where space is short
Combined IT PVA123
Top core design - advantages

- Current module is located in transformer’s head
- Voltage module is located in bottom tank.
- Enables to achieve high values of short circuit currents [both thermal and dynamic] as well as vast range of rated primary currents and outputs of secondary windings

Preferred solution of most customers
Combined IT PVA123

Competition – Market Players

- Pfiffner
- Siemens / Trench
- Alstom / ex Ritz

**ABB strength**

- Short delivery time
- Most modern design
- Very low partial discharges
- Highly competitive
Combined IT PVA123
Summary

- Less purchasing effort
- Less transport and installation
- Only one supporting structure, additional less space
- Top core construction – high short circuit currents
- Oil paper insulation only
- Low partial discharges level (below 10 pC)
- Low dielectric loss factor tan δ
- Routine tested in own laboratory with GUM and German PTB certification
- No maintenance
- Long life span, estimated > 25 years
Combined IT PVA123 Certificate
Combined PVA123

Quality assurance – ISO
Power and productivity for a better world™