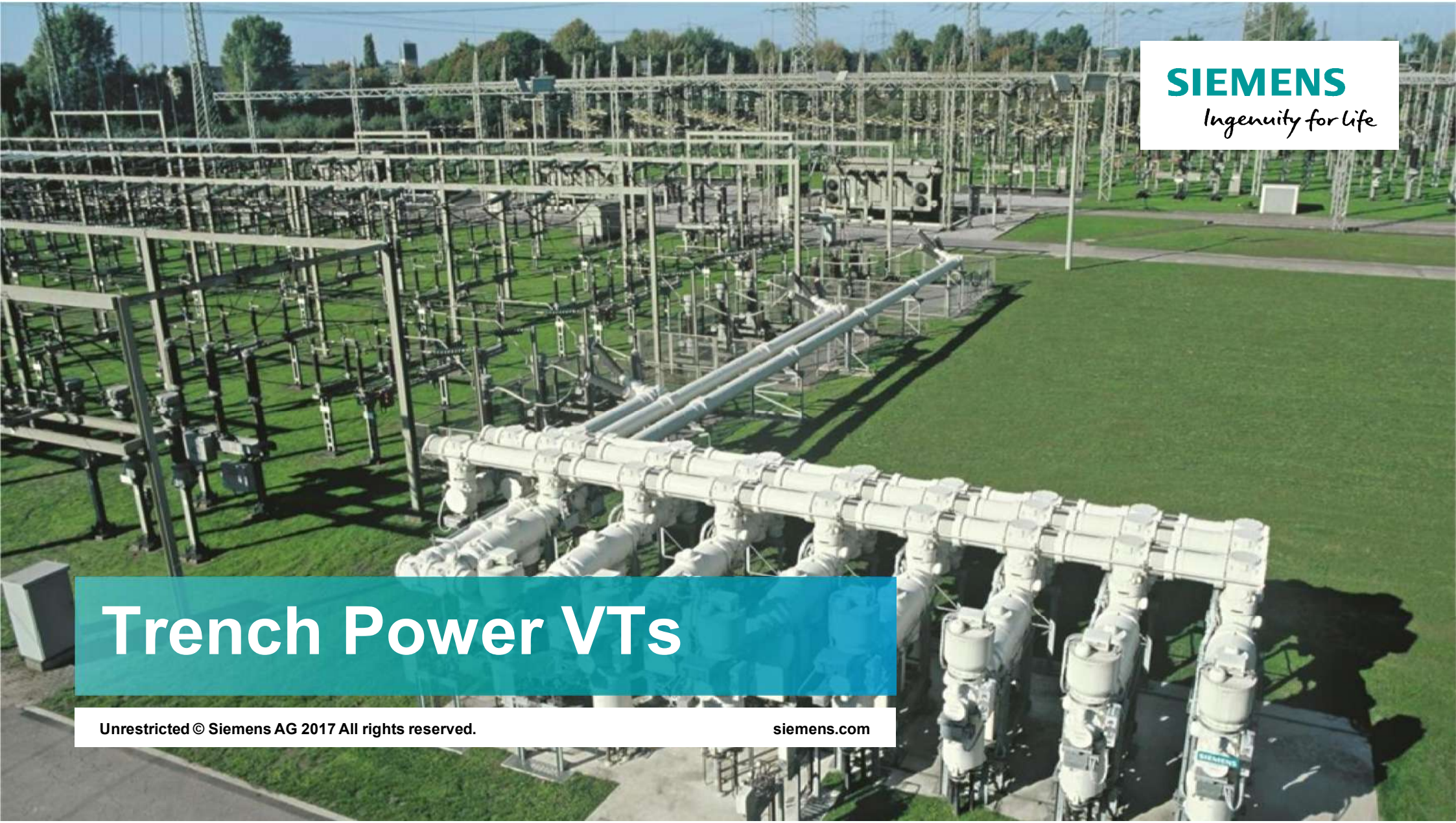

Trench Power VTs

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Power Voltage Transformers
Basic Technology

Power VT - Technology

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Measurement & Protection ➡ VA

Voltage transformer (VT), e.g.
100 VA

Measurement, protection and power ➡ kVA

Power Voltage transformer (PVT)
e.g.**100 / 125 / 167 kVA**

Power transmission ➡ MVA

Power Transformer
e.g.**100 MVA**

Power VT - Technology

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What is a Power Voltage Transformer?

- High Voltage Instrument Transformer technology + TG test transformers (test equipment). More than 4 decades of experience
- Single phase device which can operate in three phase by using three devices
- All advantages and functions of inductive voltage transformer available
- Provides higher power output than standard instrument transformer
- Connected to any HV line up to 550 kV, enable power supply up to 167 kVA
- Reliable power supply wherever other source are not available
- Sec. Voltages 120V – 690V (default values 120V/230V/240V)

Function	Inductive Voltage Transformers	Power Voltage Transformers	Notes
Measuring	√	√	Optional functions. Max Load 1000VA under this conditions
Protection	√	√	Optional. Max Load 1000VA under this conditions
Max Power	2000 VA	167 kVA	different limits depending by insulation medium, Clean air general limit will be 420kV acc. IEC standards
Cable line discharge	√	√	
Technology	Inductive	Inductive	
Insulation medium	SF6/Oil/Clean Air	SF6/Oil/Clean Air	

Power VT – Technology Design

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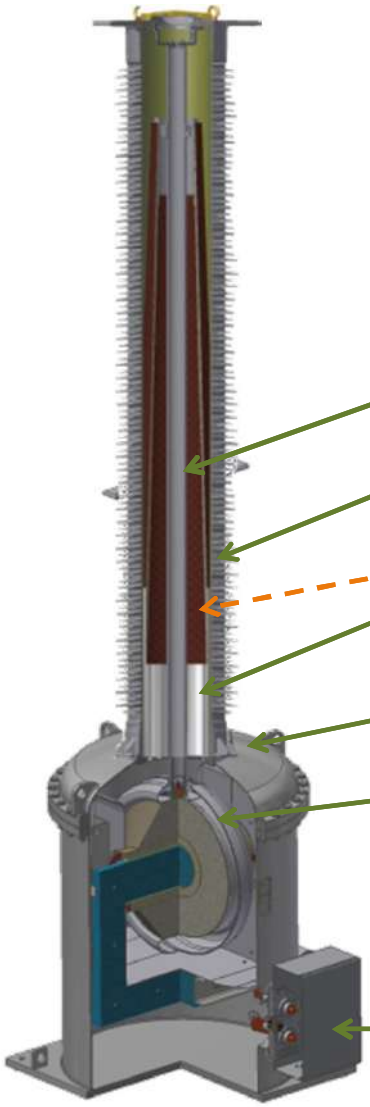


Rupture disc

Insulator

Condenser grading (inside)

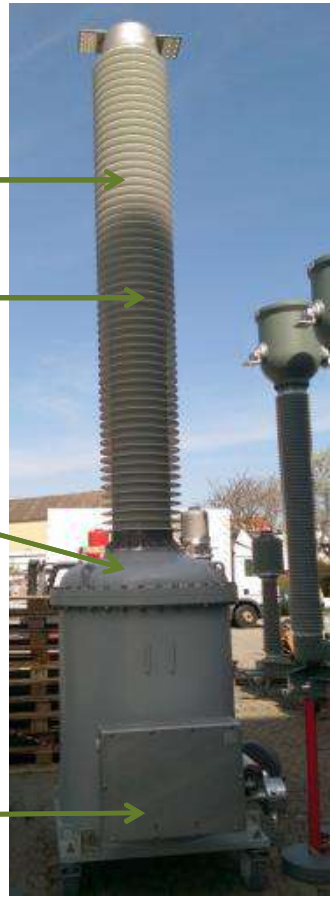
Grading electrode

Top cover

HV electrode

Terminal box with massive copper bolt outlets

(Same size as for 50kVA - 125kVA)



Design principle:

- One housing design for all voltage levels
- Adaption of insulator and grading for higher voltage levels
- General active part design remains also equal for all voltage levels – adaption of the primary in respect of the primary voltage
- Prototypes usually built and tested at highest voltage level => worst case type

Main Cost Drivers:

- Active part, housing and cover major cost driver
- Insulation is not the major cost driver.
- **Pricewise, the Output Power is the leading technical parameter and not the rated voltage**

Power VT - Technology

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Power VT main function is Power Supply.

Which other power source with similar power rating are competing against Power VTs?

Solution	Advantage(s)	Disadvantage(s)
Diesel generator	+ Easy to install + No HV-Line needed	– Investment – High operation and maintenance costs – Reliability – High environmental- and carbon footprint
Distribution network	+ Easy access if available	– Investment – Redundancy – Availability (distribution lines, substations)
Power Transformer Tertiary	+ If available	– Higher transformer costs – Possible impact on transformer performance – Not available in switching substations – No power supply if transformer is de-energized
MV-Network	+ Easy if available	– No power supply if transformer is de-energized – HV-MV-transformer needed
Power VT	+ Low Investment + Easy to install + Low operation and maintenance costs + Low environmental- and carbon footprint + No distribution network needed + Redundancy	– HV-Line needed

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Power Voltage Transformers
BIC Portfolio

Power VT – Gas Insulated type PSVS

Type	PSVS								
Factory	Trench Germany								
Insulation	SF6 or SF6/N2								
	For Clean Air version, see next slide								
Voltage level	[kV]	72.5	123	145	170	245	300	362	550
Rated power frequency withstand voltage	[kV]	140	230	275	325	460	460	575	800
Rated lighting impulse withstand voltage	[kV]	350	550	650	750	1050	1050	1300	1800
Rated switching impulse withstand voltage	[kV]	-	-	-	-	-	825	825	1175
Output power	[kVA]	25							
		50							
		75	100						
		100	125						
		167 (under finalization)							
Standard output voltage	[V]	120 / 240 [2)]							
Rated voltage factor		1.4 (60 s) – 1.5 (30 s) [2)]							
Rated frequency	[Hz]	50/60 [2)]							
Creepage distance	[mm/kV]	25 – 31 [2)]							
Standard temperature range	[°C]	-50[1)] – +40[2)]							
Insulation class		E							
Metering accuracy class		0.2[3)] - 0.3[3)] –0.5[3)] - 0.6[3)] - 1.0[3)] – 1.2[3)]							
Protection accuracy class		3P[3)] – 6P[3)]							

Values in accordance with IEEE – IEC. Other values can be available upon request.
1)Some specifications are not possible with chopped wave 2) others upon request 3) not under full load condition

Power VT – Gas Insulated type PSVS

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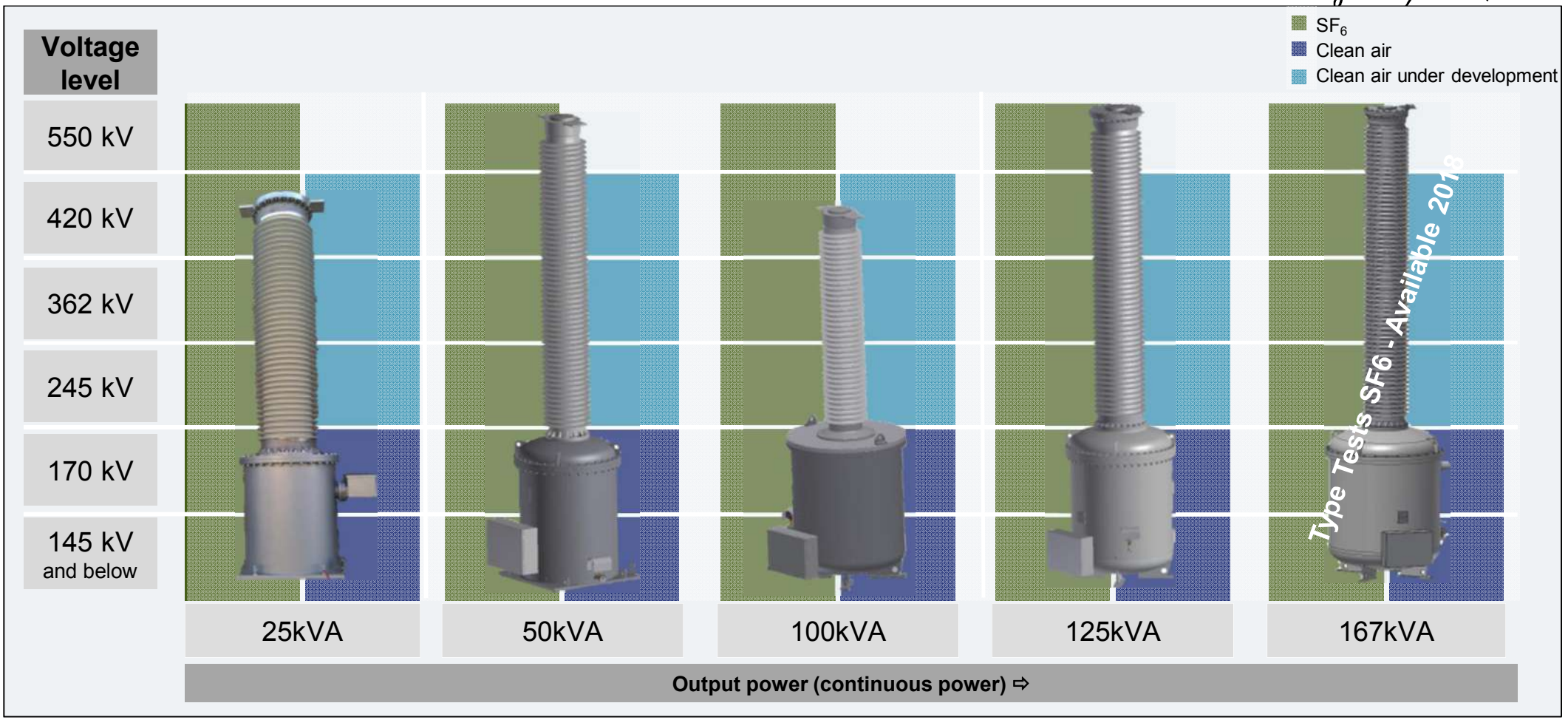

Power VT – Paper/Oil type TPVT

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Type	TPVT				
Factory	Trench Canada				
Insulation	Paper /Oil				
Voltage level	[kV]	(72.5)	(123)	145	170
Rated power frequency withstand voltage	[kV]	(140)	(230)	275	325
Rated lighting impulse withstand voltage	[kV]	(350)	(550)	650	750
Rated switching impulse withstand voltage	[kV]	-	-	-	-
Output power	[kVA]	(50)	(100)	100	100
Standard output voltage	[V]	120 / 240 1)			
Rated voltage factor		1.4 (60 s) – 1.5 (30 s) 1)			
Rated frequency	[Hz]	50/60 1)			
Creepage distance	[mm/kV]	25 – 31 1)			
Standard temperature range	[°C]	-50 1) – +40 1)			
Insulation class		E			
Metering accuracy class		0.2 2) - 0.3 2) –0.5 2) - 0.6 2) - 1.0 2) – 1.2 2)			
Protection accuracy class		3P 2) – 6P 2)			

Values in accordance with IEEE – IEC. Other values can be available upon request.
1) others upon request 2) not under full load condition

Power VT - Test

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No standard available today (activities at IEEE C57 for SSVT running, IEC working group being started)
Instrument Transformer Standard IEC 61869 and Power Transformers standard IEC 60076 have to be applied partly

Routine Tests	Type Tests	Special Tests	Calculations
Power frequency & PD measure	Temperature rise test (no load and short circuit)	Chopped wave test	Internal arc fault calculation
Voltage ratio & check of phase displacement	Lightning impulse test BIL	Secondary short circuit (only prototype)	Ferroresonance avoiding calculation
Capacitance & dielectric dissipation factor	Switching impulse test or AC (wet)	Seismic test without pedestal with factor 2.5 acc. IEEE 693 (only prototype)	Temperature cycle operation
Winding resistances	Radio interference voltage (RIV)	Internal Arc Test	Seismic calculation
Short circuit impedance & load loss			Inrush behaviour
No load losses			Cable discharge
Power frequency test on sec. Windings			
Power frequency test between sections			
Leakage test			

Power Voltage Transformers
Applications

Power VT - Applications

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Applications

- Power supply for substations (SSVT)
- Switching stations

- Railways Power Supply

- Power supply for remote areas

- Mobile Power supply

- Power supply for construction works, transmission line lighting

- Power supply for cell phone relay stations

- Mining, Oil and Gas pumping

- Power supply wind and solar farm

- High Voltage laboratories elevator

Power VT – Applications example

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Mobile Power VT mounted on trailer

PSVS 145

132 kV

100 kVA cont.

Three phase application

(Substation)

Australia

PSVS 245

230 kV

10 kVA cont.

Single phase application

(Wind farm)

Canada

PSVS 420

400 kV… kVA cont.

Pilot cable transiton substation

Tennet

Germany

PSVS 245

245 kV

125 kVA cont.

Single phase application

(Substation)

USA

PSVS 123

110 kV

5 kVA cont.

Single phase application

(HV-Overhead line tower)

Germany