

Barbro Stomberg, Marknad & Försäljning, 2012-10-27

Power transformers I Ludvika
Tekniska Muséets Vänner på besök

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Power and productivity
for a better world™

ABB i Sverige

Cirka 8 800 medarbetare
på mer än 30 orter.

Intäkter 2011: 31 miljarder kronor
- varav 80 % på export

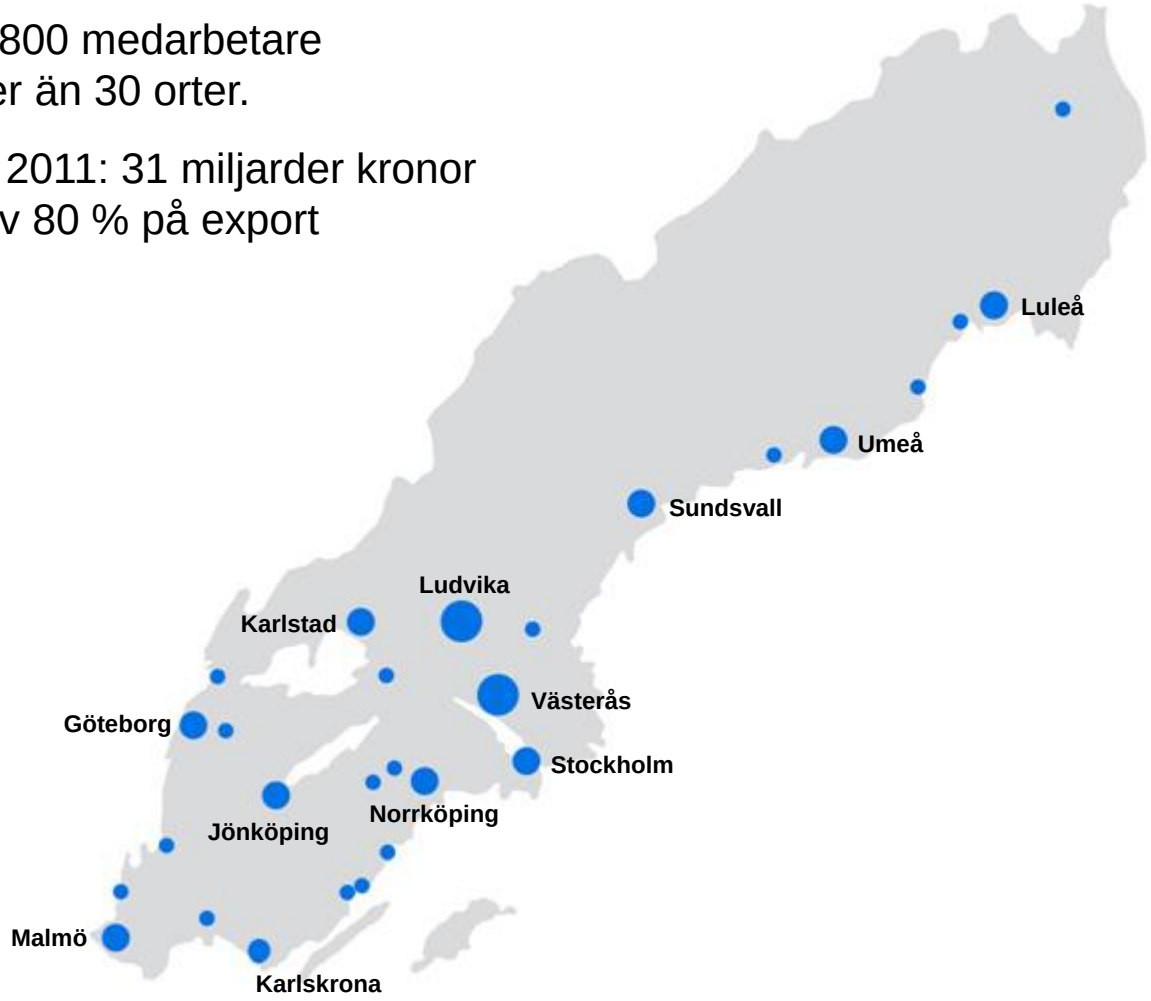

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ABB Sverige
Fem divisioner inom kraft och automation



Power Products

Intäkter:
7,9 miljarder kronor

2 300 medarbetare

Divisionschef:
Carl-Johan Linér



Power Systems

Intäkter:
11,9 miljarder kronor.

2 100 medarbetare

Divisionschef:
Per Eckemark



Low Voltage Products

Intäkter:
2,5 miljarder kronor

800 medarbetare

Divisionschef:
Anders Carlsson



Discrete Automation & Motion

Intäkter:
6,5 miljarder kronor

1 540 medarbetare

Divisionschef:
Anders Nylander



Process Automation

Intäkter:
4,2 miljarder kronor

1 280 medarbetare

Divisionschef:
Erik Oja

Varav **Service** ▪ Intäkter: 4 miljarder kronor. ▪ 1 300 medarbetare Chef: Hans Eckerrot
Varav **Svensk Försäljning** Intäkter: 6,7 miljarder kronor Chef: Eva Kvist Östgren

ABB Transformer Factories

Ludvika – a centre of power transmission

Key figures

Ludvika - Power Technology Centre





Established in year 1900

to support mining and

iron industry in mid Sweden.

Elektriska Magnet AB founded in Ludvika
Board of Directors in 1900



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ABB i Ludvika
Världscentrum för högspänning



Ludvika – power products and power systems

- Systems and products for transmitting electricity over long and short distances:
  - Large Power transformers
  - Transformer components
  - HVDC systems
  - Capacitors
  - Switchgear, HV Breakers, Surge arresters, Instrument Transformers
- Totally 2,400 employees
- Research and Development



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Power Transformers – Ludvika, Sweden
Factory history and facts

- Factory in operation since 1893
- Developed 400 kV AC which became a standard for all over the world
- Developed 500 kV, 600 kV, 800 kV and 1100 kV HVDC
- Technical Lead Center of the fundamental R&D
- Employees: 650
- Area: 55 000 m2



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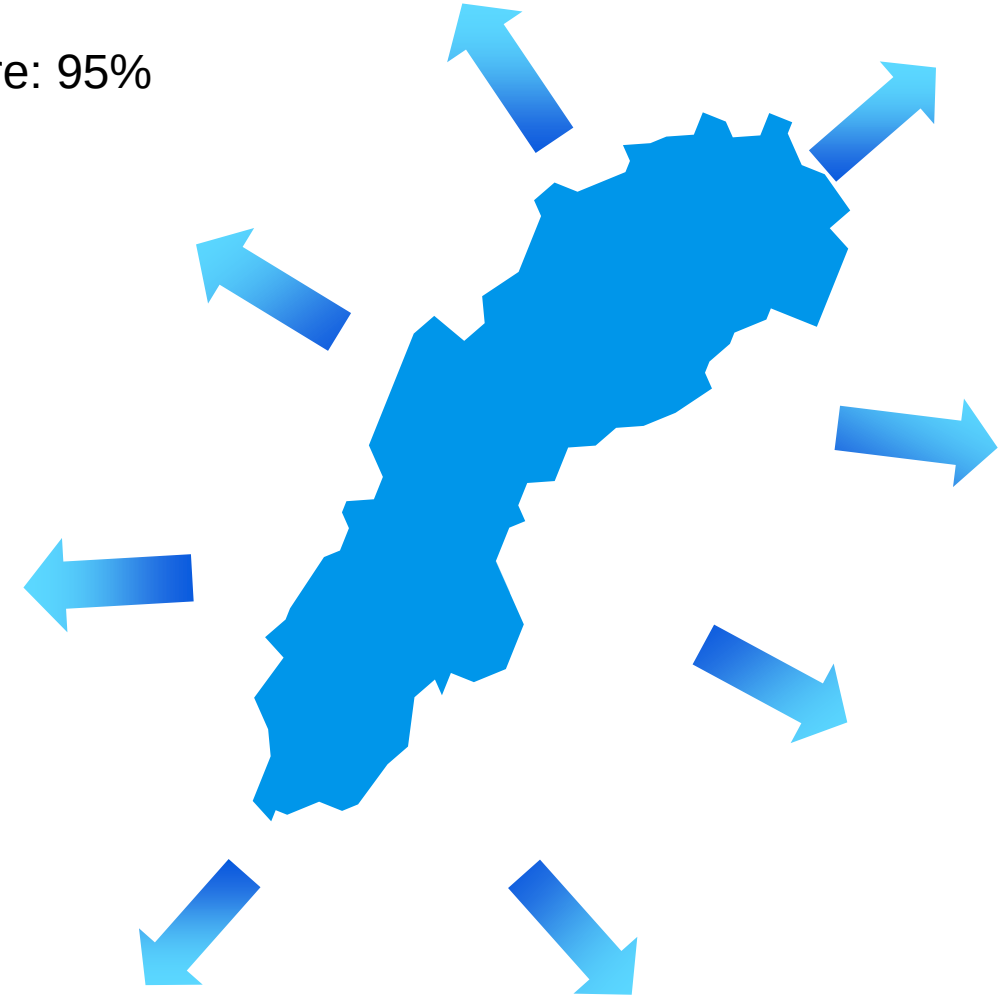
Power Transformers, Ludvika
Market

- Export share: 95%



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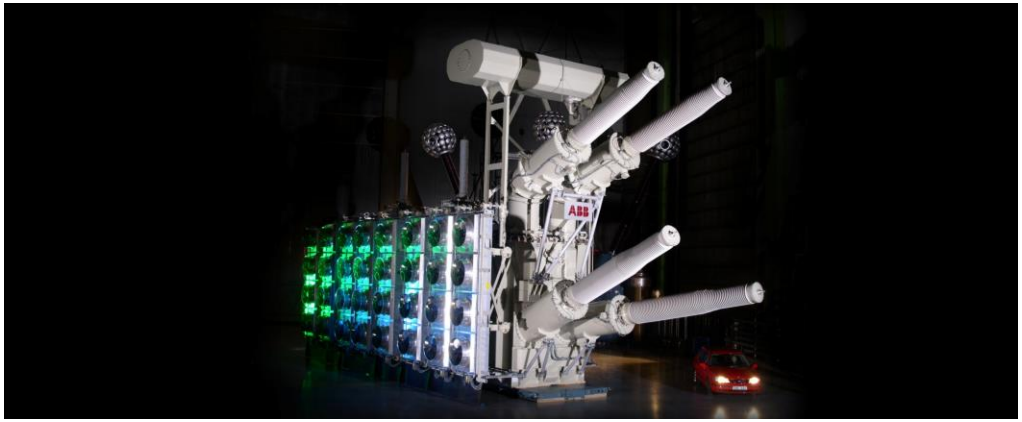
Milestones - Transformer manufacturing in Ludvika

- 1893 - Three phase transmission att Hällsjön
- 1900 - Ludvika factory founded
- 1920 - 120 kV transmission line, Sweden
- 1952 - World's first 400kV AC - system Harsprånget – Hallsberg
- 1954 - World's first HVDC power transformers Gotland – Sweden, 20 MW, 100 kV DC
- 1965 - World's first 800 kV AC transformers Hydro Quebec, Canada
- 1982 - World's first 600kV HVDC transformers Itaipu, Brazil
- 1999 - World's first Dryformer the oil-free power transformer, Lottefors S/S
- 2000 - World´s first HVDC Light transmission mainland Sweden to Gotland



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Milestones - Transformer manufacturing in Ludvika

- 2003 - World's largest HVDC Transformers, Sylmar-USA, 621 MVA, 500 kV
- 2004 - Variable shunt reactor unit launch and first delivery
- 2005 - 45 units to India´s first 800 kV AC system,
- 2007 - First HVDC unit short circuit tested, Sapei-Italy
- 2008 - Worlds first 800 kV HVDC-unit passed the test
- 2010 - 800 kV UHVDC put into commercial operation in
- 2011 - World's largest HVDC transformer, Rio Madeira
- 2012 - 1100 kV UHVDC unit passed the test



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“The old Servant” from Ludvika factory
47 years in operation, 13 years as a spare



- The first transformer for long distance transmission in Sweden with 50 Hz
- 12 units installed at Älvkarleby HPP,1915 – 1916
- Rating: 4.8 MVA, 11 / 77 kV, 1-phase, ONWF, DETC
- Customer: The Swedish State Power Board
- Acquired as a museum piece in 1983 when ASEA celebrated the 100th anniversary



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ToT: Transfer of Transformer Technology

1960's

South Africa
400 kV

1970's

Germany
400 kV

Norway
400 kV

Brasil 800 kV
± 600 kV DC

Canada 800 kV
± 500 kV

USA 230 kV

1980's

India
± 500 kV

Scotland
400 kV

Thailand
230 kV

Turkey
400 kV

1990's

Spain
400 kV

Australia
400 kV

Poland

China,
230&
500 kV
3 factories

2000´s

China
SR

India
400 kV

India
SR

China
500 kV
HVDC

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Transformers, Ludvika, Sweden

Ludvika transformer factory

Product portofolio

Outstanding Testing facilities

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Transformers, Ludvika, Sweden

Ludvika Transformers factory
Portofolio



Large Power Transformers



HVDC Transformers



Shunt Reactors incl. Variable SR

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Power Transformers – Ludvika, Sweden
Product portfolio



- Large power transformers
- HVDC transformers of up to 1100 kV

- Single and 3-phase shunt reactors
- Variable shunt reactors

- Power transformer diagnostic and engineering solutions
- Field service and installation and commissioning

- Spare parts and semi-finished products

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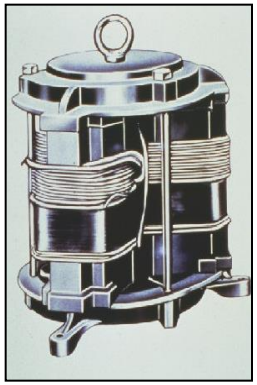
Development of Transformer Manufacturing in Ludvika







Service voltage
1 785 kV

Equivalent doublewinding capacity
1 150 MVA

1900 **1920** **1940** **1960** **1980** **2000**

ASEA + AEP: Prototype 1700 kV system voltage



- Co-operation ASEA + AEP, American Electric Power Corp.
- During 1970´s

The Power Transformer unit:

- 333 MVA for 1700 kV AC system
- voltage, single-phase
- serving a research station in South Bend, south from Chicago, USA.

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Power Transformers – Ludvika, Sweden
Factory and thus testing capability



Power transformers:

- up to 800 kV system voltage 1-phase 500 MVA
- 400 kV units up to 1000 MVA 3-phase
- HVDC units up to 1100 kV DC

Shunt reactors:

- 800 kV 1-phase 133 MVA
- 400 kV 3-phase 300 MVAr full scale 3-phase tested

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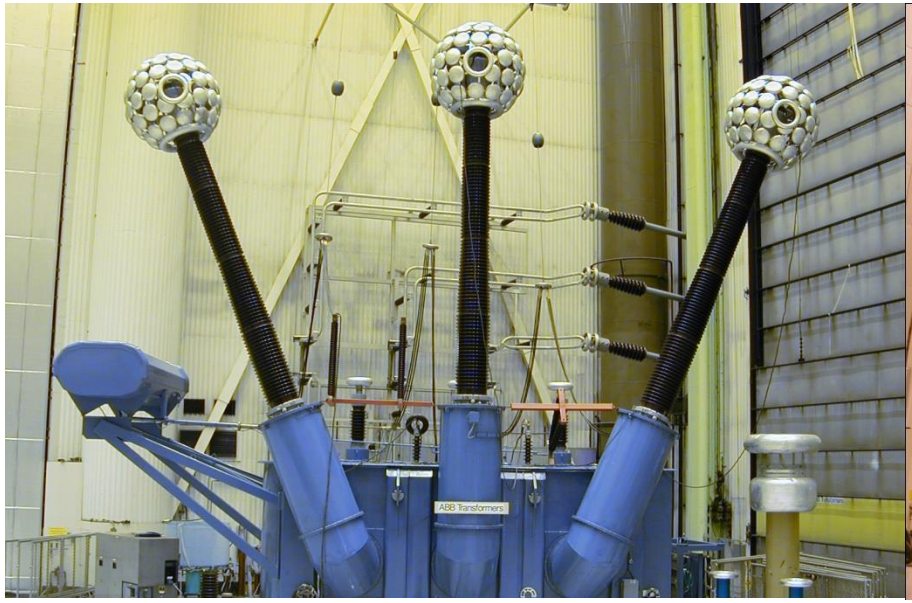
Testing – 2 transformers built for test purposes



Test transformer, Built 1984

Performance: 468 MVA, 900 kV, 50/60Hz, 3-ph 1200kV, 240Hz



World´s most powerful test transformer
Built 2007
Performance:
780 MVA, 120/ 900 kV, 50/60 Hz, 3-ph

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New Test hall in Ludvika – bushings, HVDC valves
Inagurated June 2009



H = 40 m, test capacity DC 2000 kV, AC 1700 kV

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Transformers, Ludvika, Sweden

New mega test hall for bushings
Inagurated June 2009



- Testing of electrical components for ultra high voltage levels
  - 2000 kV DC
  - 1700 kV AC
- Bushings and HVDC valves
- ABB is a leading force in ultra high voltage technology development

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Ludvika a center for HP & HV tests



- High power tests



- High voltage tests at STRI
- Long-term testing of 1050 kV UHVDC apparatus for HVDC

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Short circuit test of converter transformer
Sapei project - tested at Kema



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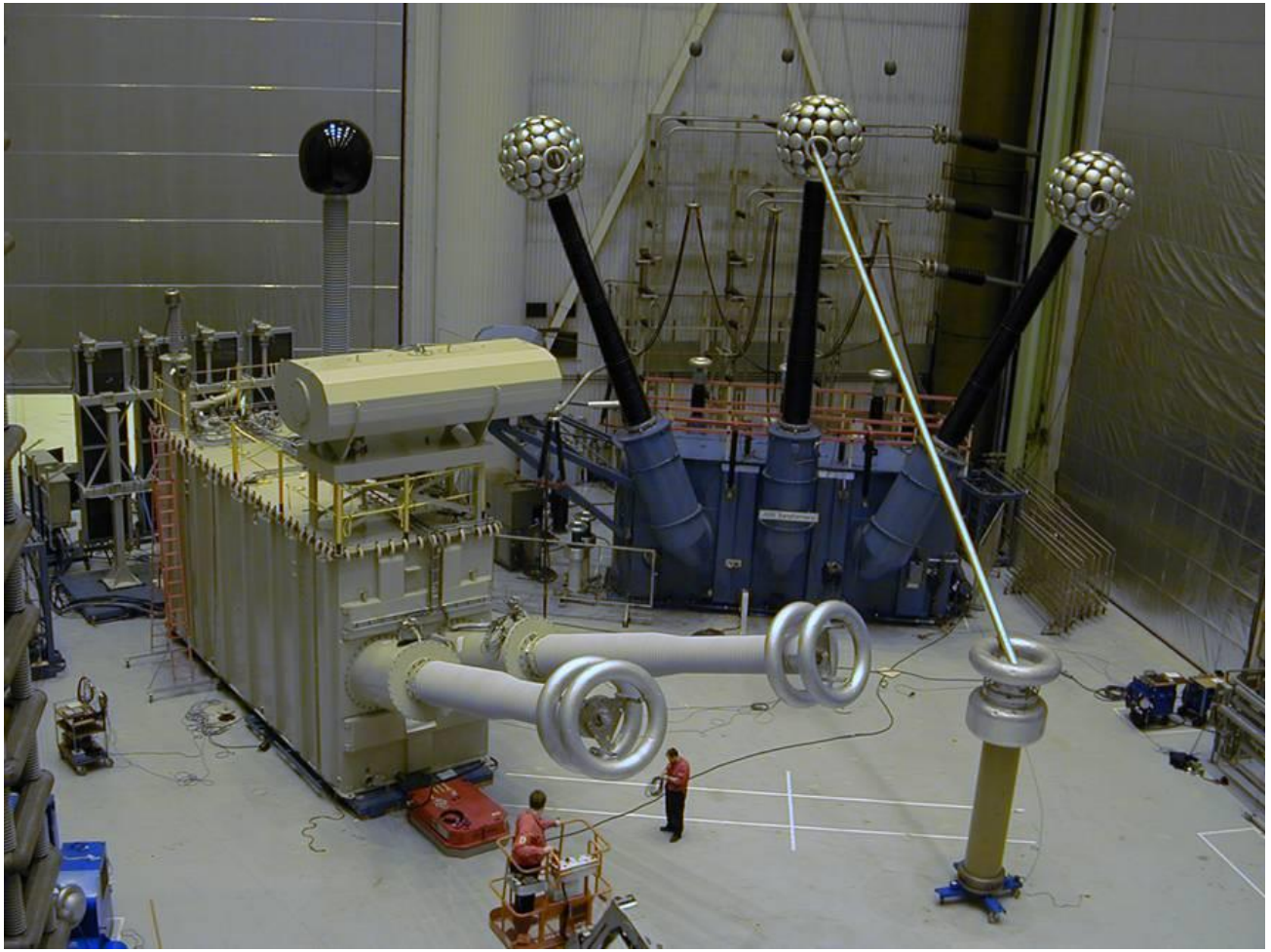
Test hall



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Test hall



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Test hall



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Ludvika transformer factory

Some delivered units

Shipping

Installation & Service

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Saratovskaya HPP, 320 MVA, 242 kV, Russia
3-phase Generator Step-up Transformer



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3-phase GSU Transformer for China
370 MVA, 525 kV





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OKG AB - Oskarshamn T3
1-phase Generator Step-up Transformer



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Viklandet, Norge

1000 MVA/400 kV 3-phase Auto-connected Transformer,



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Endrup S/S, Danmark.
3-phase Auto-connected Transformer, OLTC

No. 8329 581
ABB ref: 341019
Del.year 2001



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Sha He Ying S/S, Shenyang, China
750 MVA / 525 kV, 3-ph Auto-connected Transformer



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765 kV for India, 333 MVA, 765 kV, NTPC



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Transformers, Ludvika, Sweden

HVDC Transformer
Rio Madiera, Brazil



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HVDC Transformer
NorNed, Norway



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HVDC Transformer
China, Three-Gorges project – 3GC



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Transformers, Ludvika, Sweden

Three Gorges project
Converter Transformers lining up



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Three Gorges HVDC
Converter bushing on the way



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Borwin 1
HVDC Light





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Words first 800 kV HVDC Converter Transformer
…that passed all tests - Feng Xian DC Station, China



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Words first 800 kV HVDC Converter Transformer
Feng Xian DC Station, China



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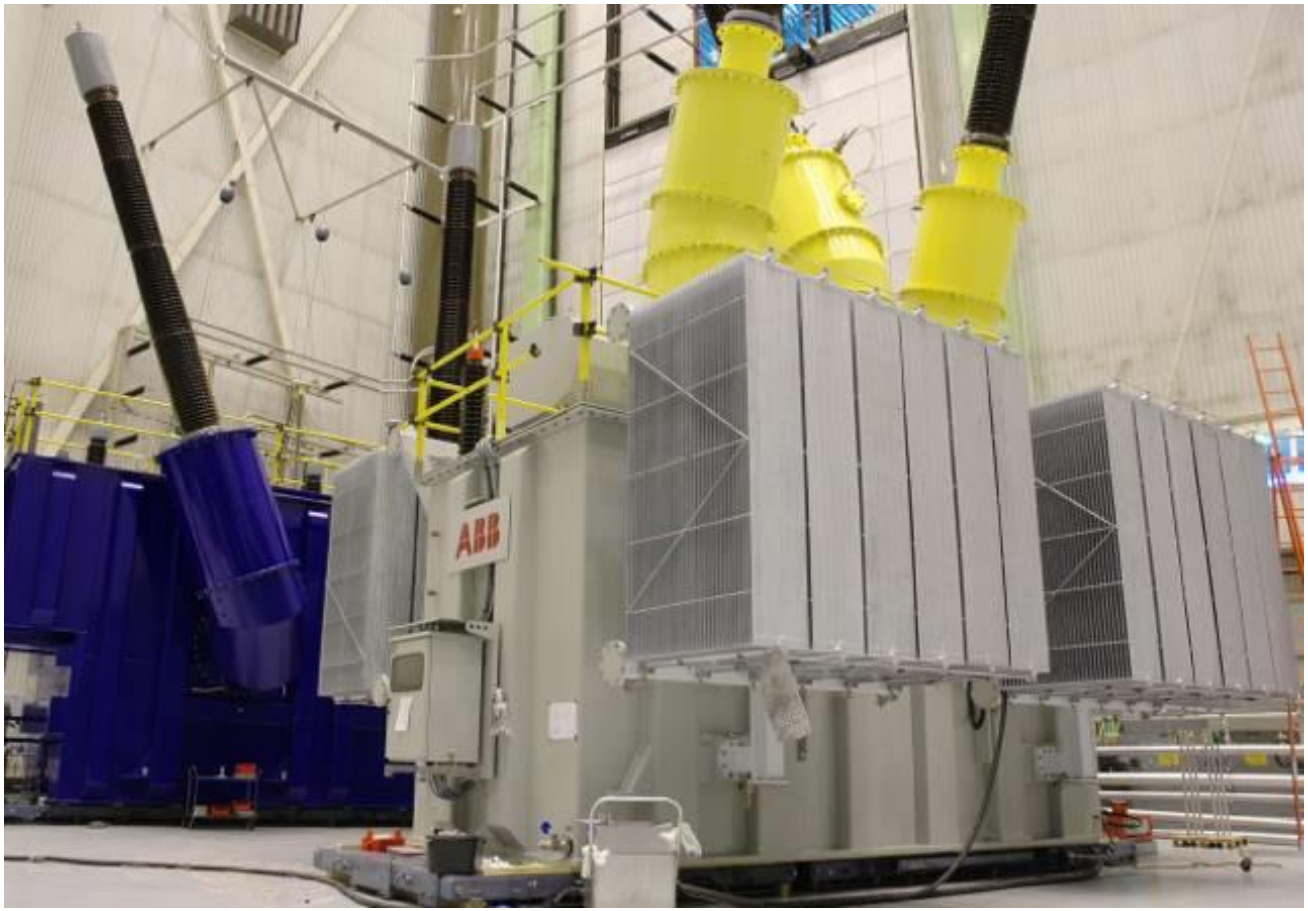
Worlds most powerful 3-ph Shunt Reactor
300 Mvar, 400 kV, 50 Hz, Saudi Arabia



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Bonifacio shunt reactor, Corse
25 Mvar, 150 kV, 50 Hz



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ESKOM 133 MVAr, 765 kV Shunt reactor



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We handle all transport challenges…
Train



© ABB AB, Power
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Edelca 765 kV/268,5 MVA Railway transport



We handle all transport challenges…
On the water



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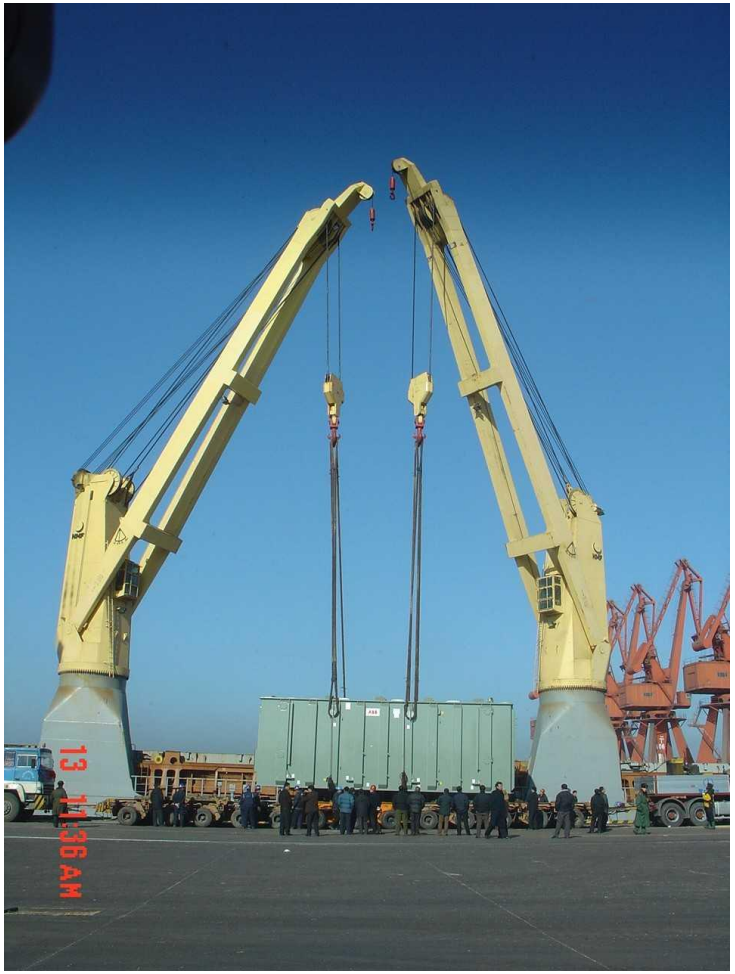
Shipping
Heavy lift in North-East China



ShaHeYing unit
3-ph auto-connected transformer
Transport weight: 320 tonnes
525 / 230 / 66 kV, 750 MVA
H: 4,4 m
W: 3,7 m
L: 12,3 m

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Indien 765 kV AC



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NorNed HVDC, Norge



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Service & After Sales
Complete service portfolio



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Säkerhetsregler

- Rökning förbjuden
- Fotografering förbjuden
- Varning för hängande last
- Varning för trucktrafik
- Varning, halkrisk vid oljespill

  eller föremål på golvet
- Skoskydd innanför röd linje













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Power and productivity
for a better world™



Leyte Luzon, HVDC, Phillippines
Sliding



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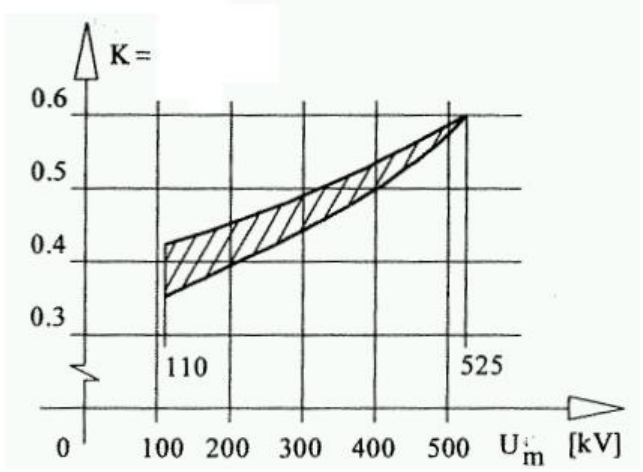
Variable Output Shunt Reactor



- Increased transmitted power in long AC cable or overhead lines
- Reduced losses in the power system
- Better fine-tuning of voltage for system stability
- Regulates consumed reactive power
- Using standard Load Tap Changer
- Feasible regulating ratio

Qmin / Qmax



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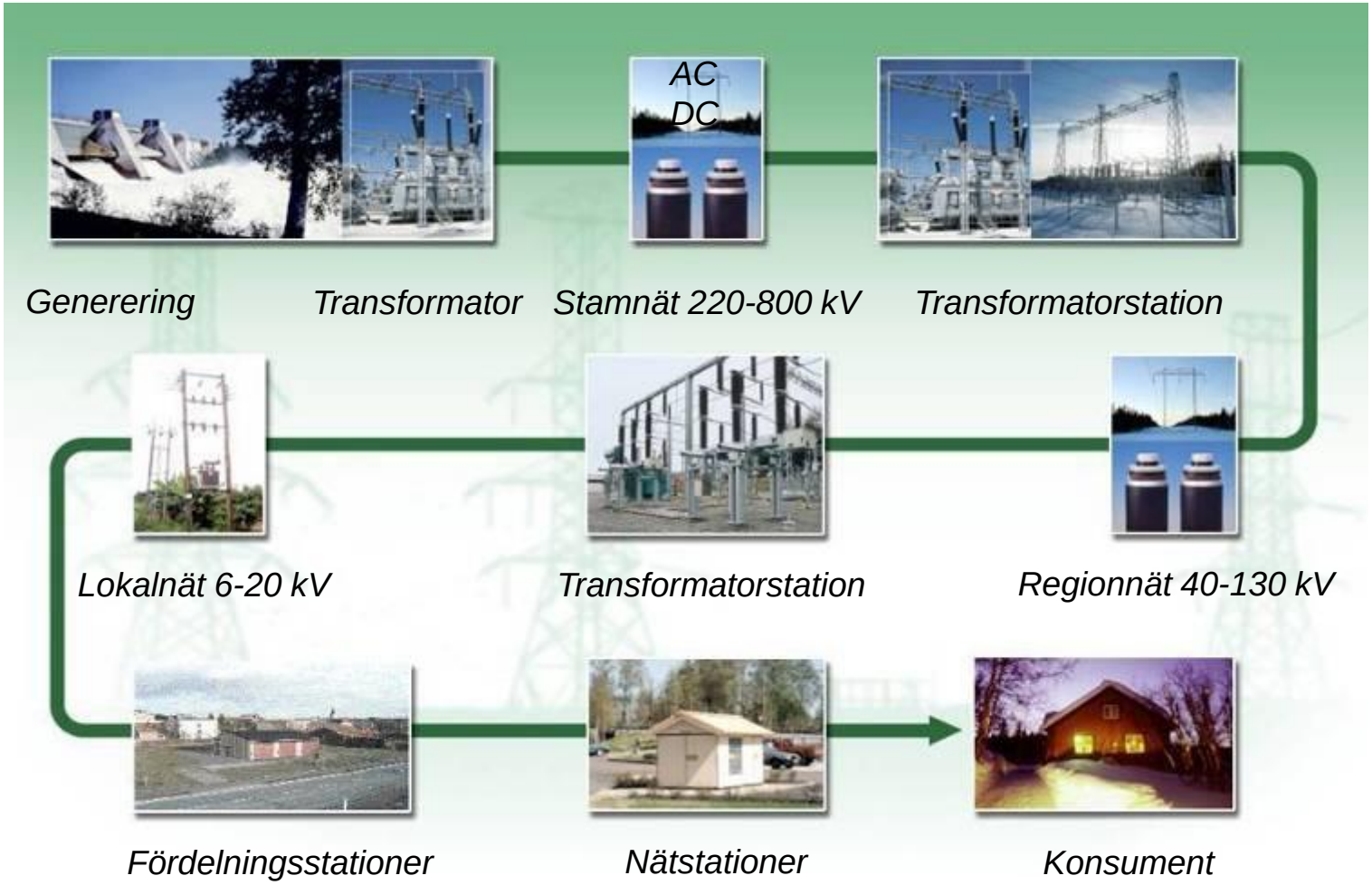

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Power Transformers – Ludvika, Sweden
Factory capability



Power transformers:

- up to 800 kV system voltage 1-phase 500 MVA
- 400 kV units up to 1000 MVA 3-phase
- HVDC units up to 1100 kV DC

Shunt reactors:

- 800 kV 1-phase 133 MVA
- 400 kV 3-phase 300 MVAr full scale 3-phase tested

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19 Large Power Transformer factories in the world
Global manufacturing capability



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19 Large Power Transformer factories in the world
Global manufacturing capability



Canada, Varennes
Max. voltage 800 kV

USA, St. Louis
Max. voltage 230 kV

Colombia, Bogota
Max. voltage 138 kV

Brazil, Guarulhos
Max. Voltage 800 kV

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19 Large Power Transformer factories in the world
Global manufacturing capability



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Test room extension



- **New Capacitor bank made in Ludvika**
- **188 Mvar 50/60/240 Hz**
- **289 Mvar 146 / 73kV 50/60/240Hz**
- **Installed 2007**
- **27 meters / 89 ft high**

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