



PG Dry October 2013

# Dry-type transformers

## HiDry<sup>72</sup>

# Dry-type transformers

## Class 72.5 kV



- A technical breakthrough
- Safe and ecological
- Reliable transformer technology
- Limited contribution with calorific energy to the source of fire
- Self-extinguishing

# Dry-type transformers

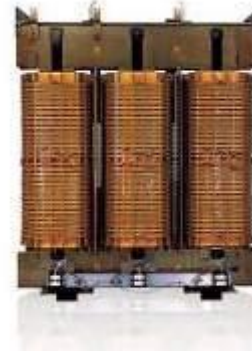
## The widest technology available



Vacuum cast coil



RESIBLOC®



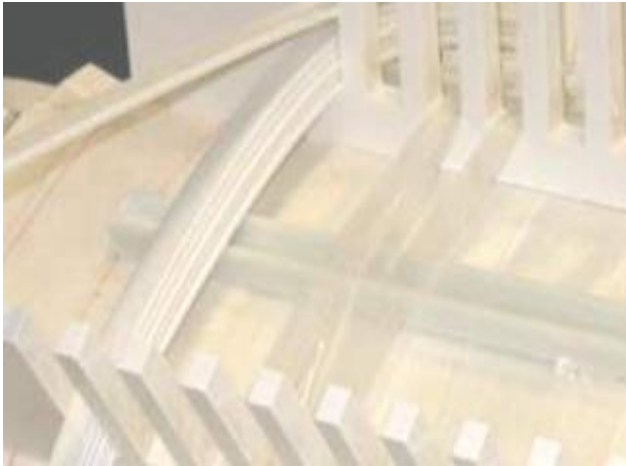
Open wound

- Unique manufacturer with three coil technologies:
  - Vacuum cast coil
  - RESIBLOC®
  - Open wound
- Complementing technologies dedicated to specific market demands.
- Nearly 40 years of experience
- Proprietary technology and R&D departments

# Dry-type transformers

## Difference between RESIBLOC<sup>®</sup>, vacuum cast coil and open wound

Open wound



Vacuum cast coil  
HV disk winding

RESIBLOC<sup>®</sup>  
HV insulation  
application



Vacuum cast coil  
Casting under vacuum

# Dry-type transformers

## Global producer with focus factories I

Focus factories  
dedicated to  
produce dry-type  
transformers



# Dry-type transformers

## Global producer with focus factories II

\* Assembly units

	Vacuum cast coil	RESIBLOC®	Open Wound
CN	X	X	
DE		X	
KR	X		
ES	X		
US	X	X	X
SA*	X		
EG*	X		
IN*	X		
RU*		X	



# Dry-type transformers

## Main advantages of dry transformers



- Safety for people and property
- Environmentally friendly
- Maintenance and pollution-free solution
- No fire hazard
- Easy installation
- Excellent resistance to short circuit currents
- Excellent capacity to support overloads
- Excellent performance in case of seismic events
- Suited for damp and contaminated areas
- Reduced cost on civil installation works and fire protection systems

# Dry-type transformers

## Applications



- Public works
- Hospitals
- Airports
- Shopping centers
- Public buildings
- Office buildings
- Stadiums
- Variable speed drives
- Special industries
- Utilities
- Ships
- Oil and gas
- Metal and mining industry
- Metro systems/ trains
- Wind and solar power
- Application with rectifiers



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## The range I



- Ratings up to 63 MVA
- Primary voltage up to 72,5 kV:
  - with 325 kV BIL / AC 140 kV according to IEC
  - 350 kV BIL / AC 140 kV according to IEEE
  - 180 kV BIL / AC 90 kV, according to GOST
- Secondary voltage up to 36 kV:
  - with 170 kV BIL / AC 70 kV according to IEC
- With or without on-load tap changer (OLTC)

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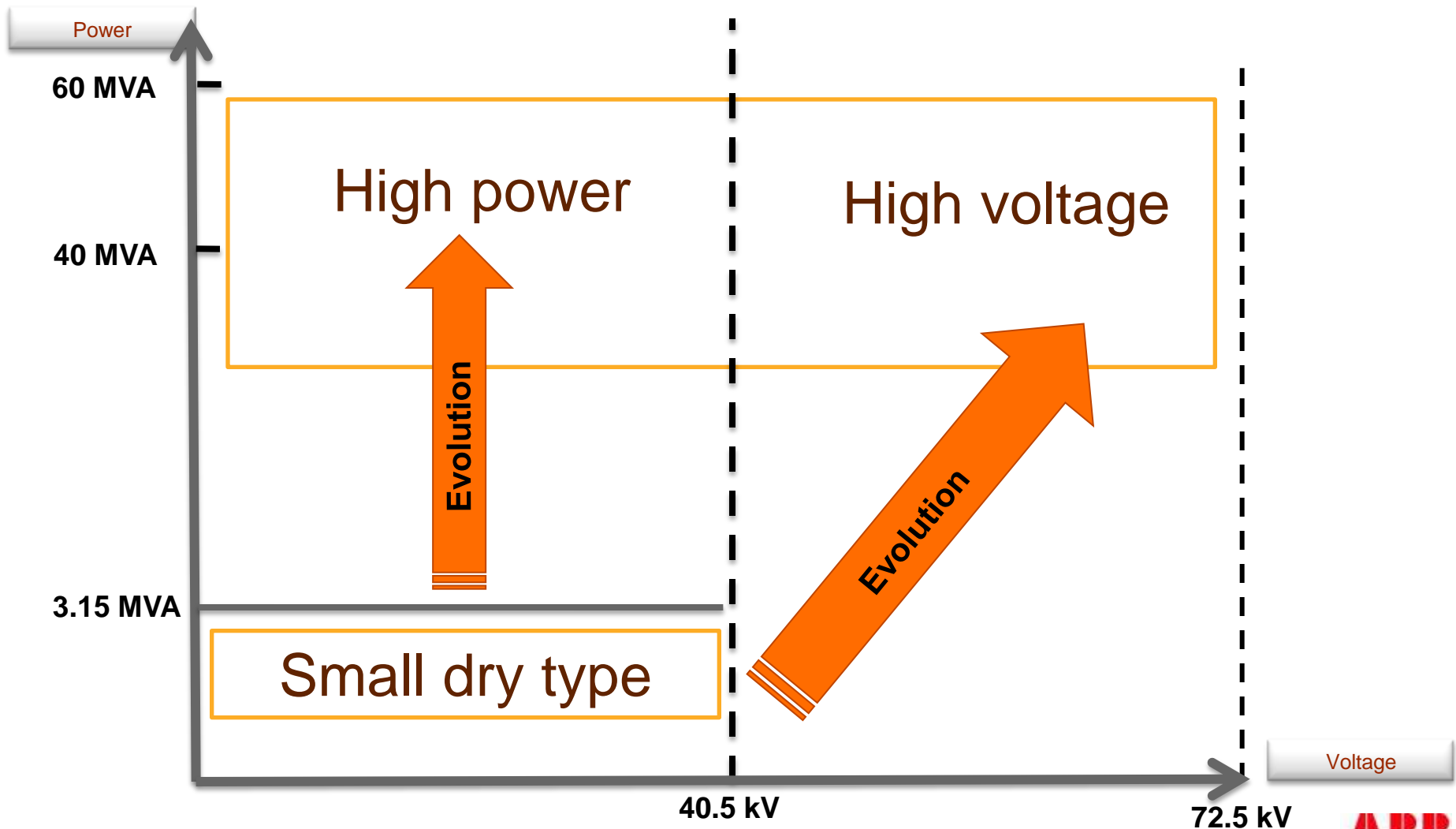
## The range II



- Classes: E2, C2, F1
- Partial discharges: <math><10\text{ pC}</math>
- Insulation: 155 °C (F), 180 °C (H)
- AN, ANAF (up to +30%), AFWF
- Design temperature: 40 °C
- Star or delta connection
- Up to 17 taps with  $\pm 10\%$  regulation range
- Options, enclosure IP21 up to IP54

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## The boarder lines



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## Technical advantages



### **For retrofit or new installations**

- Similar footprint as existing transformers
- For indoor or outdoor installation
- Paralleling with existing oil-transformers possible

### **Safe and environment friendly**



- No flammable liquids
- Self-extinguishing solid insulation
- 10-20 times smaller combustible mass, minimum smoke
- No risk of explosion
- Lower insurance liabilities

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## Customer benefits



### **Environmentally-friendly and cost-efficient**

- Optimized load loss
- Lower infrastructural cost
- Simple installation, no special civil works
- Minimal requirements for safety and protection installations
- Bushings available upon customer request
- Virtually maintenance free
- Easier unload and more efficient logistic costs



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## Applications areas



- Inner-city substations
- Indoor and underground substations
- Chemical, oil and gas industry
- Environmentally sensitive areas (e.g. water protection areas)
- Renewable generation (e.g. off-shore wind turbines)
- Fire-risk areas (e.g. forests)



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## Example on utilization



Before



Now

- The compact internal substations can be built in urban areas with limited space.
- Lower cost, lower environment impact.
- Less losses and higher people's security.

# Erection and commissioning

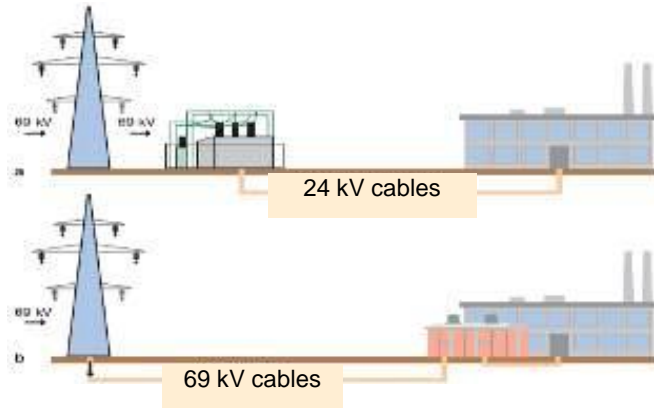
## Easy and fast installation and commissioning



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## Energy efficiency

5 km of 24 kV cable can be replaced by 69 kV one



- Saving in losses :
  - Dry transformers allow installation close to/inside buildings.
  - Quantified over a 30-years period, the total saving is 8.5 GWh or 280 MWh per year.
  - Resulting in reduced emissions (EU power mix):
    - CO<sub>2</sub>: 140 tons/yr
    - SO<sub>2</sub>: 375 kg/yr
    - NO<sub>x</sub>: 175 kg/yr
- Additional savings:
  - Civil works.
  - Fire protection system.
  - Commissioning.
  - Yearly maintenance.

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Technical achievements

# 72.5 kV dry-type transformer

## A technically demanding design



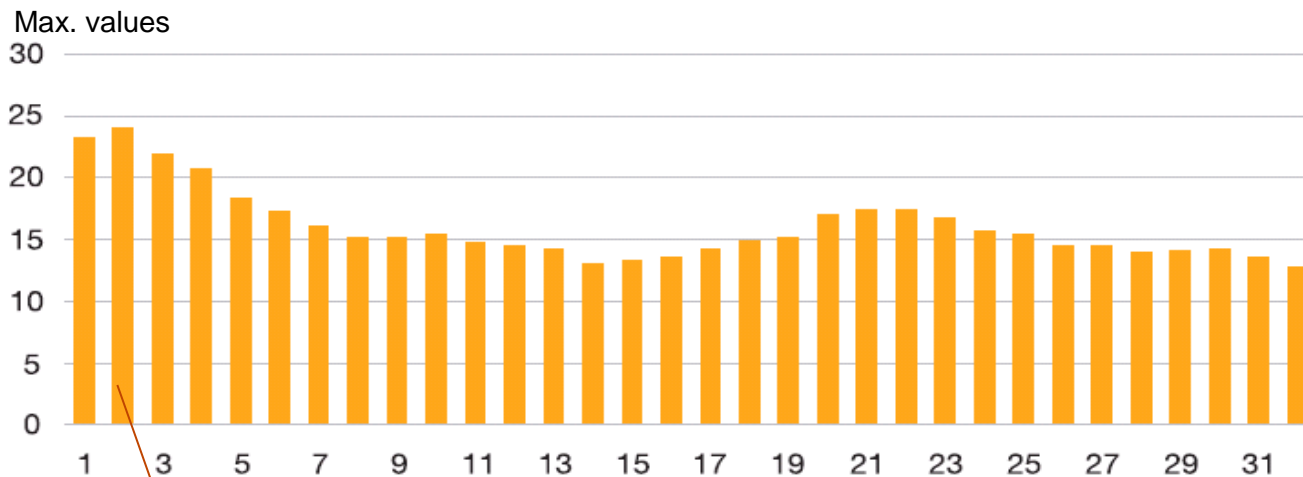
- Development strongly supported by ABB Corporate Research and University collaborations.
- Extensive use of computer simulations allowed fast development and product optimization.



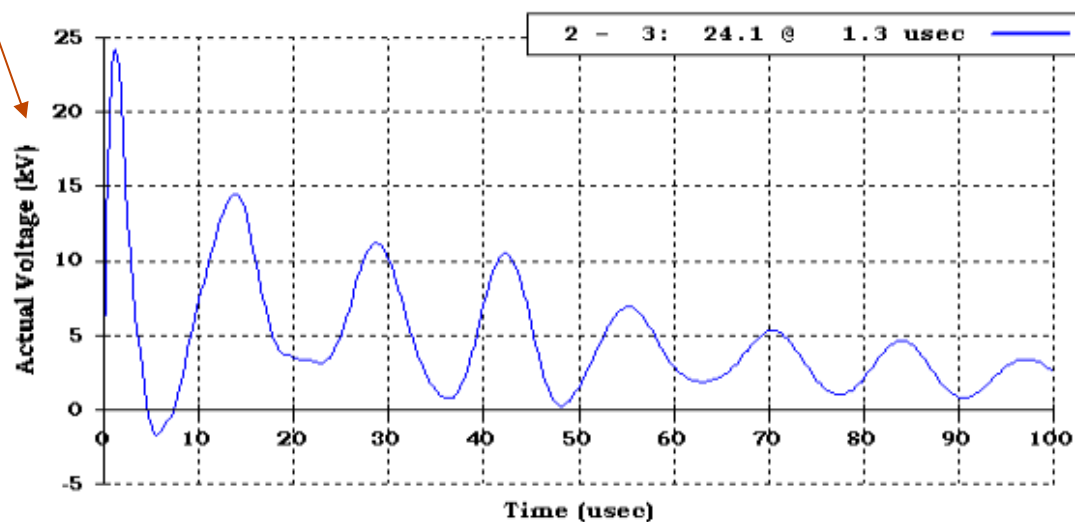
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## Voltage distribution during impulse test

Voltage distribution along windings for 325 kV lightning impulse test



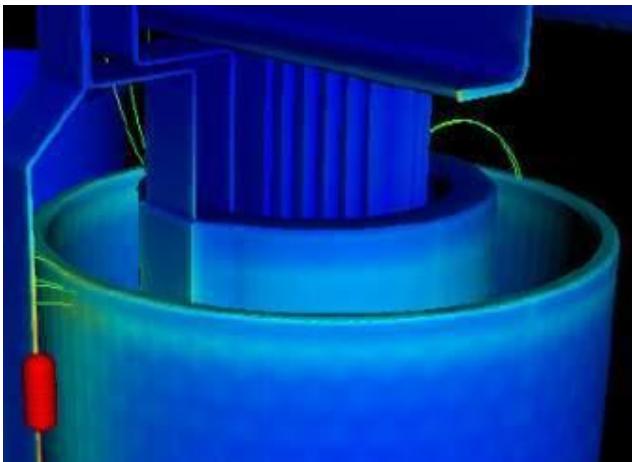
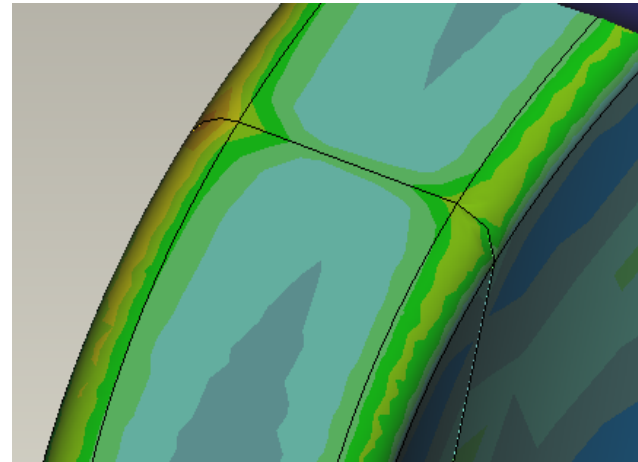
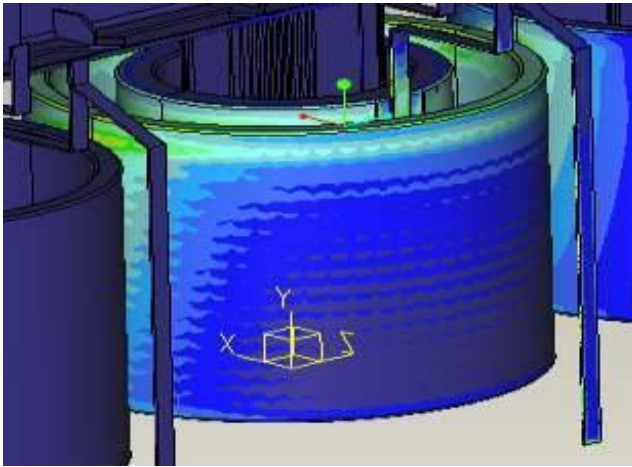
Temporal behavior of voltage distribution during application of lightning impulse



# Development strongly supported by simulations

## Dielectric field stress

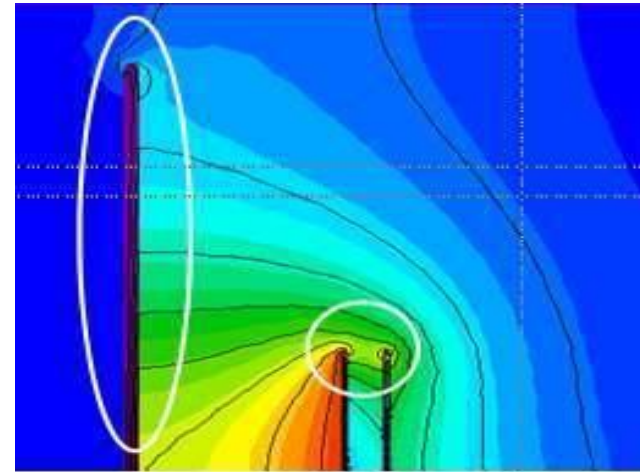
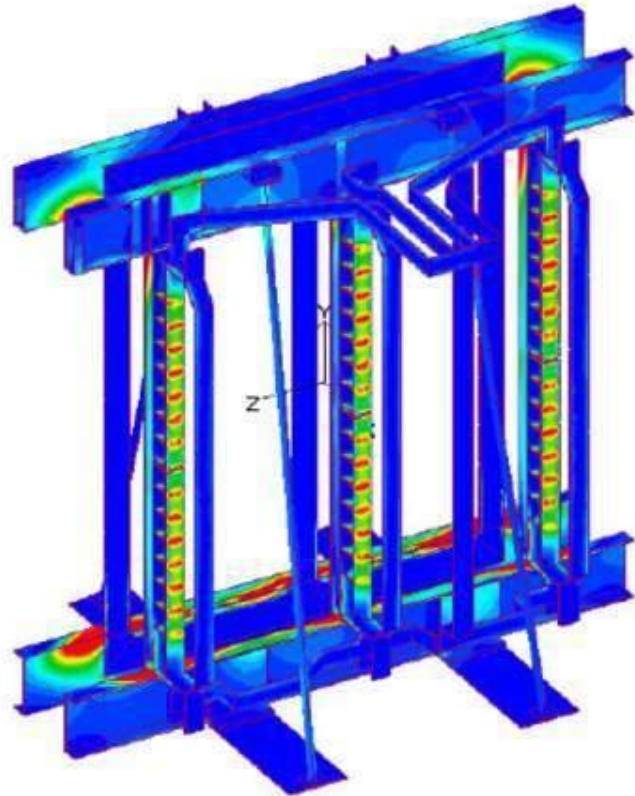
Simulation of electrical field stress during BIL and AC testing



# Development strongly supported by simulations

## Magnetic fields and eddy currents

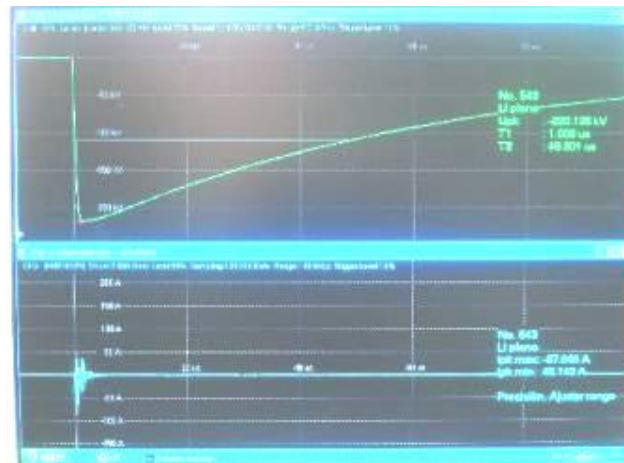
Eddy current losses in structural components



Magnetic stray field

# ...and confirmed by extensive experimental testing Exceeding the limits of standards

...and being tested beyond the limits in order to prove the expected safety margin

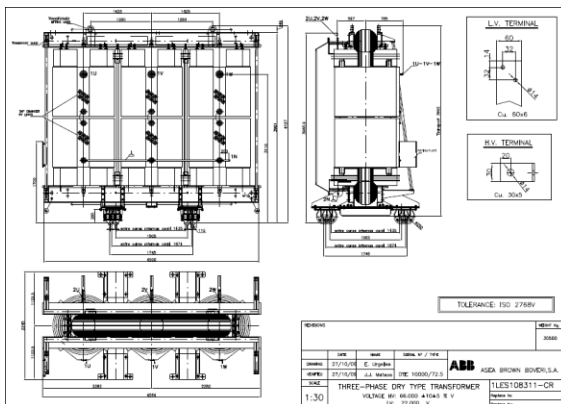


# 72.5 kV dry-type transformer

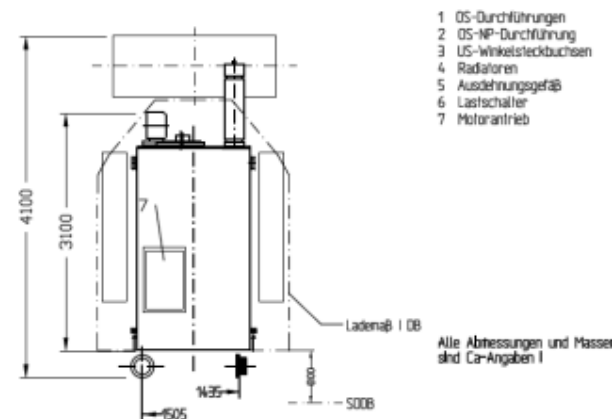
## Overall sizes

	25 MVA, 66 / 10 kV		40 MVA, 66 / 10 kV	
	Dry-type w/o OLTC	Oil-filled	Dry-type w/o OLTC	Oil-filled
Length (mm)	4370	4500	4970	5000
Width (mm)	2000	2300	2000	2500
Height (mm)	4120	4100	4120	4100

Dry transformer



Oil transformer



# 72.5 kV dry-type transformer On-load tap changer

Transformer with On-load tap changer



(\*) presently limited availability, please contact us for clarification

## Characteristics of OLTC:

- Dry, oil-free technology
- Linear type
- For up to 23 taps and  $\pm 18\%$  regulation range (\*)
- > 100'000 operations
- Low maintenance



# Conclusion and summary

# Conclusion and summary: ABB transformers

## Safety – reliability – low losses



- Based upon a wide experience, ABB manufactures dry type transformers with the most **technologically advanced design**.
- Ratings of up to 60 MVA and voltages of up to 72.5 kV.
- Your advantages:
  - Protection of the **environment**
  - All materials practically halogens free
  - Limited contribution with calorific energy to the source of fire
  - **Self-extinguishing**
  - Enhanced **safety**
  - **Reliable** technology
  - Nearly maintenance free
  - **Cost-efficient** solutions

Power and productivity  
for a better world™

