

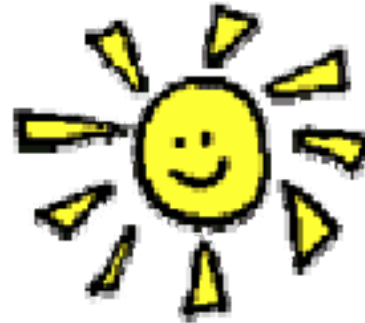
Alstom GIGATOP Turbogenerators

Willi Rütli

Paris, 2008-08-27

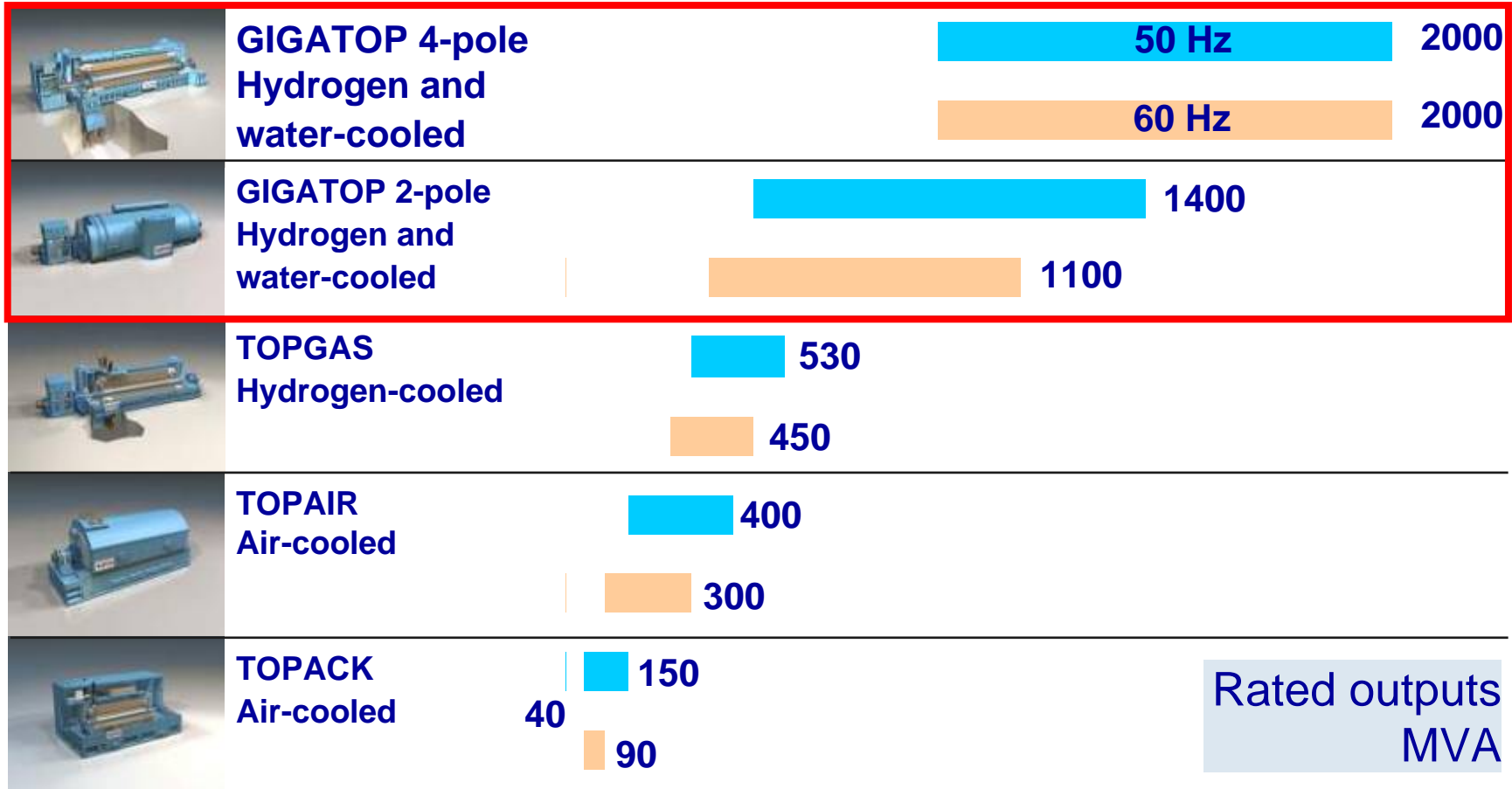
ALSTOM

Power Generation ... a booming market



Turbogenerators

Product families



Comprehensive range from 40 to 2000 MVA

GIGATOP 2-pole

In operation today – for close to 25 years



Leibstadt, Switzerland

- 1318 MVA
- Commercial operation since 1984

More than 20 years experience with highest ratings

GIGATOP 2-pole

In operation today – newest technology



Lippendorf, Germany

- Europe's most modern lignite plant
- 2 x 1166 MVA
- Commercial operation since 1999
- > 99% availability

Newest technology with potential for higher ratings

GIGATOP 2-pole

Projects in execution – Units delivered



Neurath, Germany

- World's largest lignite fired plant
- 2 x 1333 MVA
- Commercial operation: 2010

First unit delivered to site

GIGATOP 2-pole

Projects in execution – Largest unit being built



Datteln 4, Germany

- World's largest hard coal fired plant
- 2 x 1400 MVA
- Commercial operation: 2011

World's largest 2-pole turbogenerators under construction

GIGATOP 4-pole

In operation today



Chooz & Civaux, France

- Largest turbogenerators in operation today
- 4 x 1710 MVA
- Commercial operation since 1996
- 99.97% reliability

Largest 4-pole units in operation with highest reliability

GIGATOP 4-pole

Projects in execution



60 Hz recent orders

50 Hz recent orders



18 units (25 GW) ordered since 2005

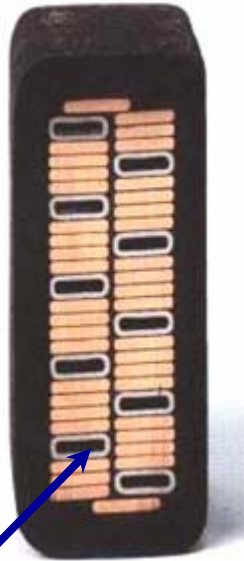
GIGATOP

Unique stator bar design



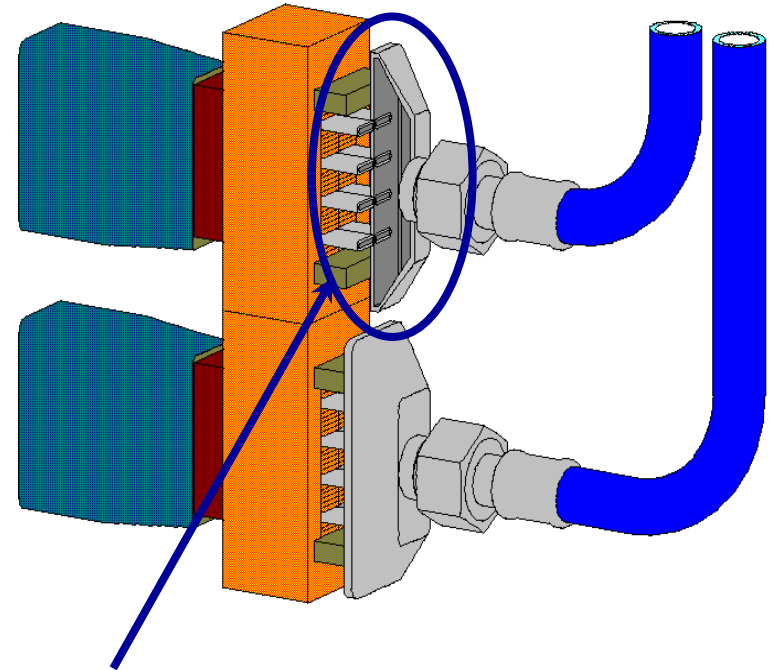
MICADUR®

- High performance VPI Insulation
- Up to 30 KV



Maintenance free through stainless steel

- No copper oxides
- No clogging

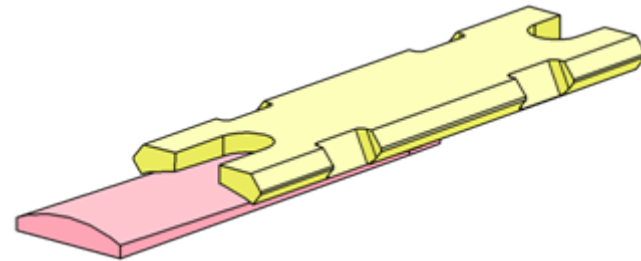
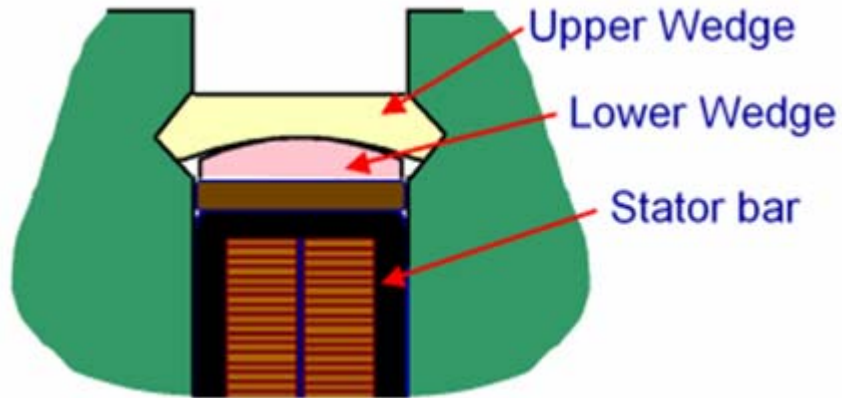


- Welded connections
- Functional separation of electrical and hydraulic connection

VPI insulation and stainless steel tubes for reliable operation

GIGATOP

Stator wedging designed for ease of maintenance



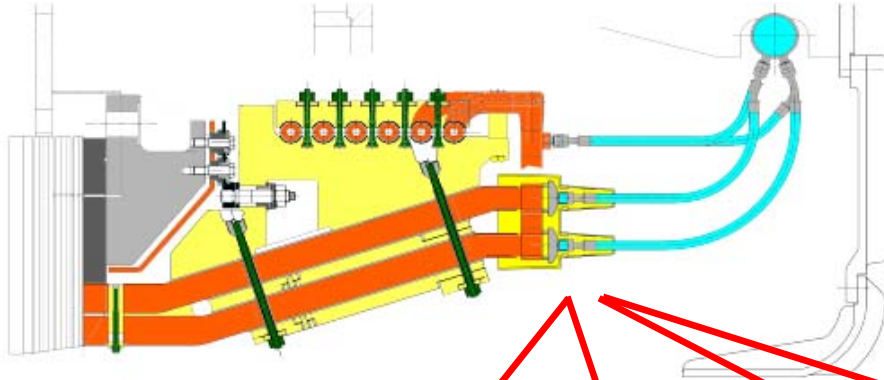
- Constant radial pressure
- Settling effect compensation
- Re-tightening

GIGATOP

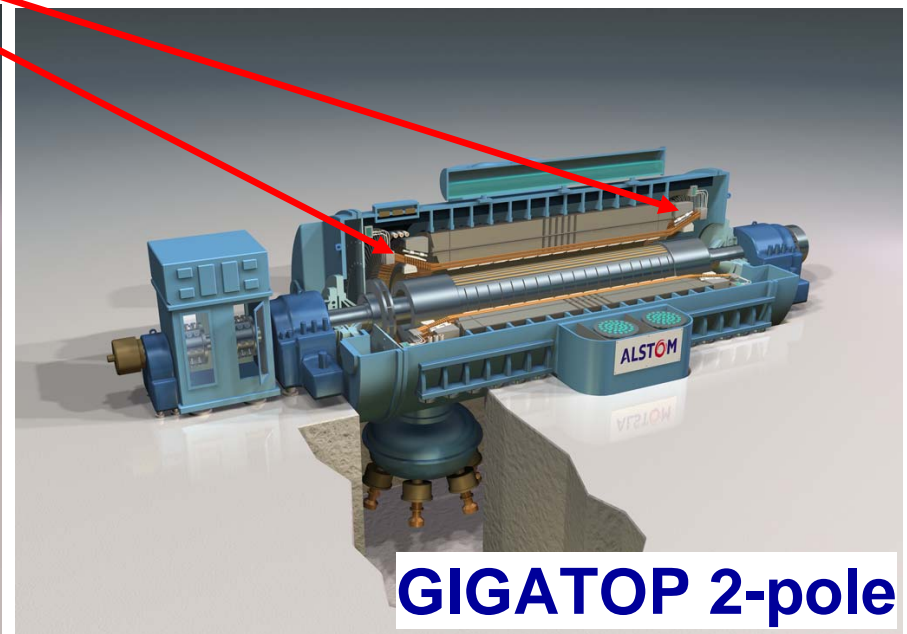
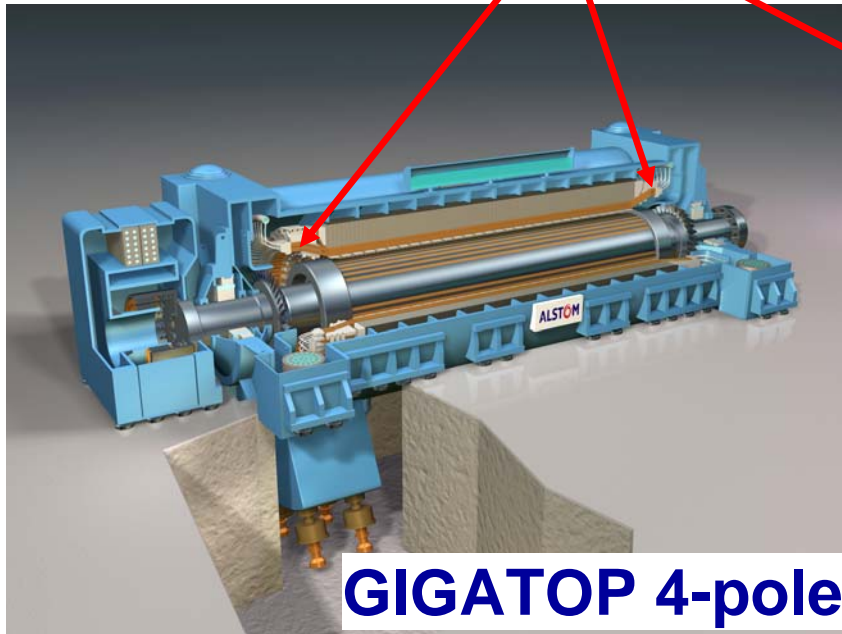
Retighten able stator end winding support



To allow short maintenance time



- Massive support rings
- Free axial expansion
- No loosening in operation
- Re-tightening possible during regular maintenance



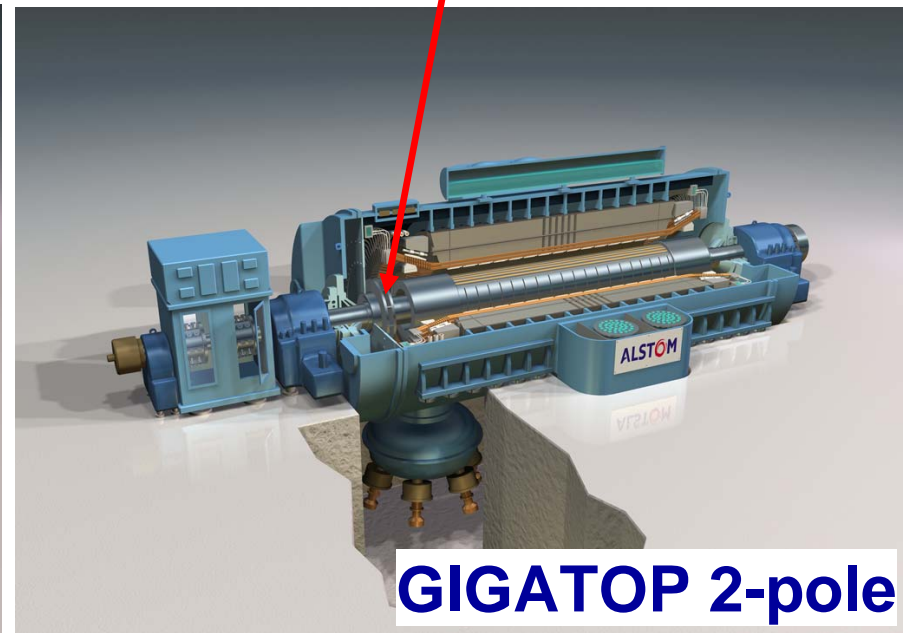
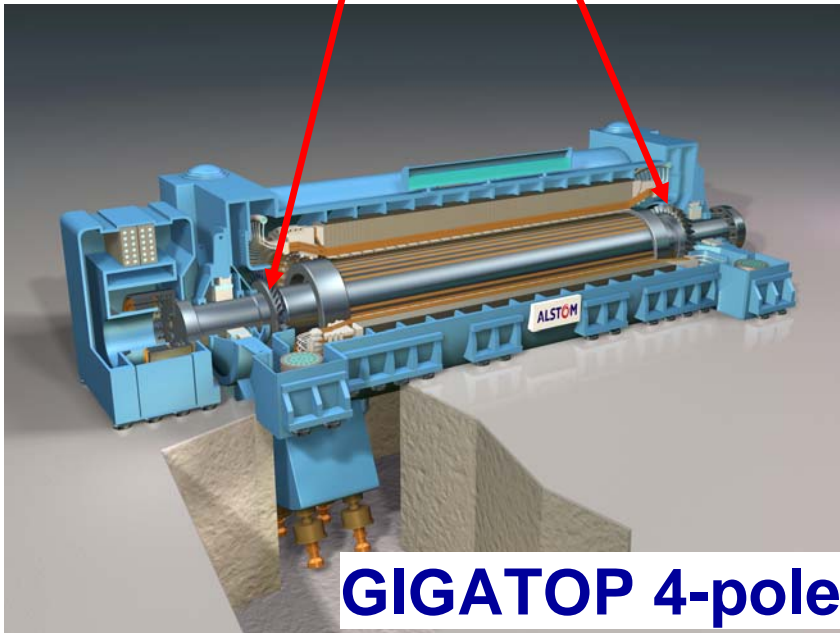
GIGATOP

Single stage fans for highest efficiency



2 high efficient
axial fans

1 high efficient
radial fan



GIGATOP 4-pole

Compact and high performing brushless exciter



Reduced shaft line length



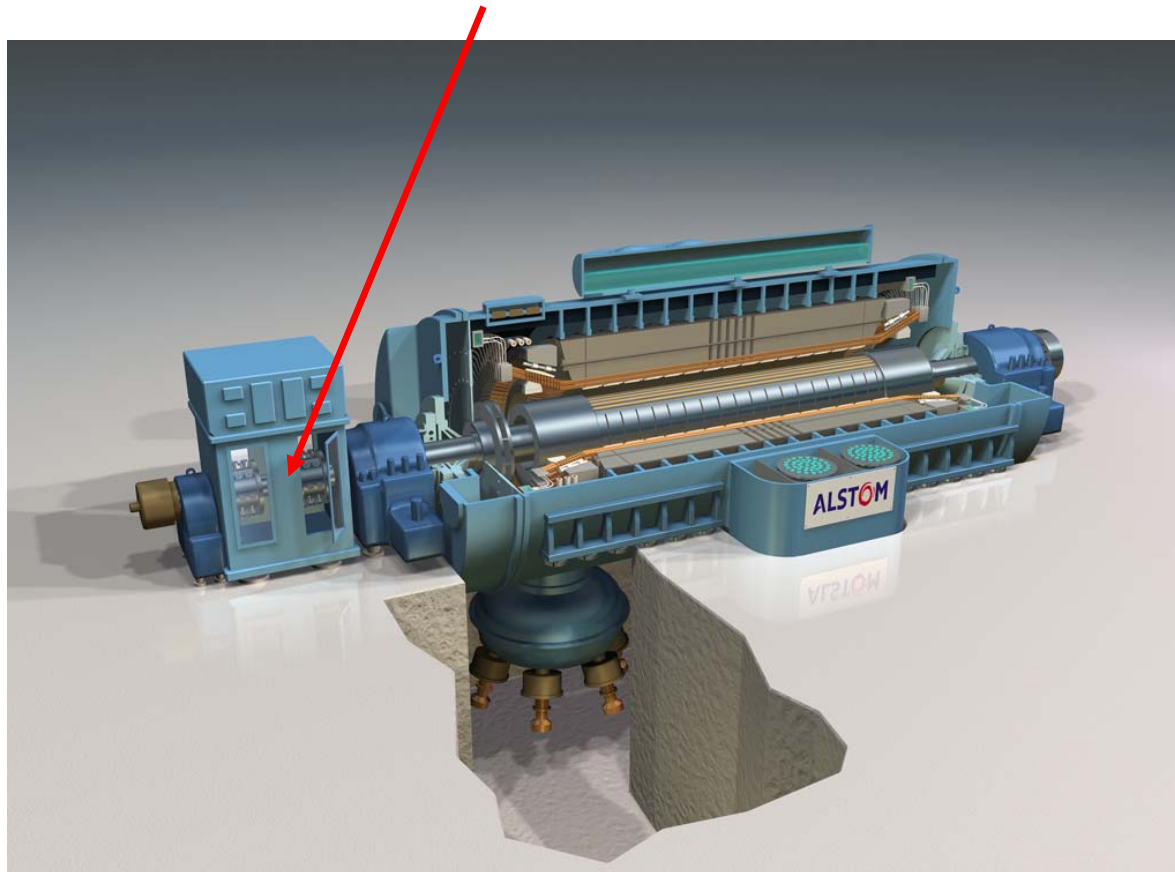
- No slip rings and brush gear
- Excellent dynamic behaviour supporting grid stability
- Extreme compactness
- No need for 3rd bearing

GIGATOP 2-pole

Brush gear designed for ease of maintenance



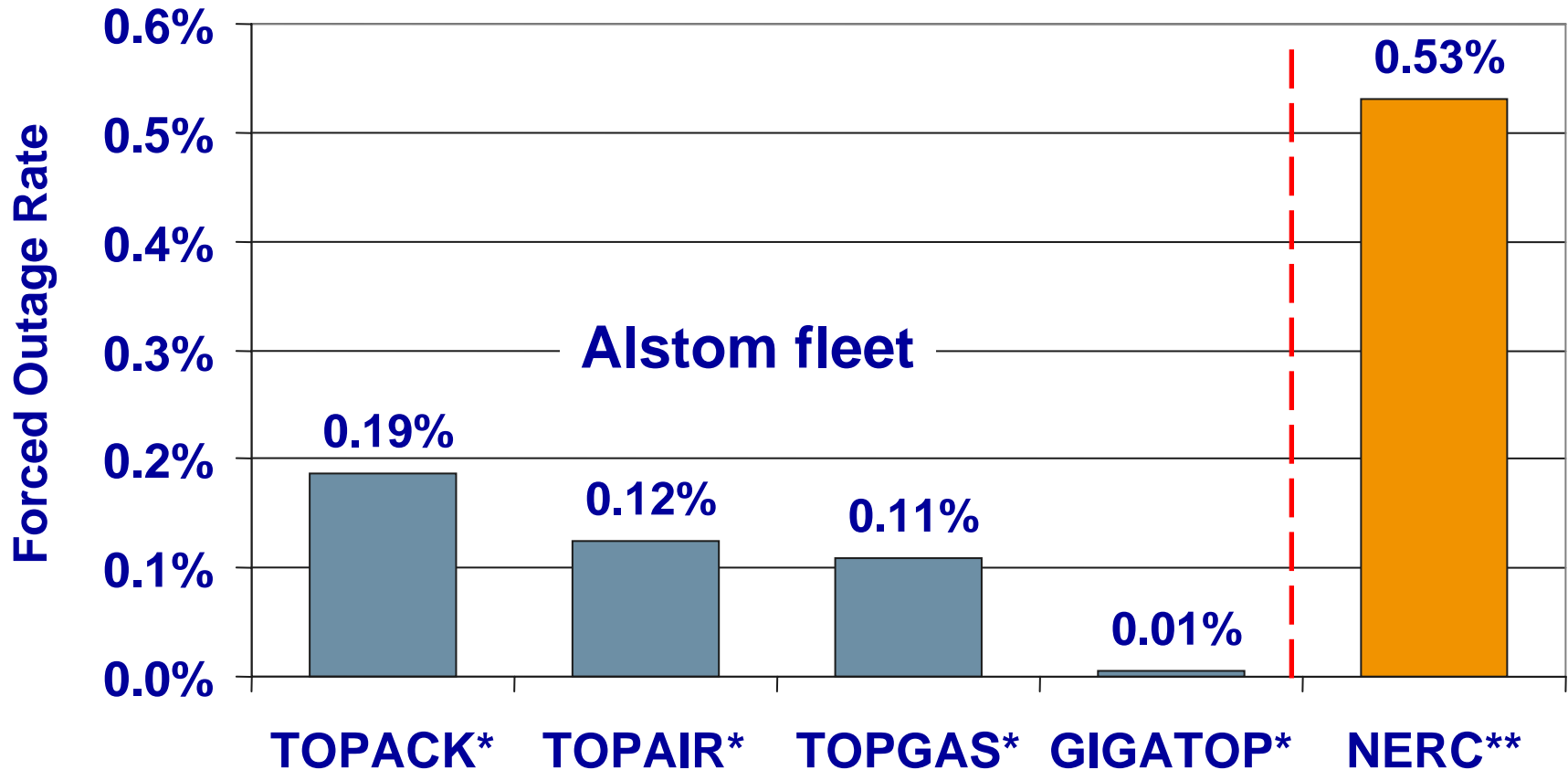
- Air-cooled
- Brushes online exchangeable



- Easy, short and lowest maintenance
- Reliable operation
- Highest efficiency
- Reduced shaft line length
- Unique brushless exciter

Turbogenerators

Reliability



Very high reliability demonstrated

* Alstom data derived from Strategic Power Systems Inc. (1990-2007)

** North American Electric Reliability Council (NERC), Data cover all fossil steam plants (2002)

Turbogenerators

Minimize risk for OEM and customers



- Technology Development Quality Process
- Product Development Quality Process
- Type tests
- Modern design/calculation tools
- Systematic operation feedback analysis



Schnabelcar

- Railway transportation
 - Frame diameter: 4,15 m
 - Stator frame weight: 450 T
- Alternatives
 - Road transportation
 - Stator stacking/assembly on site

- Grid stability influenced by generator pf and scr
- Use of modern digital AVR
- Stiffening grid by reinforcing lines
- Innovation in plant equipment
- Superconducting technology based on 2nd generation HTS

From focus on generator to focus on full system

- Rotor limitations
 - Capability of forging suppliers
 - Material stress limits
 - Rotor dynamics
- Up-rating potentials
 - Cooling system optimization
 - Electrical field strength in HV insulation
 - Higher voltage ratings

Still some room for higher ratings

www.alstom.com

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