

Large Hydro Generators Experience and references

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ALSTOM

- Large low speed machines
- Large high speed machines
- Bulb units
- Special type machines

Structural design with oblique elements

- Circularity, concentricity and stability is guaranteed under any operation
- Reduced forces to the foundation in case of faulty conditions
- Reduced forces on structural design



Designed for reliability and stability

Stator core pressing system

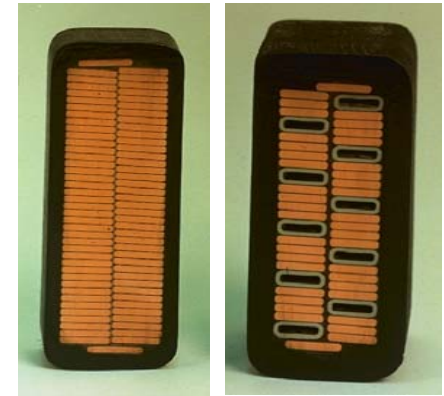
- Complete pre-stress force concentrated in core
- Guaranteed pressing under all circumstances
 - Sufficient elongation length (bolt and spring elements)
 - Settlement of core will be compensated
- Prevent any buckling or loosening of core during whole life time



Designed for reliability and stability

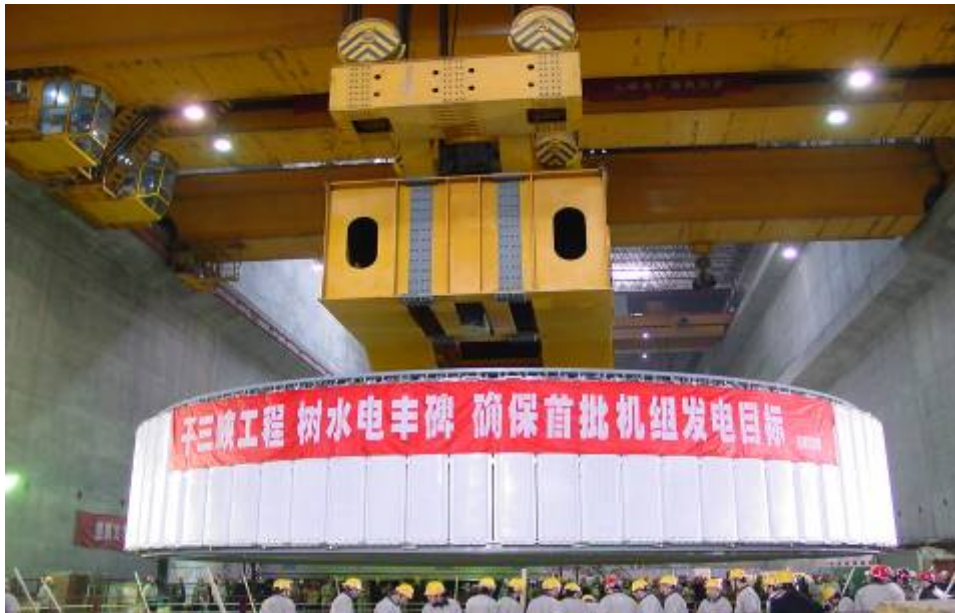
Stator winding technology

- VPI insulation system (Micadur[®])
 - System up to 30 kV
 - High operational reliability proved
- Unique corona protection with tapes
- Bar fixation with ripple springs
 - Permanent electric and mechanic coupling to the core is guaranteed
- Solid support of winding overhang and connections



Designed for reliability and stability

Three Gorges (China)



Rated output: 778 MVA

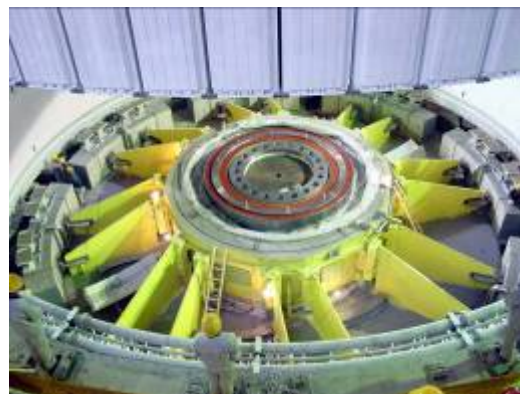
Max. output: 840 MVA

Speed: 75 rpm

Voltage: 20 kV

Frequency: 50 Hz

Current: 22450 A



Development towards air cooled machines

- Longtan
778 MVA, 18 kV, 111 rpm
- Xiaowan
778 MVA, 18 kV, 150 rpm
- XianJaBa
889 MVA, 23 kV, 71.4 rpm



Longtan HPP

Air cooled machines for biggest outputs

- Large low speed machines
- Large high speed machines
- Bulb units
- Special type machines

Requirements for peak load motor generators

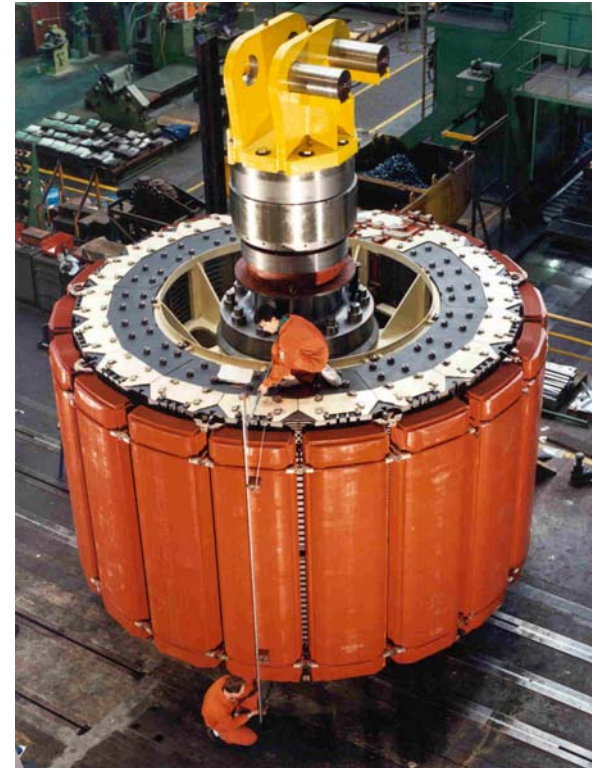
- Load and thermal cycles due to frequent starts and stops
- Bi directional speed for pump and generator mode
- High availability and reliability



Designed for high availability and reliability

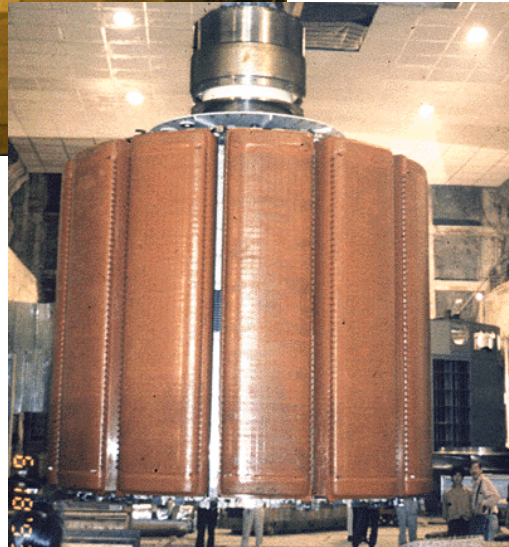
Design features for peak load motor generators

- Structural design with oblique elements
- Stator core pressing system
- Stator winding technology
- Self pumping bearings
- Rim ventilation without electrical fans (self ventilated)



Designed for high availability and reliability

Guangzhou - China



4 Generator Motor
333 MVA, 500 rpm

- Air cooling system for 30 MVA / pole
- In operation since 1997
- Efficiency 98.57%

Current Projects

Huizhou - China



8 x 333 MVA
500 rpm

Baoquan - China



4 x 333 MVA
500 rpm

Bailanhe - China

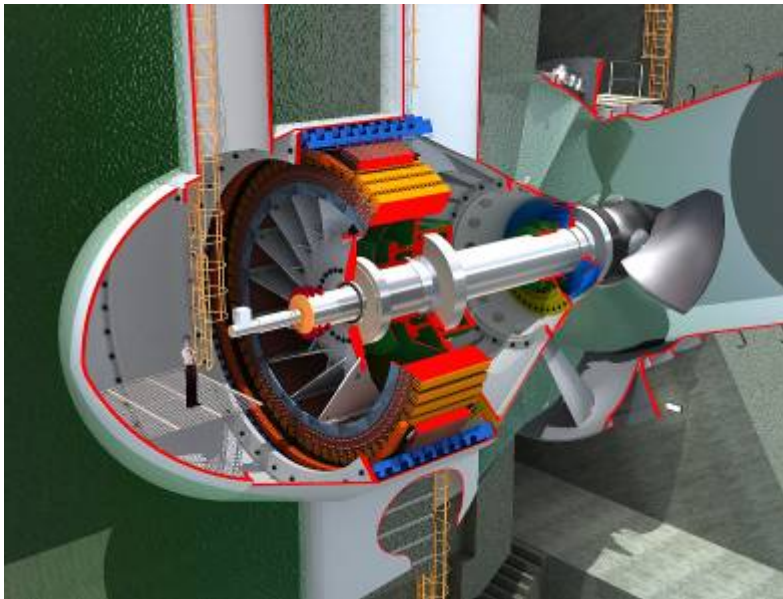


4 x 333 MVA
350 rpm

Largest installed fleet of motor – generators

- Large low speed machines
- Large high speed machines
- Bulb units
- Special type machines

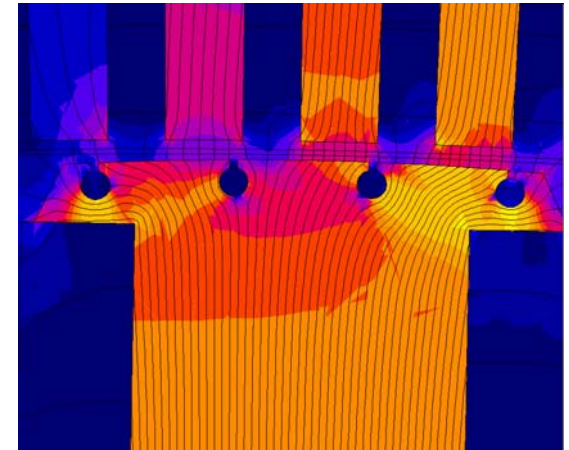
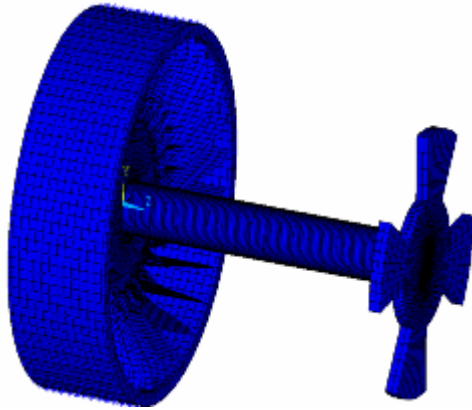
Overall optimization



- Bulb outer diameter
 - Turbine productivity
 - Generator efficiency
 - Cost of generator active parts
 - Cost of the entire structural design of the Bulb unit
- Generator access shaft
 - Hydraulic design
 - Installation of auxiliaries
 - Maintenance
 - Bus ducts, cables

Focus on entire unit is mandatory

Main challenges for Bulb Units



Rotor dynamics

- Bending of shaft line
- Air gap concentricity

Rotor spider

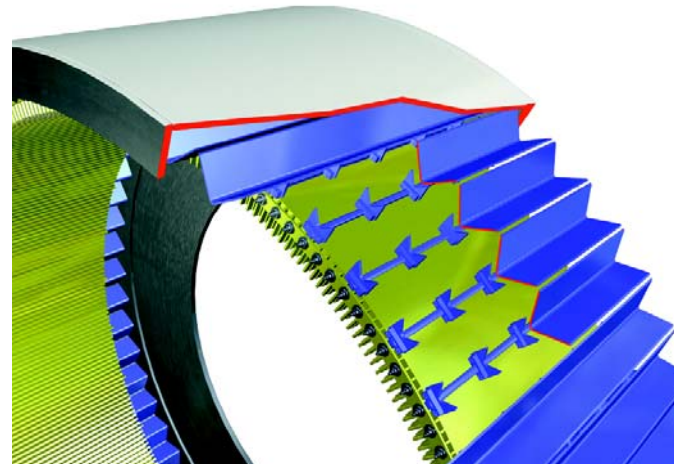
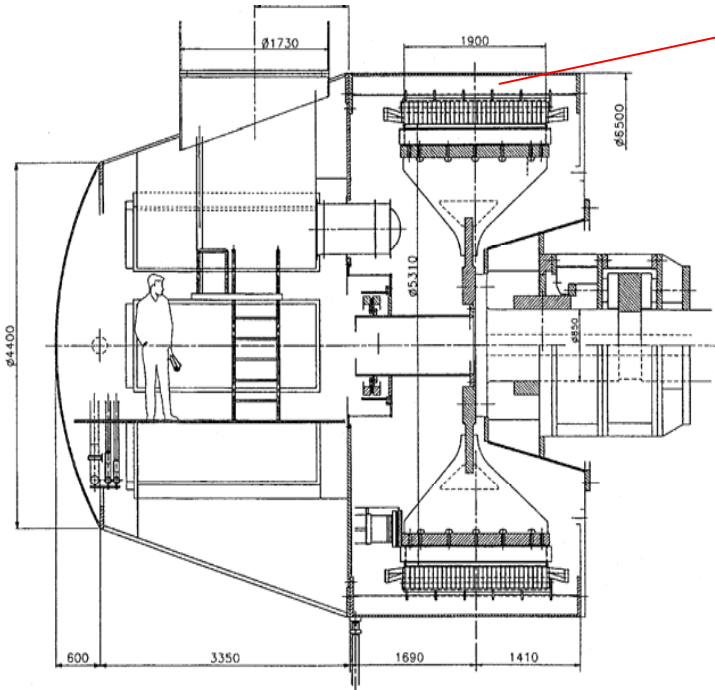
- Cracks in the spider
- Connection between spider arms and rim

Damper winding

- Broken damper bars

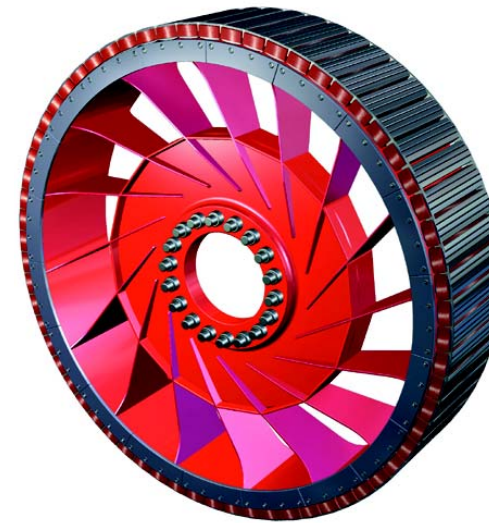
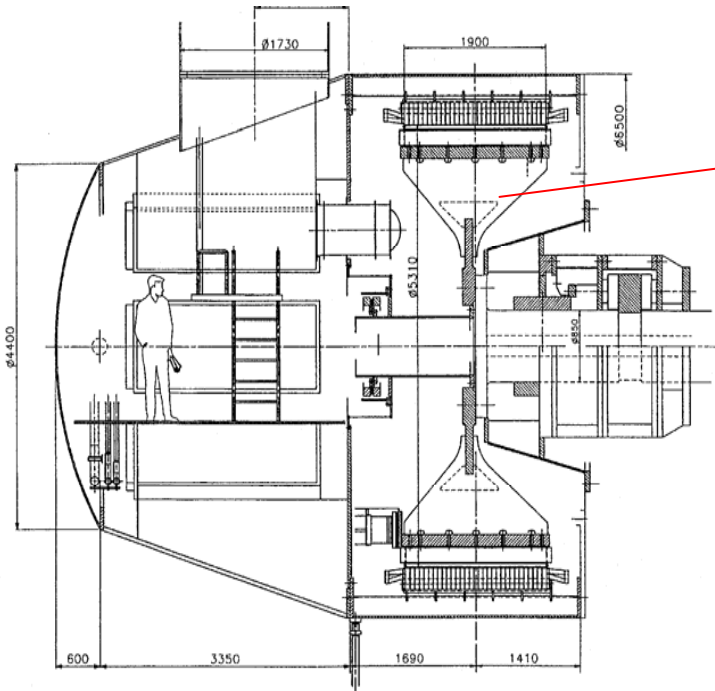
Technical solutions for all critical components

Structural design



- V-elements
 - Stiffness with less radial height
 - Axial cooling between V-elements

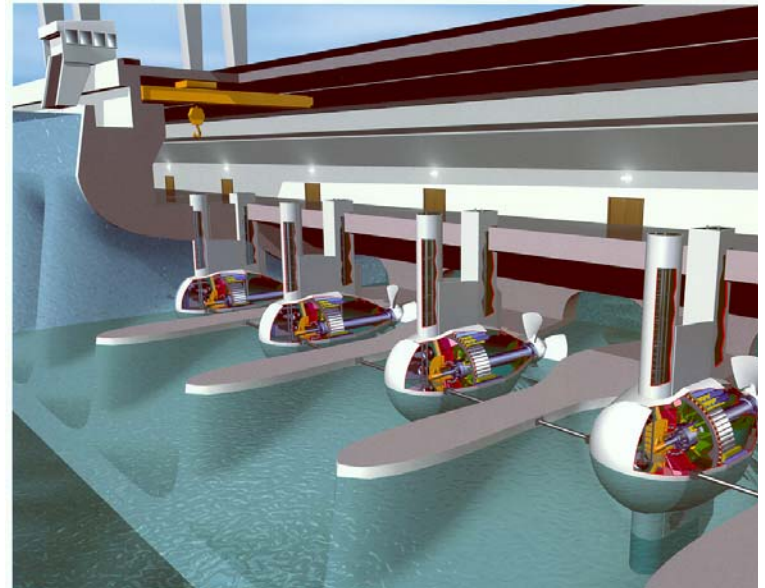
Structural design



- Oblique arms
 - Rigid connection
 - Radial expansion possible
 - Cooling air through spider

Current Projects

- ZGLK 4 x 40 MVA
- ChangZhou 3 x 46 MVA
- TongWan 4 x 47 MVA
- QiaoGong 4 x 62 MVA

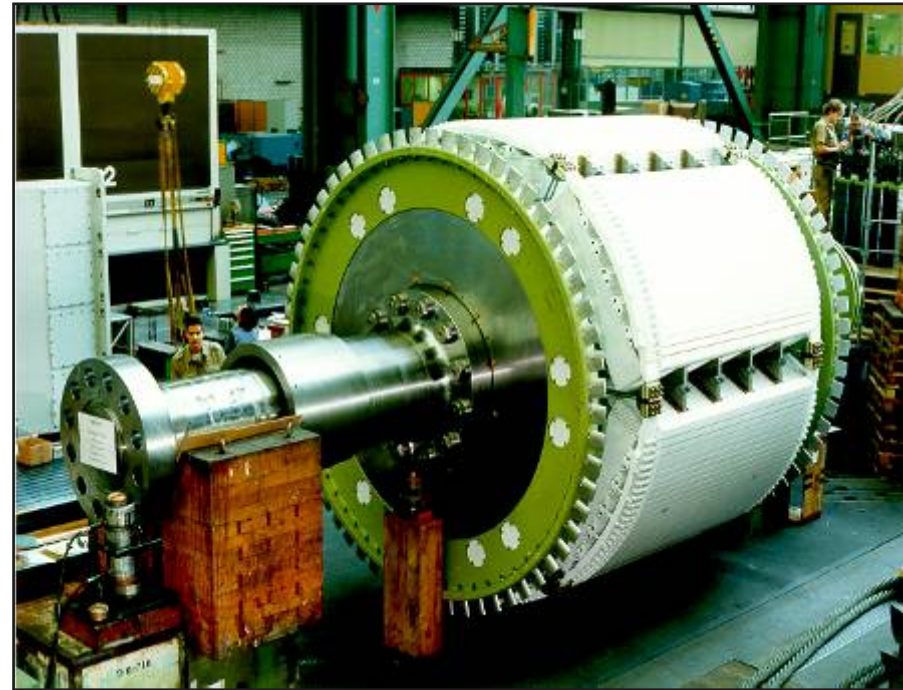


Ensure feedback of experience

- Large low speed machines
- Large high speed machines
- Bulb units
- Special type machines

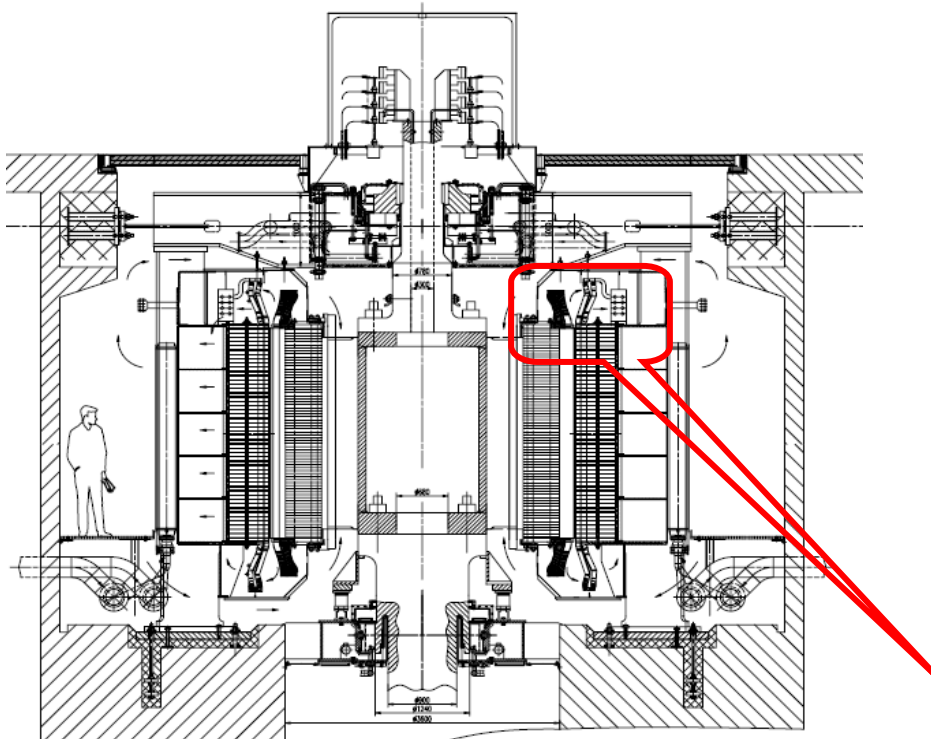
Machines designed for dedicated applications

- Single phase machines for railway power network
- Large rotating converters
- Large variable speed drives
- Pole commutable synchronous machines

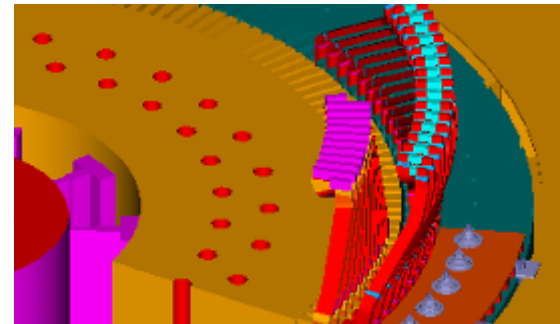


Designed for high availability and reliability

Double fed induction motor - generators



- Variable power in pump mode
- Higher efficiency at partial load
- Increased operation range



Dedicated machines for higher flexibility

Nant de Drance - Switzerland



- 4 x 155 MW Motor - Generators
- 428.6 ± 7 % rpm
- Operation planned for 2015

Dedicated machines for higher flexibility

Linthal 2015 - Switzerland



- 4 x 250 MW Motor - Generators
- 500 ± 6 % rpm
- Operation planned for 2015

Dedicated machines for higher flexibility

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