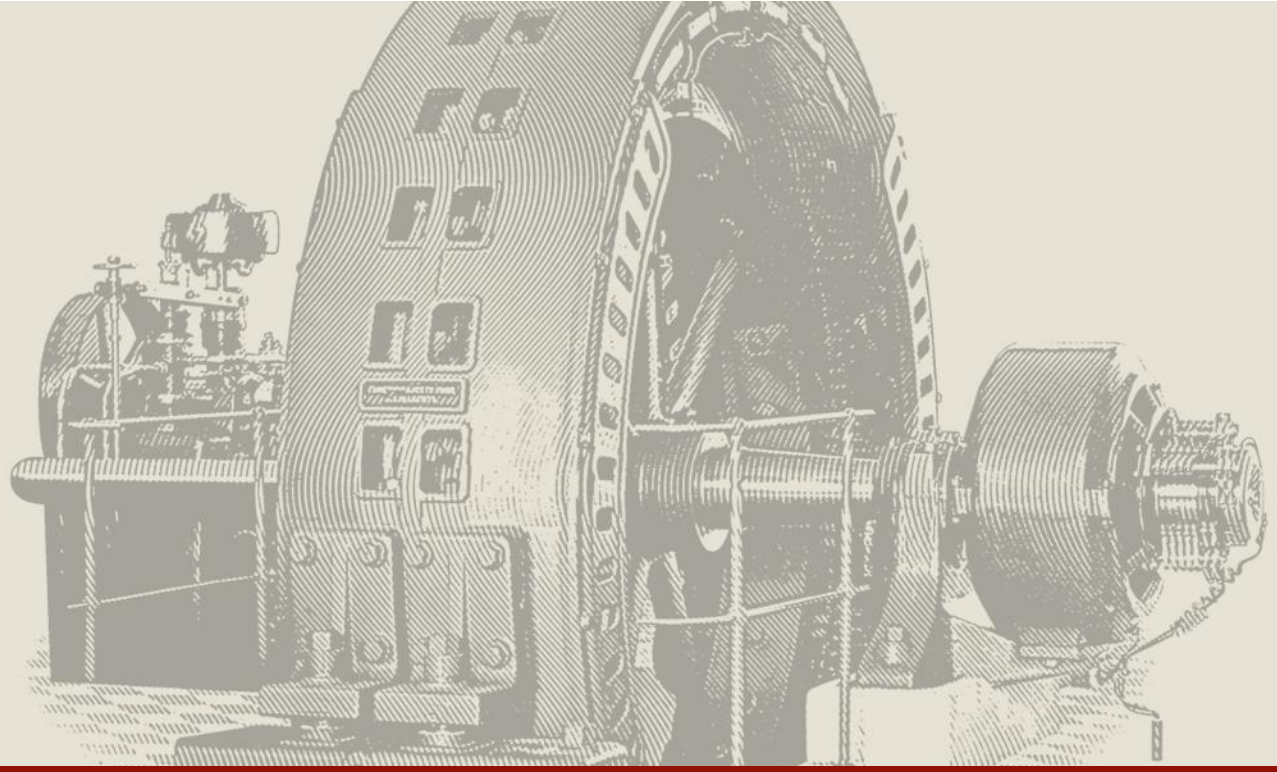


GANZ
ROTATING MACHINES
SINCE 1878

Valuable design and manufacturing of GANZ Rotating Machines Division
Tradition and innovation with 145 years of experience

Bence Flösser (Engineering Manager)

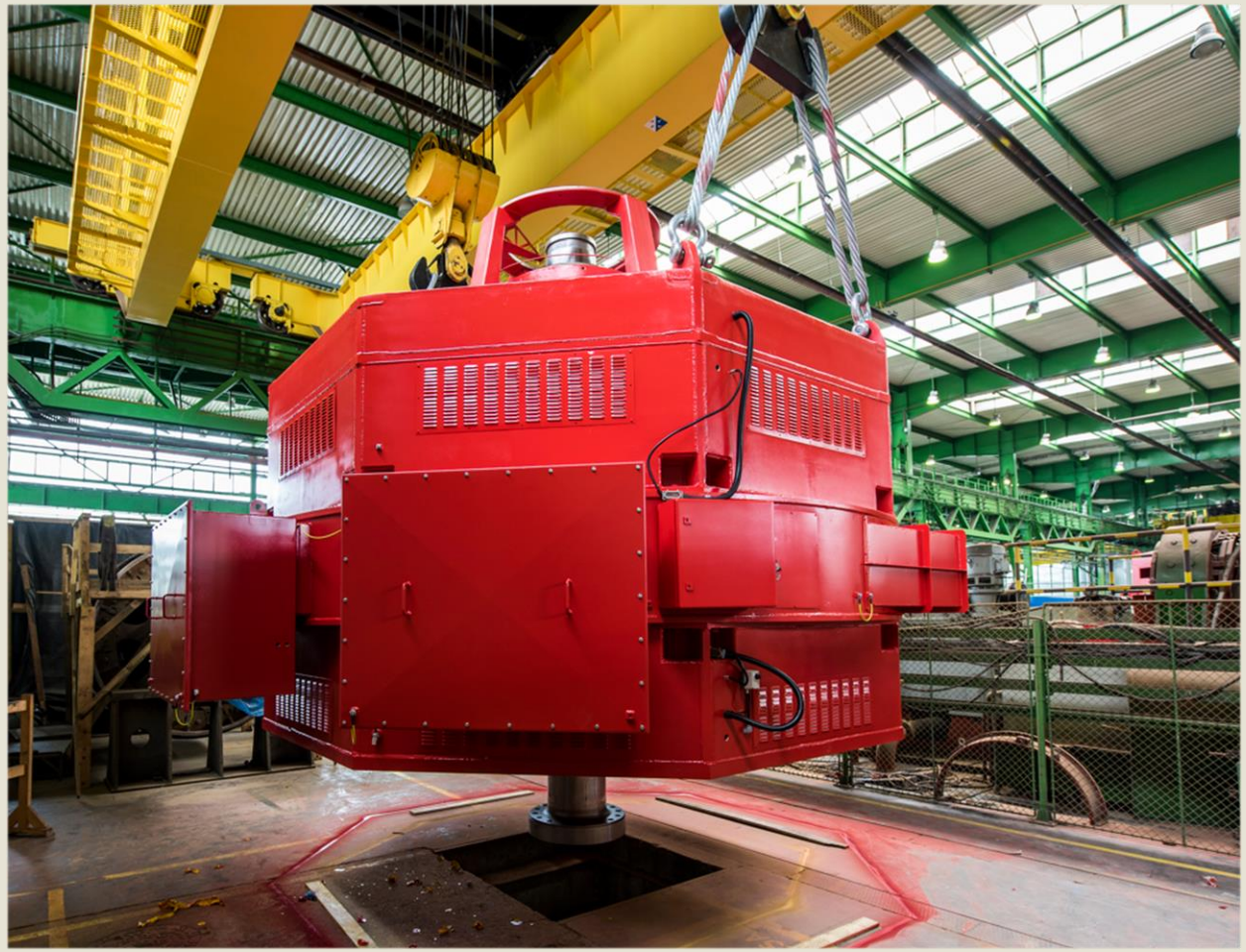
19.03.2024

Today's content

- Brief history of our 145 years old Electrical Department
- Product range
- Engineering team & tools
- GANZ Intelligent Solutions for rotating machines
- Manufacturing
- Testing capability

History of GANZ Electrical Department

PRODUCT RANGE



Product range

Squire cage rotor induction machines

500 kW – 15 000 kW
690 V – 15 kV

Slipring rotor induction machines

500 kW – 15 000 kW
690 V – 15 kV

Industry: oil & gas, cement, mining, steel, nuclear, desalination, irrigation, thermal, recycling

Application: pump, compressor, fan, mill, shredder, conveyor belt etc.

Cylindrical pole synchronous machines

500 kVA – 50 000 kVA
690 V – 15 kV

Salient pole synchronous machines

500 kVA – 40 000 kVA
690 V – 15 kV

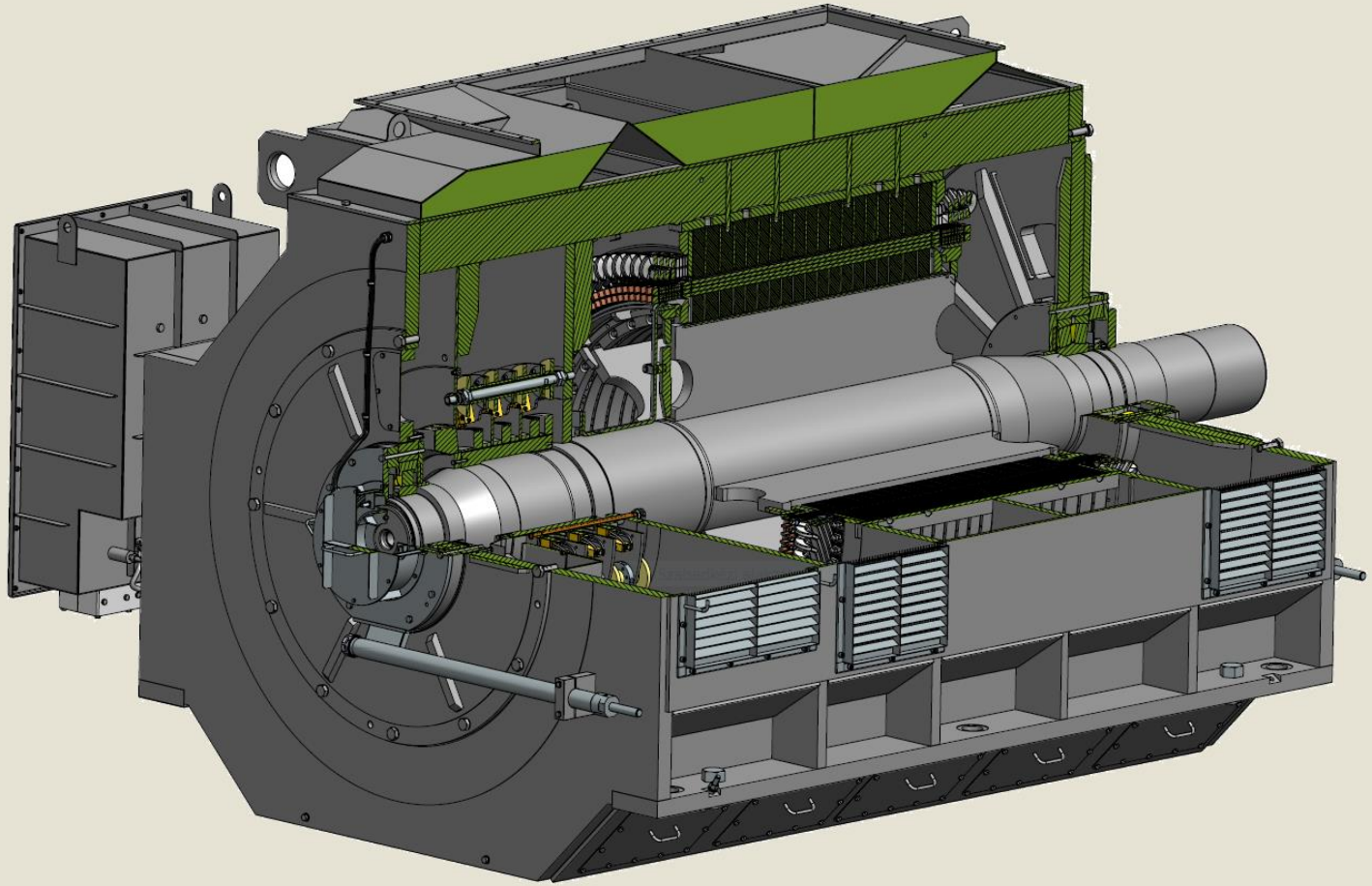
Industry: power generation, special testroom, grid inertia service

Application: hydro turbine, steam turbine, gas turbine, reactive power compensation, short curcuit power supply for testing

Product range

Standard:	IEC 60034, IEC 60079	
IC code:	IC01(6), IC11(6), IC21(6), IC31(6) IC611, IC616, IC666 IC81W7	/open ventilated/ /closed air cooled/ /closed water cooled/
IP code:	up to IP55	
IM code:	B3, B20, B35, V1	
Hazard area:	Ex ‚p' (pressurized enclosure) Ex ‚e' (increased safety)	
Mass:	up to 100 tons	

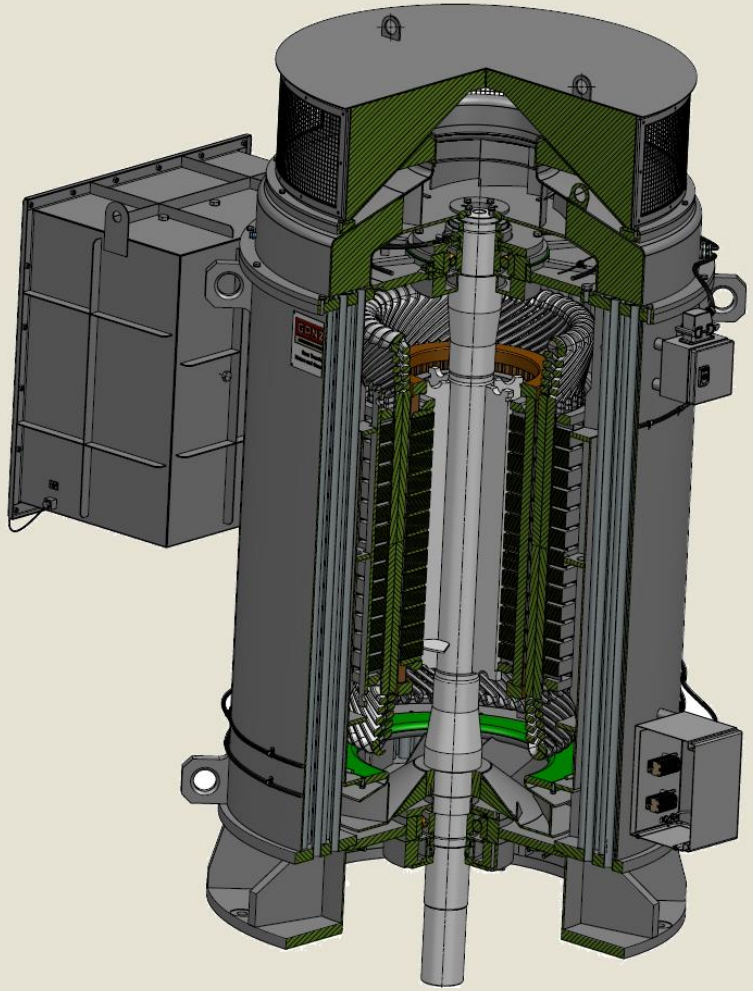
ENGINEERING TEAM & TOOLS



Engineering team & tools

Strenght of our design team:

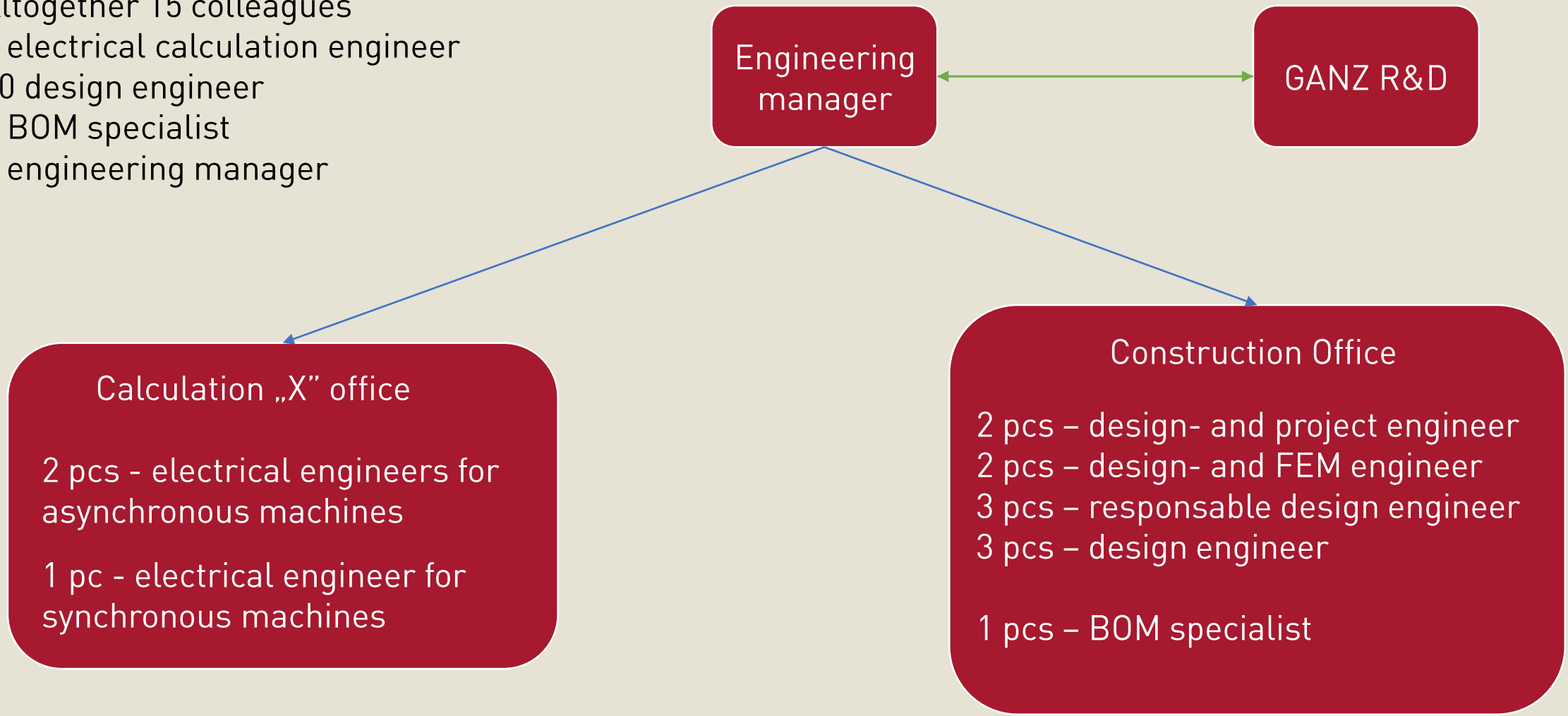
- Flexible design and communication to fulfill customer requirement
- Electrically and mechanically interchangable machines for different applications / reverse engineering
- Wide range of design capability (3 tons up to 100 tons)
- Tradition and experience



Engineering team & tools

HUMAN resources of Ganz RM design team

- Altogether 15 colleagues
- 3 electrical calculation engineer
- 10 design engineer
- 1 BOM specialist
- 1 engineering manager

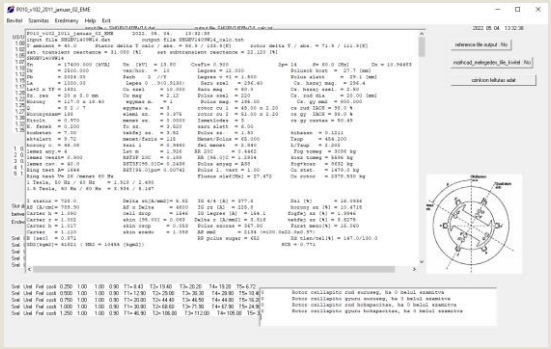


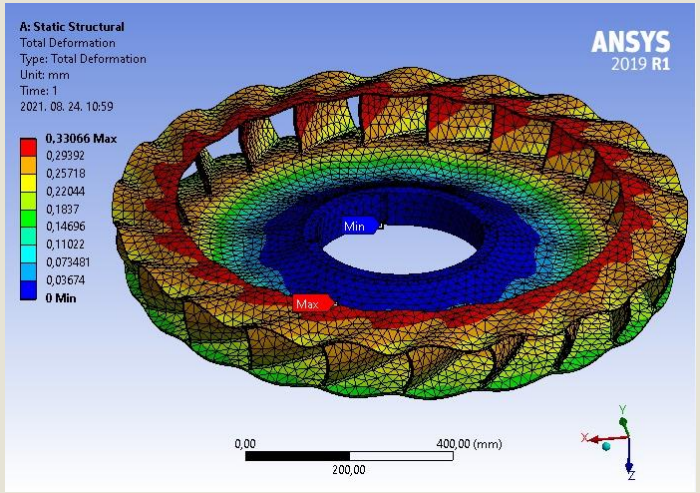
Engineering team & tools

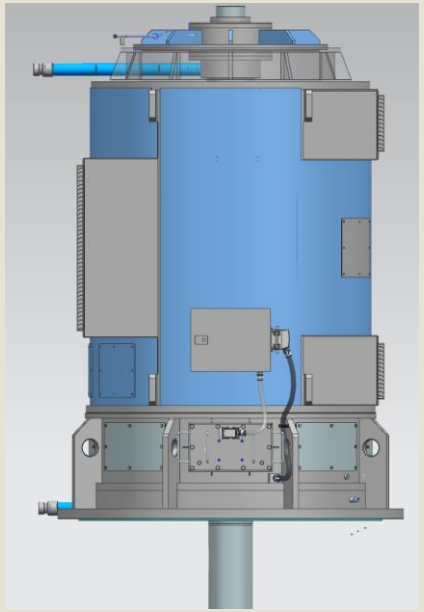
SOFTWARE resource of Ganz RM design team

3 pcs different own developed electo-magnetic calculation software:

- 1 pc for asynchronous machines
- 1 pc for salient pole synchronous machines
- 1 pc for cylindrical synchronous machines







CAD softwares for mechanical design:

- Siemens NX for 3D modeling and design
- AutoCAD for some of the 2D documentation
- KeyCreator (CADkey) for 2D design

Software for FEM calculations:

- MAXWELL 2D for electromagnetic calculations
- ANSYS for structural and airflow calculations (under dev)

Engineering team & tools

FEM calculation:

- critical speed

(hydro, 2-4 pole)

- mechanical stresses

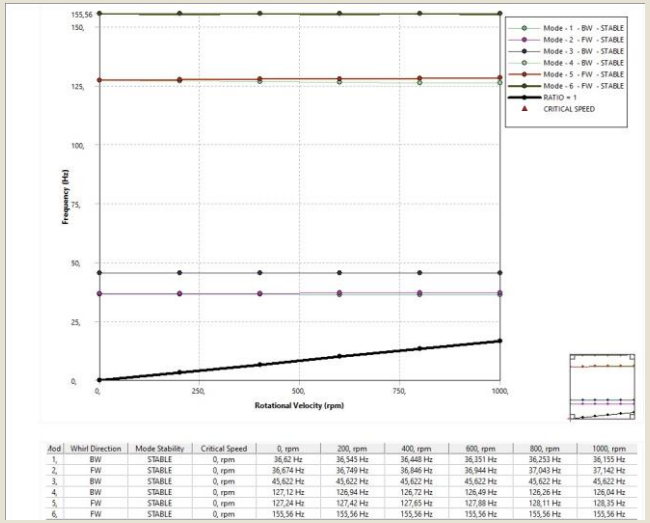
(rotating parts, frame, shield)

- bending & deformation

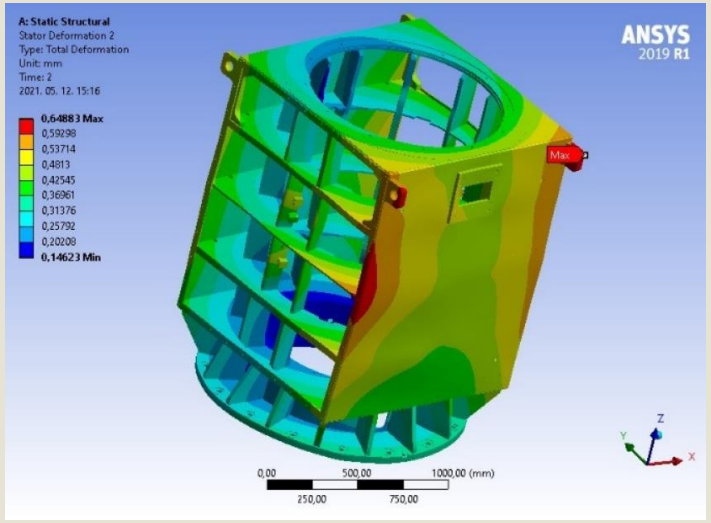
(hydro, 2-4 pole)

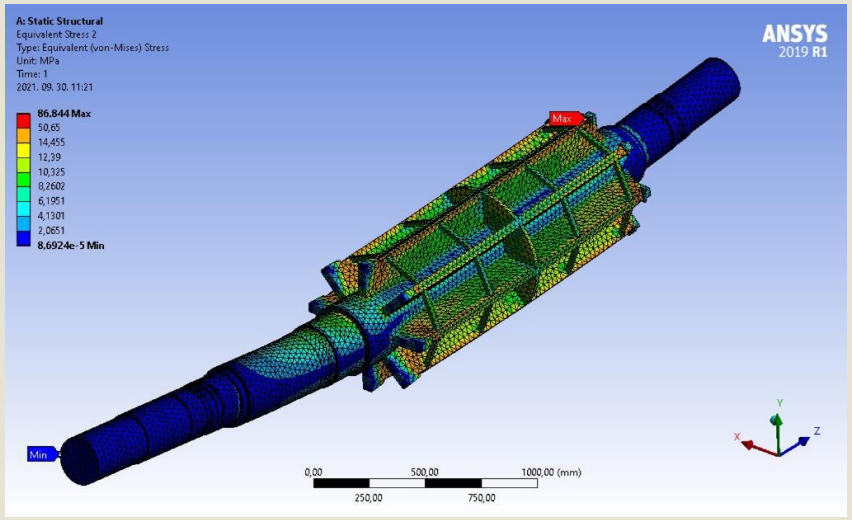
- natural frequencies

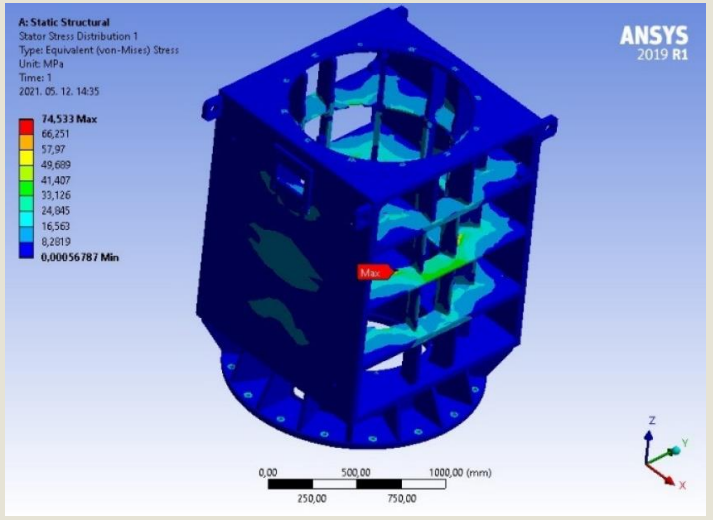
(mainly hydro)



Mod	Whirl Direction	Mode Stability	Critical Speed	0, rpm	200, rpm	400, rpm	600, rpm	800, rpm	1000, rpm
1,	BW	STABLE	0, rpm	36,62 Hz	36,545 Hz	36,448 Hz	36,351 Hz	36,253 Hz	36,155 Hz
2,	FW	STABLE	0, rpm	36,674 Hz	36,749 Hz	36,846 Hz	36,944 Hz	37,043 Hz	37,142 Hz
3,	BW	STABLE	0, rpm	45,622 Hz	45,622 Hz	45,622 Hz	45,622 Hz	45,622 Hz	45,622 Hz
4,	BW	STABLE	0, rpm	127,12 Hz	126,94 Hz	126,72 Hz	126,49 Hz	126,26 Hz	126,04 Hz
5,	FW	STABLE	0, rpm	127,24 Hz	127,42 Hz	127,65 Hz	127,88 Hz	128,11 Hz	128,35 Hz
6,	FW	STABLE	0, rpm	155,56 Hz	155,56 Hz	155,56 Hz	155,56 Hz	155,56 Hz	155,56 Hz

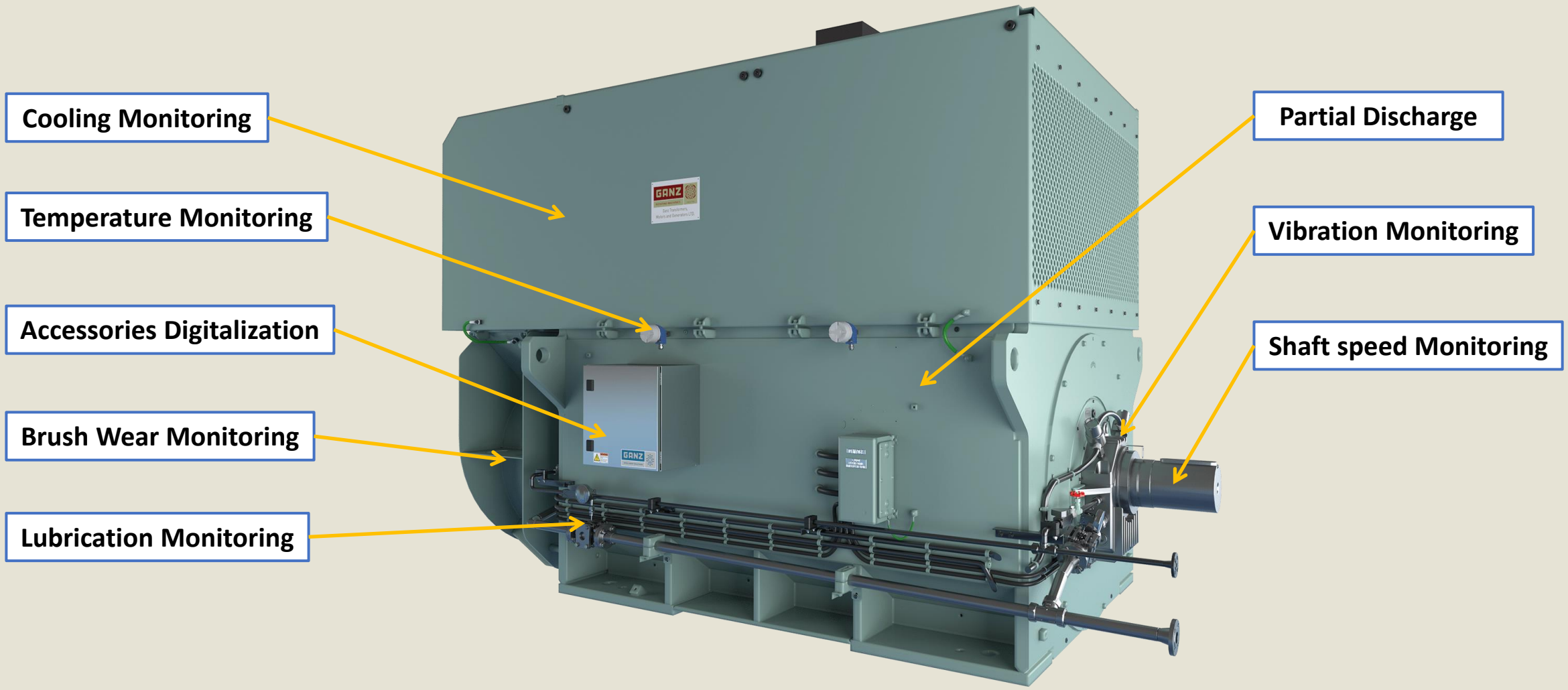






INTELLIGENT SOLUTIONS

GANZ Intelligent Solutions for rotating machines



GANZ Intelligent Solutions for rotating machines

- iReady
  - ✓ Temperature Monitoring (Winding, Bearing)
  - ✓ Vibration
- iStandard
  - ✓ Accessories Digitalization (Filter, Heater, Water Leakage, Brush wear)
  - ✓ Cooling and Lubrication Monitoring
- iAdvanced
  - ✓ Partial Discharge Monitoring
  - ✓ Multi-Parameter configurations

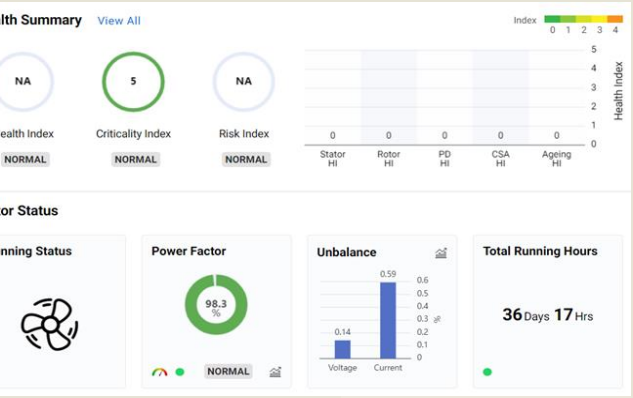
GANZ Intelligent Solutions for rotating machines

TOPOLOGY II. - Data sharing to GANZ Server, with GANZ Expert System

GUI

Data flow

GANZ Server



Communication Protocol

Notes

- Wired data transfer between monitoring system and Operator Control System
- Wired or Wireless data transfer between monitoring system and GANZ Expert System

OPERATOR
SCADA / Control System

Secure Access

GANZ Intelligent Solutions for rotating machines

ADVANTAGE OF ROTATING MACHINE EQUIPPED WITH GANZ INTELLIGENT SOLUTION

- Gives the possibility for predictive maintanence
- Extended warranty
- Additional „eye” on the machine
- Decreased downtime
- Expert report

MANUFACTURING

- Located in Tápiószele, Hungary (90 km from Budapest)
- 100 tons crane capacity
- 12 500 m^2 shopfloor

Manufacturing

OUTSOURCED RAW MATERIALS & PARTS

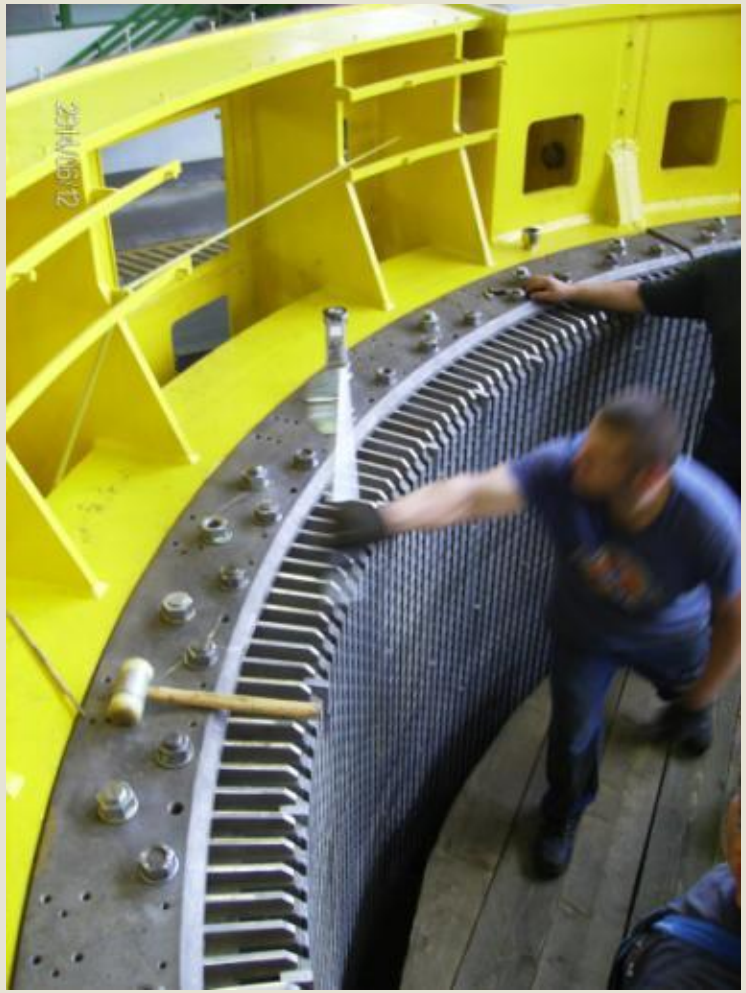
- Dynamo sheet roll
- Insulated & bare copper wires
- Thin & thick sheet welded stuctures
- Insulation materials
- Coolers
- Bearings
- Small machined parts

(most of the suppliers are from EU or Turkey)

IN-HOUSE MANUFACTURING

- Dynamo sheet punching/laser cutting
- Stator & rotor lamination
- Stator & rotor coil production
- Frame, shield, shaft machining
- Stator and rotor winding activity
- Global VPI
- Balancing and assembly
- Testing and painting activity

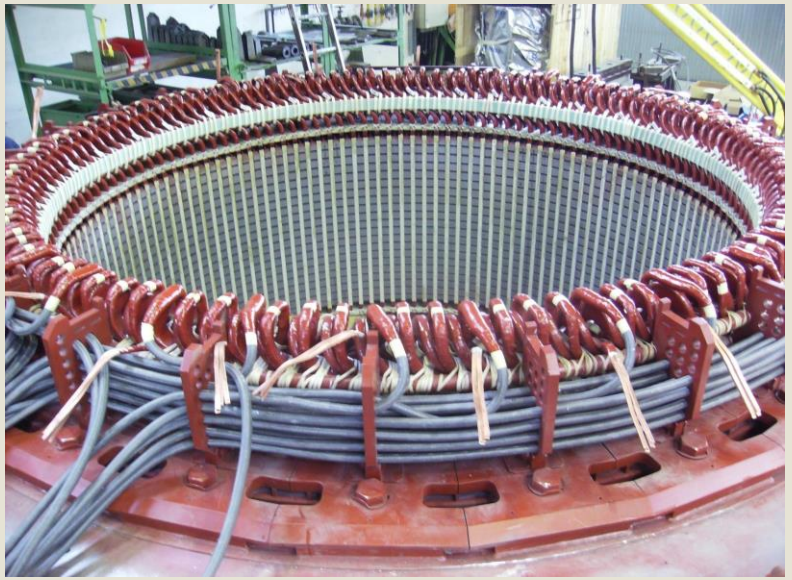
Manufacturing



In house **LAMINATION**

- Punching facility in Szolnok, Hungary (40 km from factory) → laser cutting
- Self-supporting laminated core up to 2250 mm stator outer diameter
- „In frame" lamination over 2250 mm stator outer diameter

Manufacturing



In house **COIL PRODUCTION & WINDIG SHOP**

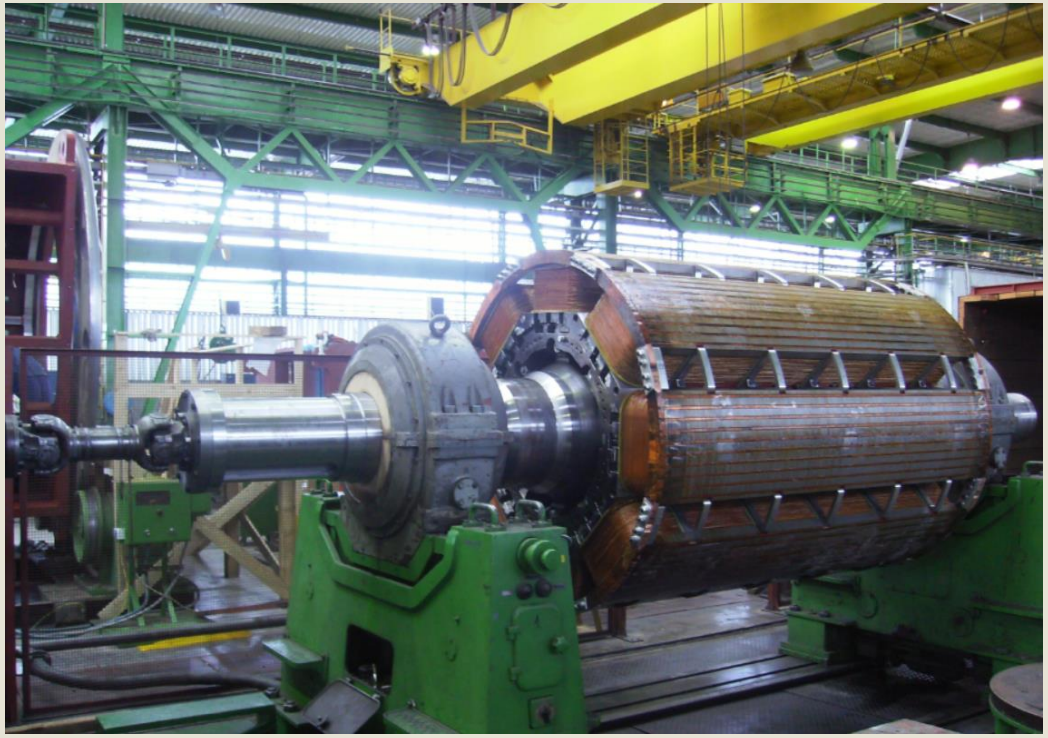
- GANZ Micasystem for Vacuum Pressure Impregnation up to 1800 mm stator diameter
- Individually heat treated coils (Resin Rich) above 1800 mm stator outer diameter
- Insulation system up to 15 kV, class „F" or class „H"

Manufacturing

In house **MACHINING**

- Up to 12 m horizontal lathe
- Up to 4 m diameter & 3 m height vertical lathe
- Horizontal & vertical milling machines

Manufacturing



In house **DYNAMIC BALANCE & ASSEMBLY**

- Dynamic **balancing** capability **up to 50 tons,** max. speed **3600 rpm**

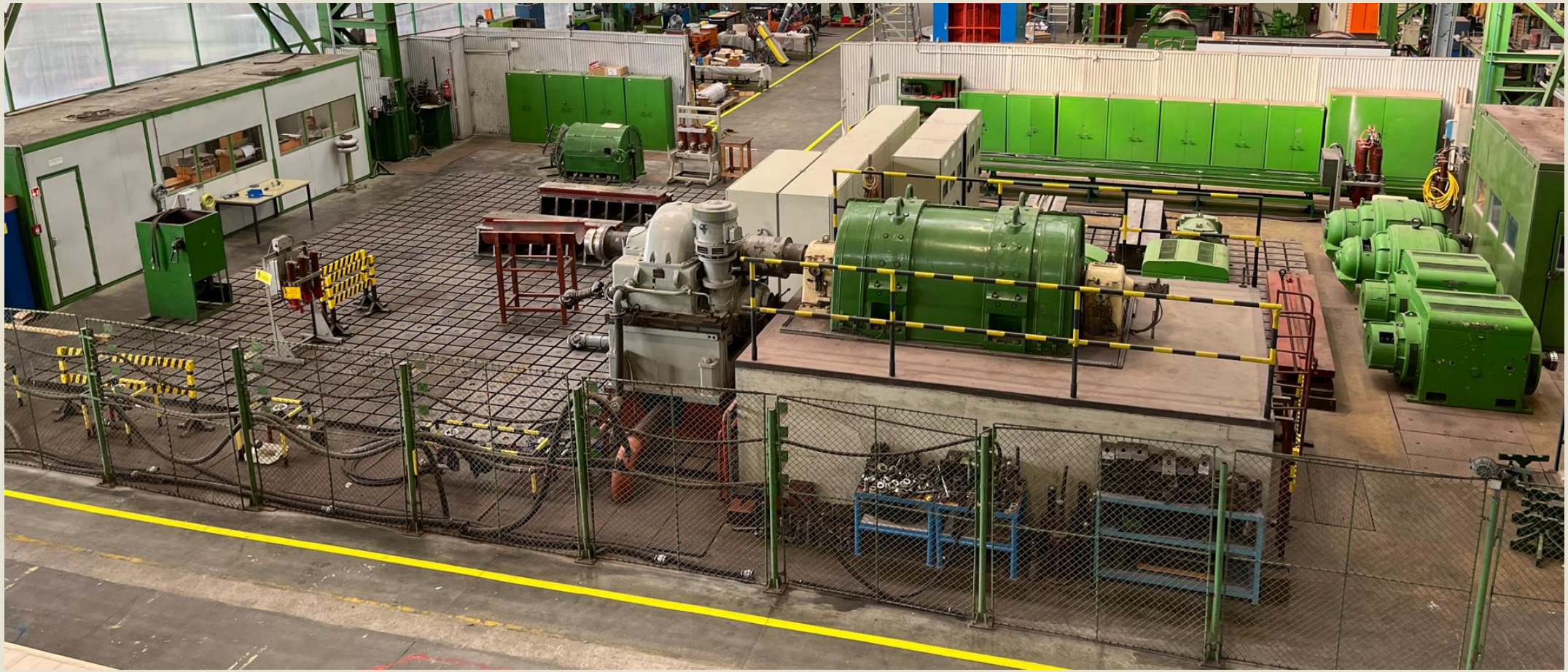
- **Up to 100 tons crane** capacity for assembly

Manufacturing

„RM 2.0": approved 12 mEUR investment for GANZ Rotating machines factory

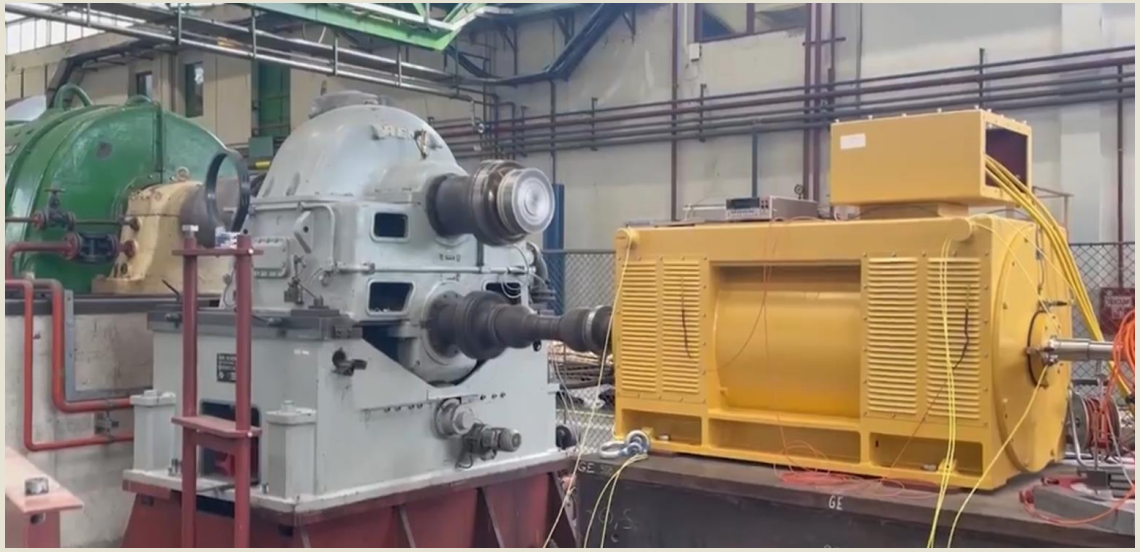
- New laser cutting machine with automatic feeder
- New deburring & coating line for dynamo sheets
- New coil stretching, automatic and manual taping machines
- Upgrade of existing VPI system + extend the capacity
- Software and mechanical upgrade of big vertical, horizontal lathe as well as drilling and milling machines

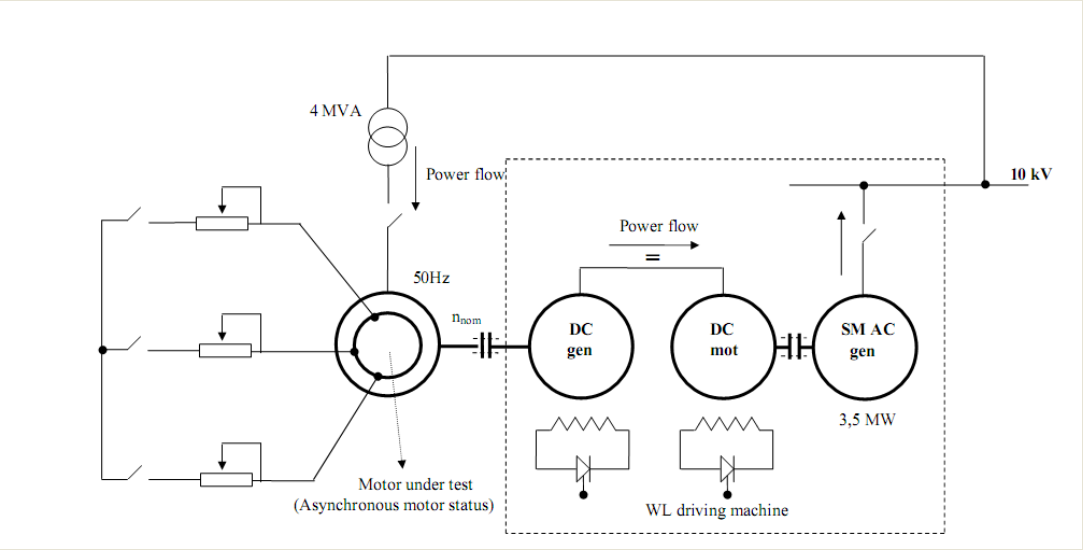
TESTING CAPABILITIES



Horizontal loading possibilities

Testing capability





POLE NUMBER	DIRECT DRIVE 1:1			RATIO 1:3		
	n(1/min)	P(kW)	M (Nm)	n(1/min)	P(kW)	M(Nm)
2p				3000	2600	8300
4p	1500	2600	16600	1500	1750	11200
6p	1000	2600	24800			
8p	750	2600	33100			
10p	600	2080	33100			
12p	500	1750	33100			
14p	428	1480	33100			
16p	375	1300	33100			
18p	333	1150	33100			
20p	300	1040	33100			

Testing capability

Vertical loading possibilities

(braking with slipring induction machine)

		Direct Load Testing (50Hz)			
Pole number	Direct driving			Gearbox (2:1)	
	n[1/min]	P[kW]	M[Nm]	P[kW]	M[Nm]
6p	1000	2000	20000		
8p	750	1500	20000		
10p	600	1000	16000		
12p	500			1000	20000
14p	428,5			900	20000
16p	375			750	20000
18p	333			700	20000
20p	300			630	20000
Max. torque= 20.000 Nm					
Max. speed= 1000 1/min					

Other applied heat run test when direct loading is not possible:

- IEC 60034-29 5.2.2.1: Method of reduced voltage and rated current

$\Delta T = (\Delta T1 - \Delta T2) + \Delta T3 \quad (K)$

(ΔT2: reduced voltage no-load)

- IEC 60034-29 5.2.2.3: Determination of temperature rise by graphical method (reduced voltage and current)

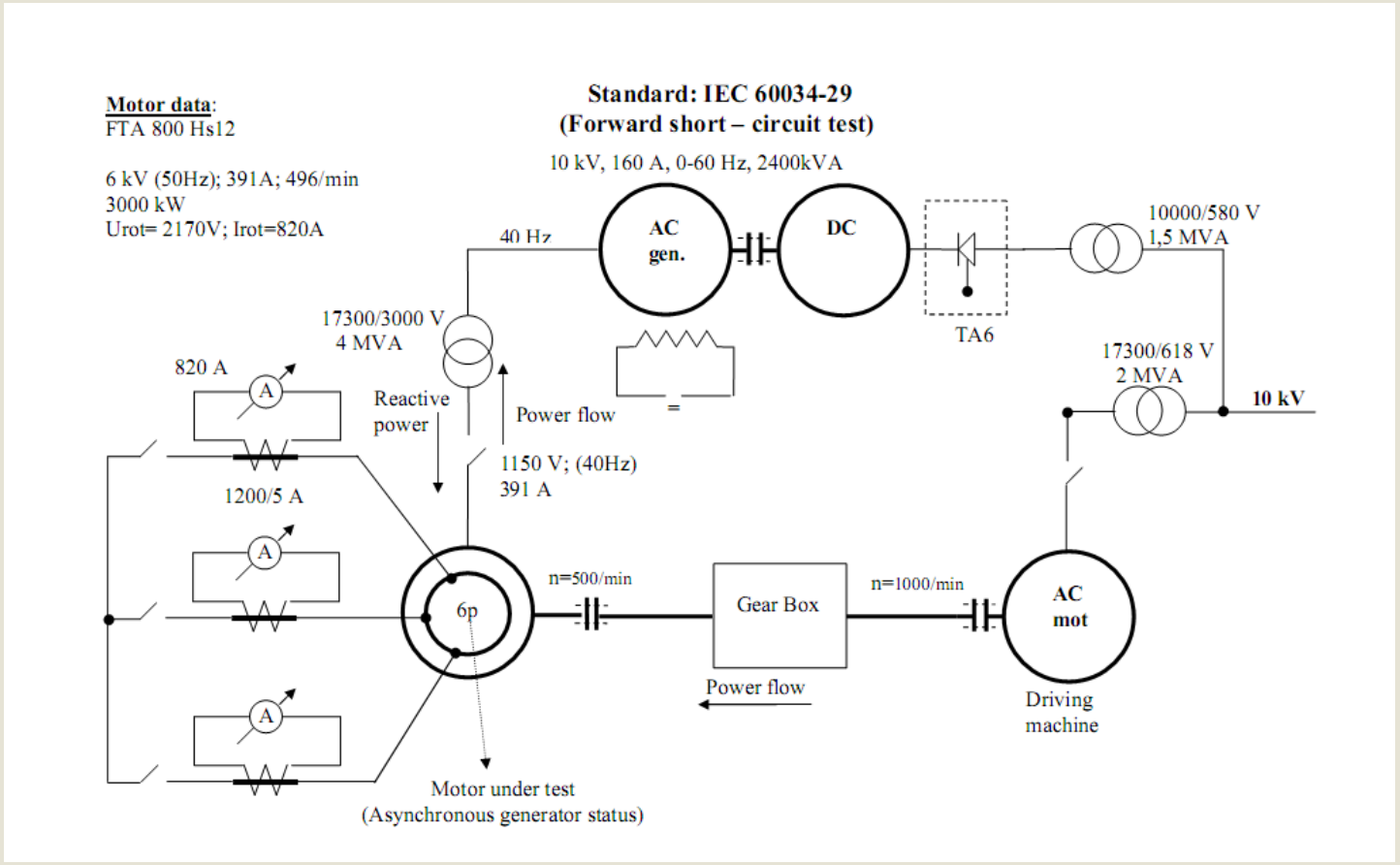
$\Delta T = ((\Delta T1 - \Delta T2) * (In/Ir)^2)) + \Delta T3 \ (K)$

(ΔT1: reduced current/voltage
ΔT2: reduced voltage no load)

- IEC 60034-29 6.2.1: Forward short circuit test (especially for 60 Hz machines)

$\Delta T = \Delta T1 - \Delta T2 + \Delta T3 \ (K)$

(ΔT1: reduced voltage, nominal current
ΔT2: reduced voltage no load)



Testing capability

Routine test list for induction machines:

- Ohmic resistance in cold state
- Sense of rotation, phase sequence and voltage ration
- **No load** characteristic curve and losses
- **Short circuit** characteristic curve and losses
- Vibration measurement
- Bearing temperature measurement
- High voltage test
- Bearing current and shaft voltage test
- Accessories checking

Type test list of induction machines:

- Retardation test, determination of inertia moment
- **Temperature rise test**
- Determination of load characteristic
- Current overloading (if possible)
- Measurement of breakdown torque
- Determination starting torque and speed-torque curve
- Determination starting current
- **Efficiency calculation**
- **Noise measurement**
- Starting trials
- Air quantity measurement
- Capacity and loss factor measuerement

Testing capability

Routine test list for synchronous machines:

- Stator resistance (each phase separately)
- Rotor resistance
- Vibration measurement at rated speed in unexcited condition
- Sense of rotation (phase sequence)
- Vibration measurement at rated speed in no-load condition
- Check line voltage symmetry
- **Record of no-load characteristic**
- Measurement of shaft voltage
- Vibration measurement at rated speed in short circuit condition
- Check of current symmetry
- **Record of short circuit characteristic**
- **Overspeed test**
- Measurement of stator insulation resistance before and after high voltage test
- Determination of polarization index of stator winding
- Measurement of rotor insulation resistance before and after high voltage test
- High voltage test of stator (test of dielectric strength)
- High voltage test of rotor and exciter rotor and rectifier bridge ofthe exciter

Type test list of synchronous machines:

- **Temperature rise measurement in unexcited condition (ΔT2)**
- Temperature measurement of bearings in unexcited condition
- Noise level measurement in unexcited condition
- **Temperature rise measurement in no-load condition (ΔT1)**
- Temperature measurement of bearings in no-load condition
- Noise level measurement in no-load condition
- Determination of line voltage wave form deviation
- Determination of line voltage total harmonic distorsion factor (THD)
- **Temperature rise measurement in short circuit condition (ΔT3)**
- Temperature measurement of bearings in short circuit condition
- Noise level measurement in short circuit condition
- Negative and zero sequence impedance
- Temperature measurement of bearings during overspeed test
- Determination of moment of inertia
- **Sudden three-phase short circuit test at 20%, 35% and 50% of rated voltage**
- **Determination of efficiency**
- Calculation of synchronous reactance and short circuit ratio
- **Determination of temperature rise based on temperature measurements (ΔT1-ΔT2+ΔT3)**
- Measurement of stator power loss factor and capacity – optional
- Measurement of stator partial discharge - optional

THANK YOU FOR YOUR ATTENTION!