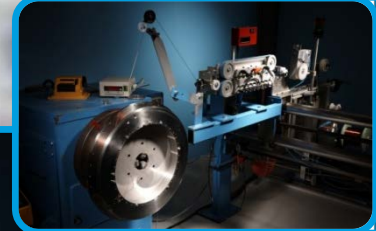
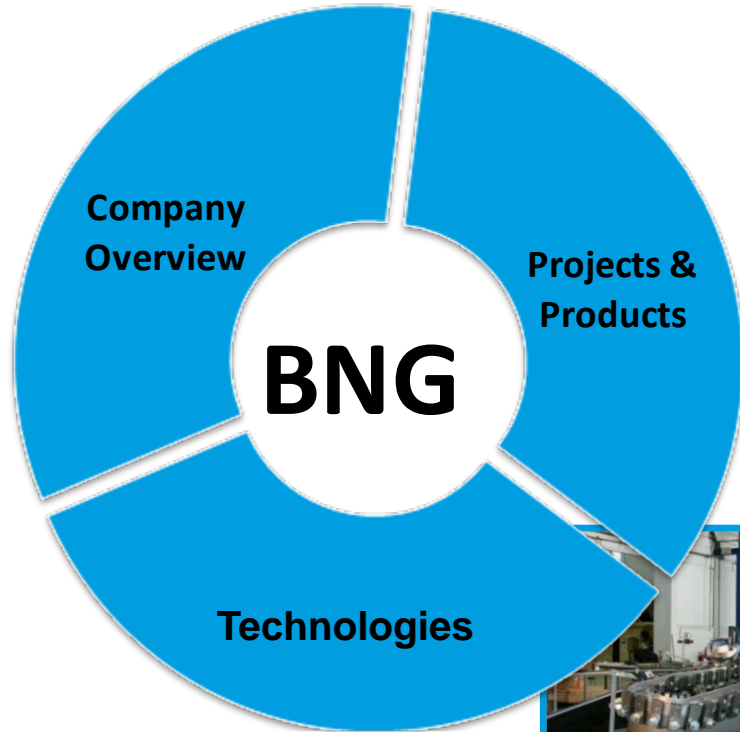


BNG – Babcock Noell GmbH, Magnet Technology

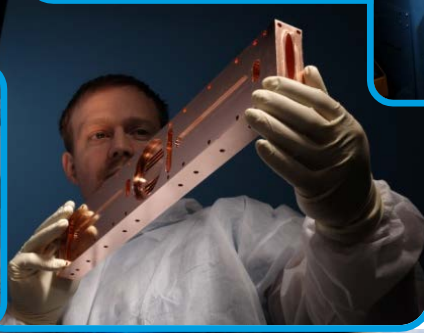
Dipl.-Phys. Michael Gehring,
3rd ASPERA Technology Forum, Darmstadt, 13/14.03.2012



Babcock Noell GmbH



Contact us!



Babcock Noell: Member of Bilfinger Berger SE



Bilfinger Berger SE

Industrial Services

Power Services

Building and Facility Services

Construction

Concessions

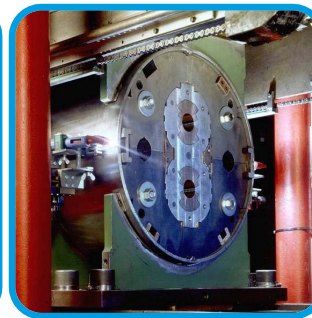
Babcock Noell GmbH



Nuclear Services



Nuclear Technologies



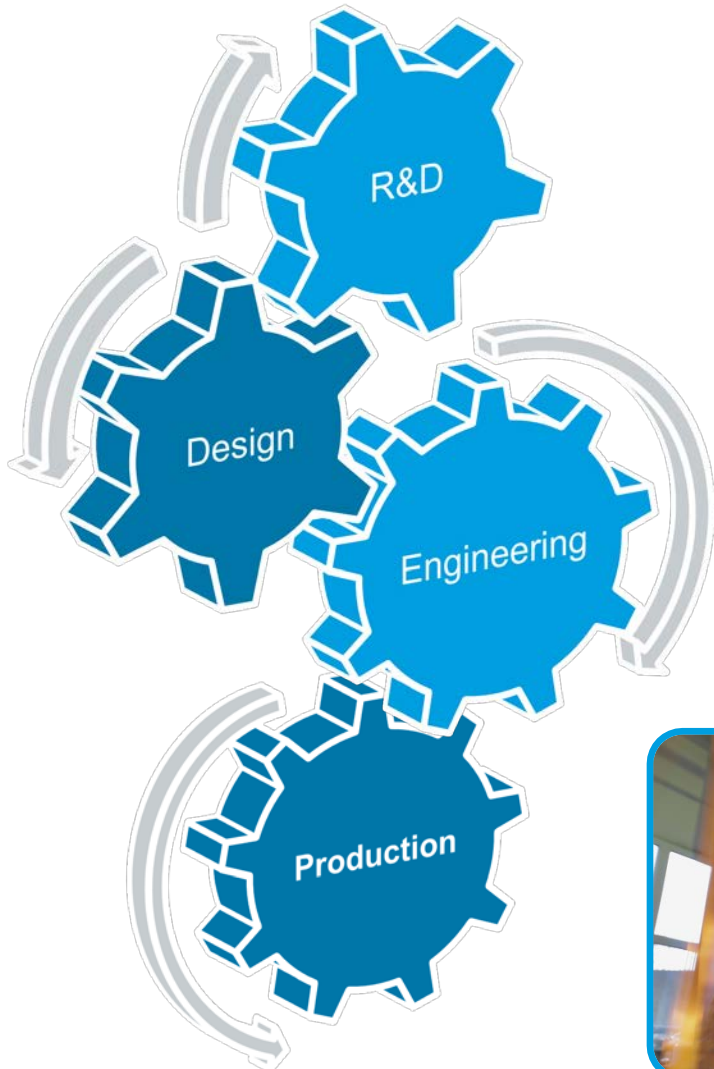
Magnet Technologies



Environmental Technologies



We are Magnet Technology



- Physicists, Engineers and Technicians work hand-in hand
- More than 30 years magnet technology experience
- Cooperation with research institutions



**Other promise the future –
We work on it!!**



Components: COLDDIAG



Flexible engineering design →
Installation in different synchrotron
light sources

UHV: $\sim 5 * 10^{-10}$ mbar in the cold

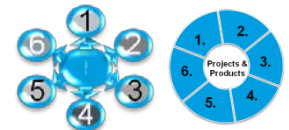


Cold vacuum chamber for diagnostics
Measuring of the beam heat load to a cold bore

Retarding field analysers

Temperature sensors

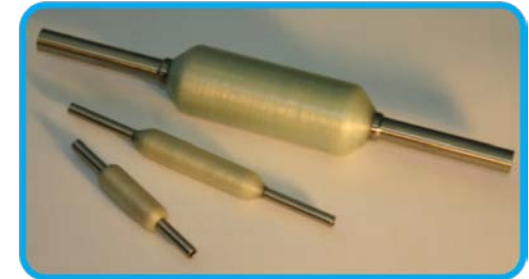
Pressure gauges & mass spectrometers



Components: Potential Breaks



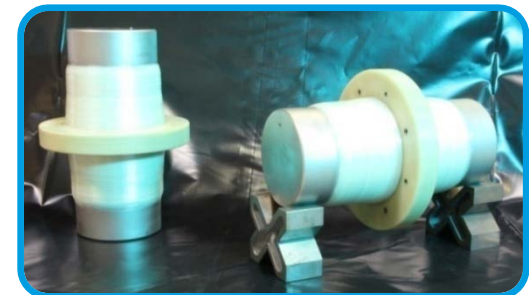
**10⁻⁹ mbar l/ s at RT Helium leakage rate
Up to 35 kV operating voltage**



**Electrical separation of high pressure cooling channels for liquid He
Good HV-capability, outstanding pressure tightness for He even after numerous thermal cycles**



Operating temperature	4.2 K
Operating pressure	up to 25 bar
Maximum pressure	200 bar
Cool down rate	30 K/h



FAIR, ITER, ITER-TFMC, Nb₃Sn- Dipole, W7-X

Functional Systems: Superconducting Undulators, SCU15 NbTi



Flexible Beam Pipe ~ $5 * 10^{-10}$ mbar

Cryogen free system, end field correction, local shimming, integral field compensation

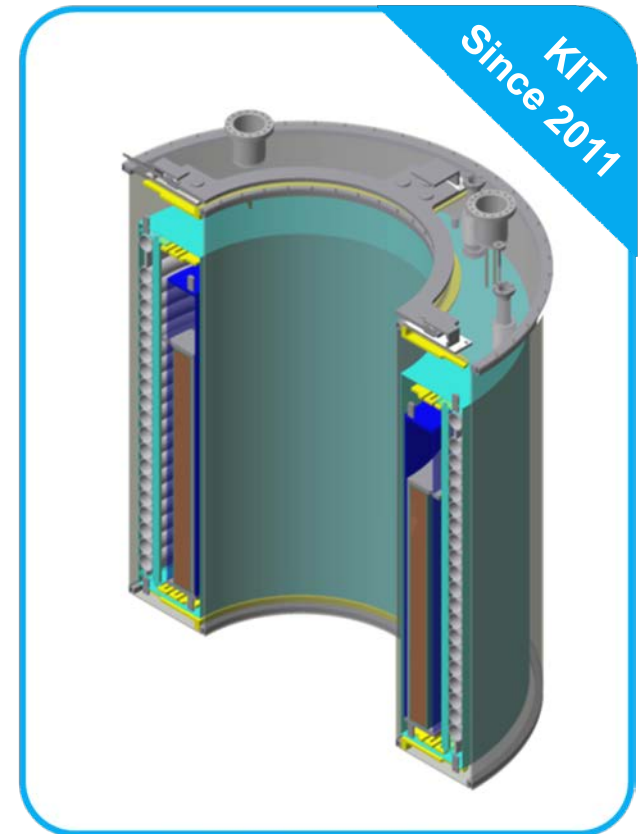
Conductor (insulated)	NbTi, 0.34 x 0.54 mm
Period length	15 mm
Active length	1,500 mm
Dimensions of gap	5 mm to 8 mm
Magnetic field	1.5 T on axis with 5 mm gap
Design beam heat load	4 W
Insulation vacuum	10^{-5} mbar
Numbers of cryocoolers	4
Operating temperature	4.2 K



Functional Systems: VATESTA

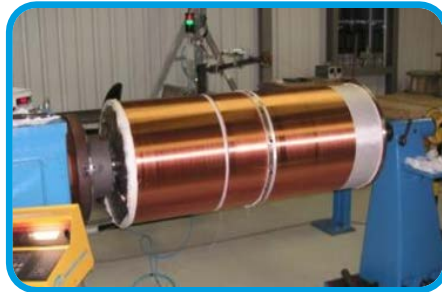
Bath cooled solenoid

Diameter bore	800 mm
Conductor	NbTi
Central magnetic field	5 T
Field homogeneity	4.78% by radial <200 mm, axial <100mm from the central axis
Operating current	< 175 A
Operating temperature	4.5 K



Functional Systems: Solenoids for Spin-Echo Spectrometer (NSE)

Active shielding
Coil position accurate to 2 μm



2 superconducting solenoid systems for the Spin-Echo Spectrometer, Spallation Neutron Source, USA

Conductor	NbTi, \varnothing 0,5 mm ²
Magnetic field	1.4 T
Operating temperature	4 K cryogen-free
Operating current	250 A

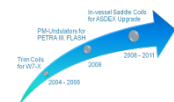
Small series: In-vessel saddle coils for ASDEX Upgrade



3D shaped coils
UHV specified: 10^{-9} mbar
UHV measured: $\sim 5 \cdot 10^{-10}$ mbar



Conductor	Hollow copper (9 mm x 9 mm)
Dimension	1,300 mm x 450 mm
Operating current	1,000 A AC, DC
Magnetic field	3.9 T



Large Projects: SIS 100 Dipols for the FAIR Project



Fast ramping → 4 T/s

113 fast ramped magnets with a superferric design

Conductor	NbTi
Length	~ 3 m
Magnetic Field	1.9 T



Large Scale Projects: Wendelstein 7-X



50 non-planar coils



NbTi, extruded conduit, 17.6 A

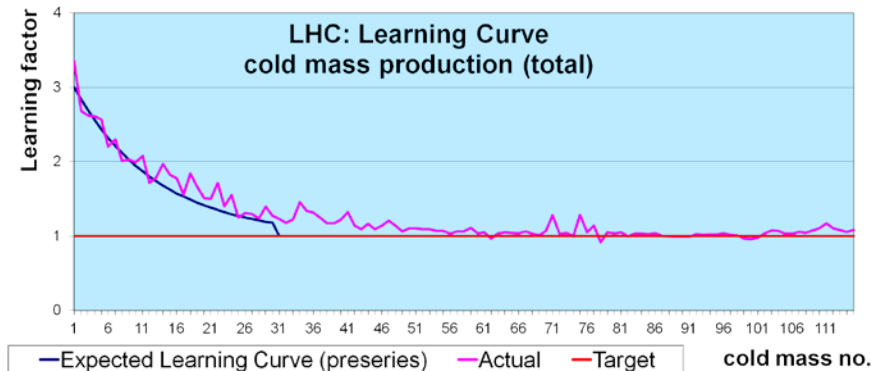
Dimension	3 m x 2.5 m x 1 m
Total weight	6, 000 kg
Magnetic field	6 T

Large Scale Projects: Dipoles for Large Hadron Collider



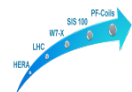
Up to 4 magnets per week

Delivery 7 month ahead of schedule

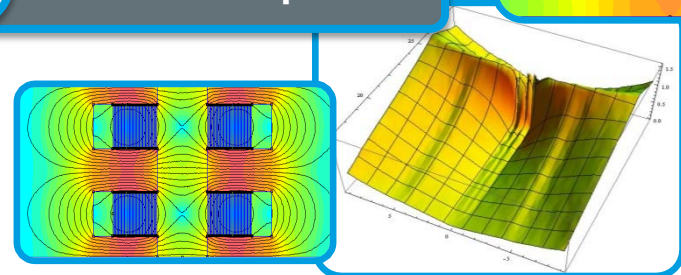
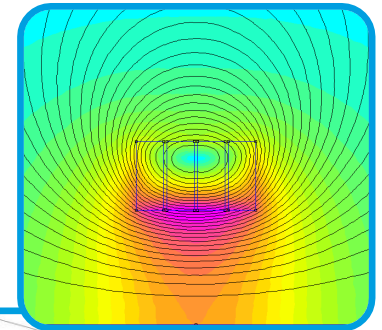
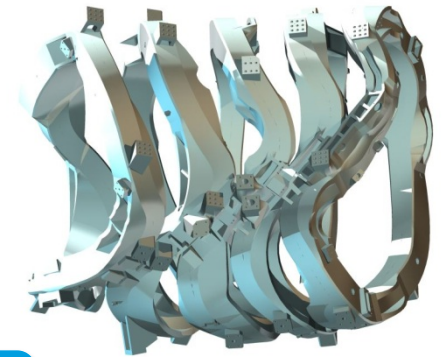


416 twin aperture dipoles
1,9 K operating temperature

Overall length:	15 m
Total weight	30,000 kg
Magnetic field	8.33 T
Operating current	11.8 kA



Software – Capabilities



Technology : Calculation and Design

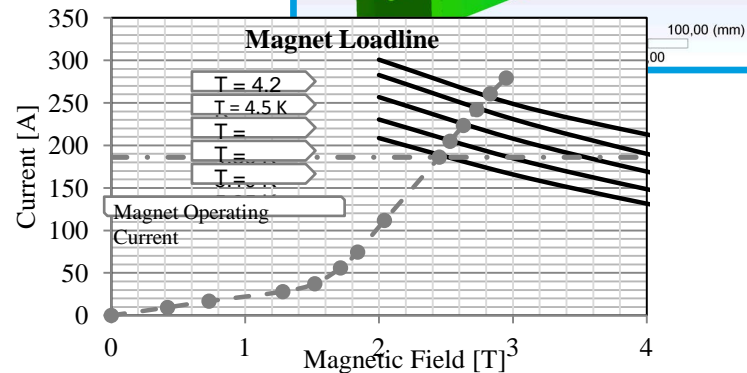
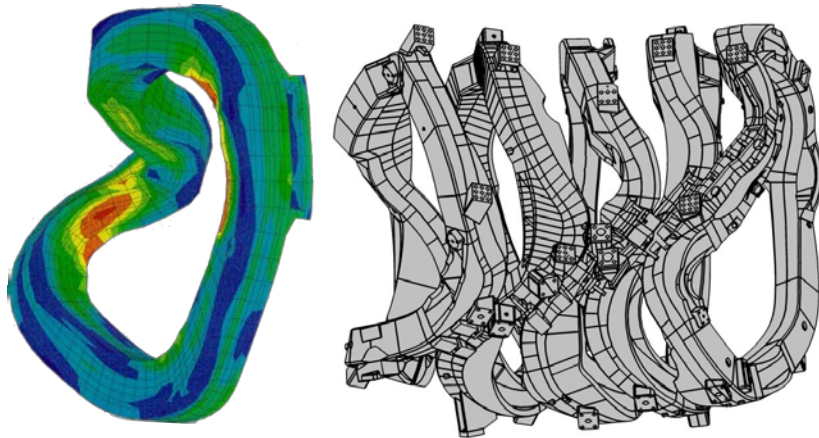
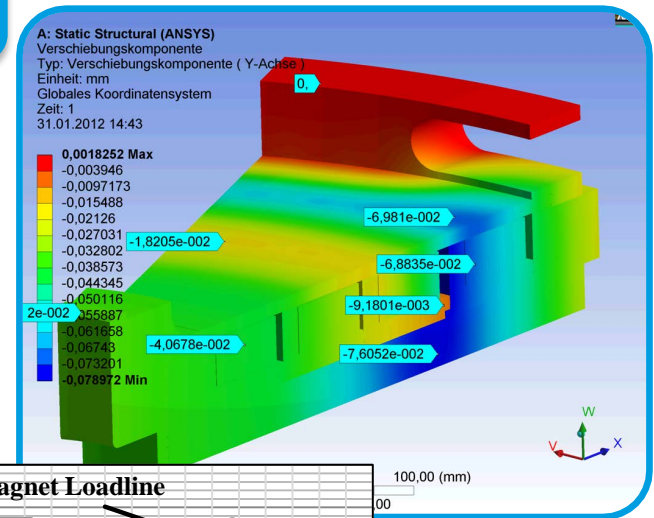


Calculations

- Dynamic
- Electromagnetic
- Multiphysics
(Coupled Problems)
- Structural
- Thermal

Design

- 2 D
- 3 D



Technology: Cryotechnique



Fluid cooled

Bath cooled

Forced Flow

LHC

CICC:
W7-X

Nuclotron-Cable:
SIS100

Conduction cooled

Undulator

NSE



Production according to the Pressure Vessel Regulation
97/23/EG



3rd ASPERA Technology Forum, Darmstadt, 13/14.03.2012



Technologies: Welding



Welding Process and Material Thickness

TIG
(Tungsten-Inert-Gas)

MAG
(Metal Active Gas)

LB-MAG

1 – 60 mm

1 – 40 mm

3 – 25 mm



Welding Base Material

Austenitic Steel

Nickel-Basic Steels

C-Steels



Technologies: Soldering and Brazing



Soldering Process

Soldering with local heating

Induction Soldering

0.5 – 4 mm

0.5 – 4 mm

Cu-Cu, brass-Cu,

Brazing Process

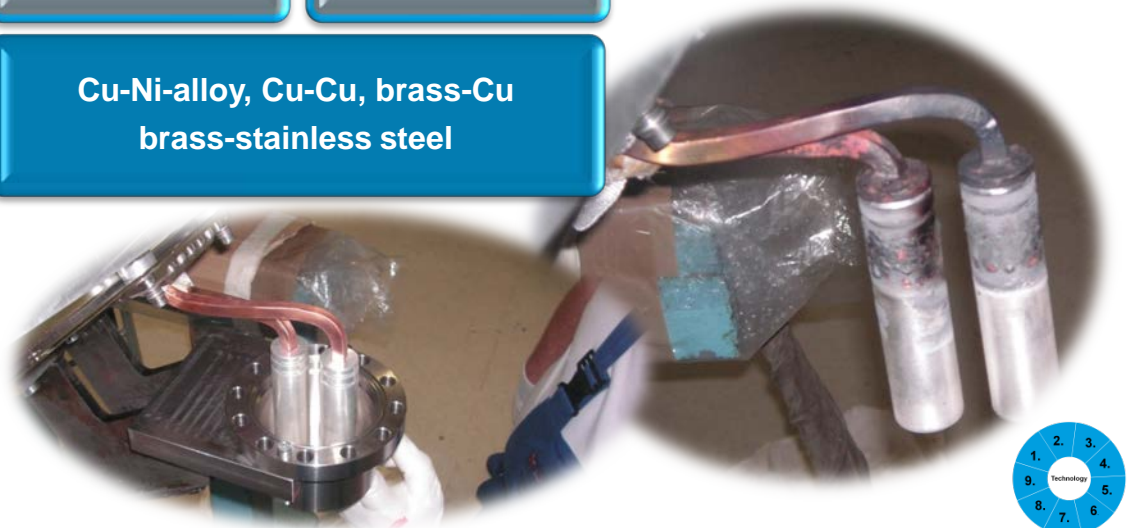
Brazing with local heating

Furnace Brazing

1 – 4 mm

1 – 4 mm

Cu-Ni-alloy, Cu-Cu, brass-Cu
brass-stainless steel



Technologies: Tests and Measurements



Impulsed Voltage Generator

Layer thickness test

Permeability measurements

Surface roughness measurement

Non Destructive Test

Visual Test (VT)
Penetrant Test (PT)
Leak Test (LT)
Helium-LT (10^{-10} mbar l/s),
Bubble-LT (10^{-3} mbar l/s)
Radiographic Test (RT, X-Ray, LinAc)
Ultrasonic Test (UT)
Magnet powder Test (MT)
Hardness test (HT, Wickens)

Geometrical measurements

Lasertracker
Faro-Arm



Certified Quality and Safety



Environmental Management System ISO 14001:2004
 Information Security Management System ISO 27001
 Quality Management ISO 9001:2008
 Safety Checklist Contractor (SCC)



Environmental Management System ISO 14001:2004
 Occupational Health and Safety Management System BS
 OHSAS 18001:2007
 Specialised company according to German Water
 Resources Act (WHG)



Distinguished Quality



Golden Hadron Award



AREVA OL3 Safety Award (HSE)



Best result for suppliers: „TOP AREVA SUPPLIER“



Thank you for your attention !

QUESTIONS ?



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