STATUS AND PERSPECTIVES AT BABCOCK NOELL

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Abstract

Babock Noell GmbH (BNG) is a magnet manufacturer known in particular for its engagement in large scale projects such as LHC or Wendelstein 7-X. The series production of 416 LHC Dipoles was successfully completed in 2006 and the fabrication of the 50 non-planar coils was finished by the Wendelstein consortium in March this year. A number of large scale projects such as ITER and FAIR are in the short term horizon. Nevertheless BNG has proven broader capabilities, other than large scale production, which extend from feasibility studies, to prototyping and design optimization. Lately, for example, we are involved in prototyping dipoles for FAIR, manufacturing a high field Nb_3Sn dipole for EFDA and developing a superconducting undulator for FZK. The aim of this presentation is to show the current status, capabilities, projects and future goals at BNG .

INTRODUCTION TO BABCOCK NOELL

Babcock Noell is active in the product areas of nuclear service, nuclear technology, magnet technology and environmental technology throughout the world and, in doing so, successfully implements the experience gained over four decades. With approximately 250 employees who are predominantly employed in the engineering area, our performance spectrum extends from the development, planning, supply and commissioning right up to the operating of the plants and equipment we supply.

Already in the 70s Babcock Noell was providing components for large research facilities like, for example, the vacuum tank for the Petra accelerator ring in Hamburg. In the early 90s Babcock Noell entered in the field of magnet technology with the development of large superconducting magnet systems for high-energy physics and nuclear fusion. There then followed contracts for the series magnets for the fusion experiment “Wendelstein 7-X” and the Hadron collider “LHC” in the research centre CERN, Geneva. A unique coil production was developed and an assembly plant established for these purposes. Today we design and produce magnets, coils, undulators and spectrometers for various international research facilities. We also undertake individual development tasks for these purposes. We have particular experience in the use of superconductors in magnet systems.

LOOKING BACK AT LHC AND W7-X

Magnet Manufacturing at Babcock Noell (BNG) was dominated by two large contracts in the beginning of the millenium:

- 416 main dipole magnets for the Large Hadron Collider (LHC) at CERN
- 50 non-planar coils for the stellerator fusion experiment Wendelstein 7-X of the Max-Planck-Institute for Plasma Physics at Greifswald

Figure 1: LHC main dipole manufacturing at BNG

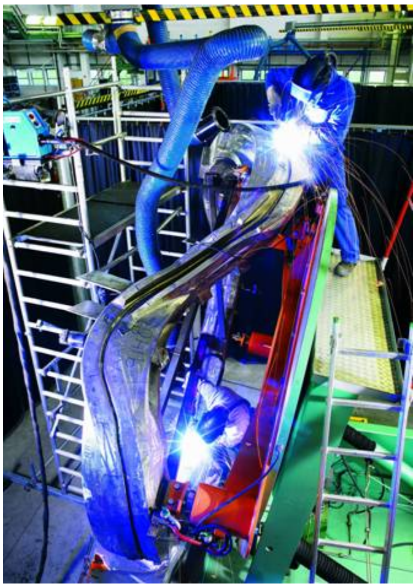

Figure 2: Welding of a coil casing for a Wendelstein 7-X non-planar coil

BNG produced in total 416 magnets about 30 tons each for the LHC, i.e. about 12,500 tons of superconducting magnets with a maximum production rate of about 3.5 magnets per week. Within the consortium Wendelstein, BNG produced 50 non-planar coils, which implied e.g.

200 tons of cast material, 6.4 million hand-made weld points and 23 km of bent cooling tubes.

In November 2005, BNG delivered the 416th LHC main dipole to CERN and in March 2008, the 50th non-planar coil for Wendeltstein 7-X was completed. The following chapters try to describe the BNG focus after the successful completion of the above mentioned projects.

FOCUS

The upcoming large scale projects such as FAIR, ITER and XFEL have just started and cannot provide a continuous work-load after the end of the above mentioned projects. BNG therefore enlarged its portfolio in order to generate additional business in the area of magnet technology. The variety of magnets was extended from Cu and NbTi Systems to Nb_3Sn and permanent magnet systems. However, magnets for large scale accelerators and fusion projects remain as cornerstone in Babcock Noell's portfolio

RECENT PROJECTS AT BABCOCK NOELL

Nb_3Sn High Field Dipole for EFDA (EDIPO)

As contractor of EFDA and on the basis of an EFDA magnet design, BNG is manufacturing a high field Nb_3Sn dipole. A cable in conduit conductor will be operated for this magnet at 20 kA to reach the nominal field of 12.5T.

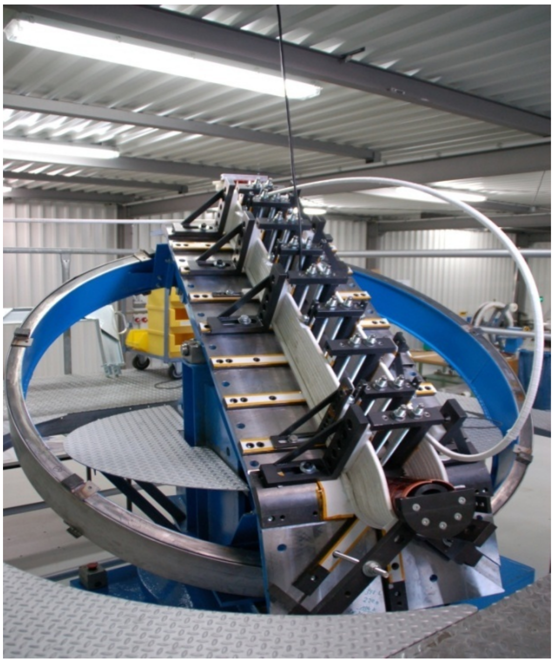

Figure 3: Winding machine with test winding for the Nb_3Sn dipole.

Undulators

In 2006, the companies Accel, Danfysik and Babcock Noell were awarded contracts for the manufacturing of prototype undulators for the XFEL project at DESY, Hamburg. BNG built a 5m long device with a 316LN beam, whereas the other companies built 2m long devices with Aluminium beams. BNG delivered its device first, in the beginning of 2007.

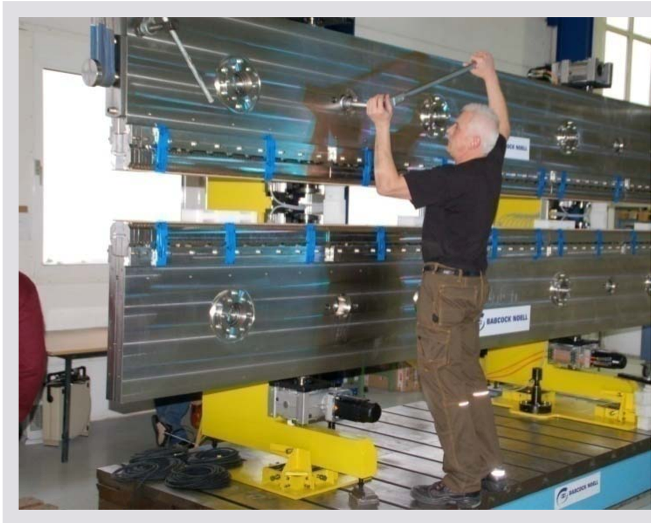

Figure 4: Assembly of a 5m long undulator prototype for XFEL

Additional 11 undulators for the upgrade of the PETRA lightsource at DESY, are being build by BNG at the moment. The ambitious goal is to deliver 11 devices within 11 month time.

Apart from that, BNG also builds a superconducting undulator to be installed at the ANKA lightsource at the Karlsruhe research centre.

Functional Systems

In addition to the above mentioned projects, BNG offers also to design and build magnet systems from scratch. In order to include such functional systems in the BNG portfolio, additional engineers/physicists with a background in the relevant technologies were hired and additional software tools were acquired and programmed. At the moment BNG is building a solenoid system for a Neutron-Spin-Echo (NSE) spectrometer to be installed at the Spallation Neutron Source (SNS) in Oak Ridge, USA by the Jülich Research centre. A NSE spectrometer measures tiny velocity changes of the neutrons encoded by the neutrons spin clock at a sample while the Neutron spin precesses in large magnetic fields following Bloch's equation. This instrument will be the best of its class both with respect to resolution and dynamic range. In order to reach this ambitious goal, a large magnetic precision field integral before and after the sample is required which directly scales linearly with the resolution of the instrument. Therefore superconducting technology is used to allow for a higher magnetic field integral. The solenoids generate an integrated magnetic flux density of 1.8 Tm. In order to reduce the fringe field, active shielding is foreseen and modern pulse-tube cryocoolers cool the NbTi windings below Tc while minimizing vibrations. A special feature of this magnet is a real time position measurement system for the cold mass with an accuracy in the order of micrometers during operations.

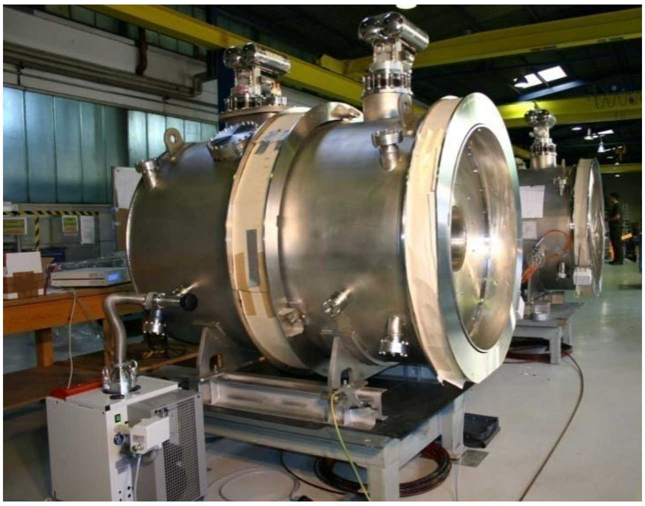

Figure 5: Factory test of a solenoid system for a NSE spectrometer

CONCLUSION

After the successful completion of the contracts for the LHC main dipoles and the Wendelstein 7-X non-planar coils, BNG restructured successfully. The portfolio at BNG has been considerably extended to include permanent-magnetic and Nb_3Sn magnet systems, functional systems and magnets for lightsources. However, magnets for large scale accelerators and fusion experiments remain to be a cornerstone of BNG's business also in the future.

REFERENCES

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